

CONTRACT DOCUMENTS AND SPECIFICATIONS

Montana State Hospital

Wastewater Treatment System

January 2021

Prepared By: Adam Eckhart, *P.E.*

Checked By: Paul Montgomery, *P.E.* and Scott Anderson, *P.E.*

Anderson-Montgomery Consulting Engineers, Inc. 1064 N. Warren St. Helena, MT 59601 Tele. # - (406) 449-3303 FAX # - (406) 449-3304









WASTEWATER TREATMENT SYSTEM MONTANA STATE HOSPITAL WARM SPRINGS, MT A/E#2011-11-01-03

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BIDDING REQUIREMENTS, CONTRACT FORMS AND CONDITIONS OF THE CONTRACT

NOTICE

THE CONTRACTOR WILL BE RESPONSIBLE FOR PAYING THE DEPARTMENT OF LABOR AND INDUSTRY BUILDING CODES BUREAU FOR BUILDING, ELECTRICAL, MECHANICAL AND PLUMBING PERMITS.

CONTACT: BUILDING CODES BUREAU DEPARTMENT OF LABOR & INDUSTRY 301 SOUTH PARK AVENUE P O BOX 200517 HELENA MT 59620-0517 (406) 841-2056 Sealed bids will be received until the closing time of 2:00 p.m. on <u>FEBRUARY 18, 2021,</u> and will be publicly opened and read aloud in the offices of the Architecture & Engineering Division, 1520 East Sixth Avenue, P.O. Box 200103, Helena MT 59620-0103, for: UPGRADE WASTE WATER TREATMENT SYSTEM, MONTANA STATE HOSPITAL, WARM SPRINGS, MONTANA, A/E #2011-11-01-03.

Bids shall be submitted on the form provided within the Contract Documents. Contract documents may be obtained at the offices of:

ANDERSON-MONTGOMERY CONSULTING ENGINEERS 1064 N WARREN ST HELENA MT 59601 406 449-3303 adam@a-mce.com

A refundable deposit of **\$100.00** is required for each plan set.

A PRE-BID WALK-THROUGH IS SCHEDULED FOR WEDNESDAY, FEBRUARY 3, 2021, AT 10:00 A.M. PARTICIPANTS SHOULD MEET AT THE ENTRANCE TO WARM SPRINGS IN THE PARKING LOT, ON THE NORTHWEST CORNER OF GARNET WAY AND THE FRONTAGE ROAD, NEXT TO UNCLE BUCK'S. ATTENDANCE IS STRONGLY RECOMMENDED.

Bids must be accompanied by a bid security meeting the requirements of the State of Montana in the amount of 10% of the total bid. After award, the successful bidder must furnish an approved Performance Security and a Labor & Material Payment Security each in the amount of 100% of the contract.

No bidder may withdraw his bid for at least thirty (30) calendar days after the scheduled time for receipt of bids except as noted in the Instructions to Bidders.

The Owner reserves the right to reject any or all bids and to waive any and all irregularities or informalities and the right to determine what constitutes any and all irregularities or informalities.

The State of Montana makes reasonable accommodations for any known disability that may interfere with an applicant's ability to compete in the bidding and/or selection process. In order for the state to make such accommodations, applicants must make known any needed accommodation to the individual project managers or agency contacts listed in the contract documents. Phone 711 for Montana Relay Service services offered. Persons using TDD may call the Montana Relay Service at 1-800-253-4091.

ARCHITECTURE & ENGINEERING DIVISION DEPARTMENT OF ADMINISTRATION STATE OF MONTANA

FRONT PAGE HIGHLIGHTS

Note: This list of items is not an exhaustive or all-inclusive list of the contractor's responsibilities for the project but is provided solely for convenience and reference.

ITEM	REFERENCE	GENERAL CONDITIONS
Prevailing Wage Rates	Article 3.4.4	The Commissioner of The Montana Department of Labor and Industry (DOLI) has established the standard prevailing rate of wages in accordance with 18-2-401 and 18-2-402, MCA.
Warranty	Article 3.5.2	The warranty period shall be defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project.
Schedule	Article 3.10	The Contractor's schedule shall be in the "Critical Path Method" and shall be in a form that is acceptable to the Owner and meet all the conditions of 3.10.
Time Limit on Claims	Article 4.3.1.1	Claims by either party must be initiated within 21 calendar days after occurrence of the event giving rise to such claim.
Weather Delays	Article 4.3.5.2	If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the current critical- path scheduled construction activities.
Waiver of Consequential Damages	Article 4.3.6	The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract.
Mediation & Arbitration	Article 4.5 & 4.6	The parties shall endeavor to resolve their Claims by mediation unless the parties mutually agree otherwise. Claims not resolved by mediation shall be decided by arbitration.
Changes	Article 7.1	Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive, or order for a minor change in the Work subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.
Change Order Allowable Costs	Article 7.2.2	As described with a 5% allowance for overhead and a 10% allowance for profit.
Time	Article 8.1.1	Time is of the essence in performance, coordination, and completion of the Work contemplated herein.
Liquidated Damages	Article 8.1.6	The Contractor and his surety shall be liable for and shall pay to the Owner the sums stipulated as liquidated damages for each calendar day of delay until the Work is substantially complete.
Contract Duration/Milestones/Phases	Article 8.1.8	All Work shall reach Substantial Completion by the date(s) listed or within the consecutive calendar days indication after the start date on the written Notice To Proceed.
Applications for Payment	Article 9.3.2	The Owner has thirty-five (35) calendar days after receipt for approval of the Contractor's Pay Request without being subject to the accrual of interest.
Retainage	Article 9.3.7	Until the Work is complete, the Owner will pay 95% of the amount due the Contractor on account of progress payments. If the Work and its progress are not in accordance with all or any part, piece, or portion of the Contract Documents, the Owner may, at its sole discretion and without claim by the Contractor, increase the amount held as retainage to whatever level deemed necessary to effectuate performance and progress of the Work.
Safety & Protection	Article 10	The Contractor shall be solely responsible for initiating, maintaining and supervising all safety, safety precautions, and safety programs in connection with the performance of the Contract.
Indemnification and Insurance Requirements	Article 11	The Contractor shall indemnify the Owner against the Contractor's negligence. The Contractor shall least carry Workers' Comp, General Liability, Automobile/Equipment, and Property (all-risk) Insurance Coverages as identified. State of Montana shall be listed as an additional insured with copy of ENDORSEMENT provided along with certificates of insurance. No waivers of subrogation shall be accepted.
Performance & Payment Bonds	Article 11.7	The Contract shall furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract. The Contractor shall also furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith.
Payroll & Basic Records	Article 13.8	Payrolls and basic records pertaining to the project shall be kept on a generally recognized accounting basis and shall be available to the Owner, Legislative Auditor, the Legislative Fiscal Analyst or his authorized representative at mutually convenient times. Accounting records shall be kept by the Contractor for a period of three years after the date of the Owner's Final Acceptance of the Project.

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- 2. Viewing of Contract Documents
 - 2.1. The Contract Documents may be viewed at the following locations:

BUILDERS EXCHANGE OF BILLINGS

2050 BROADWATER STE A BILLINGS MT 59102 Phone: (406) 652-1311 bbx@billingsplanroom.com

BOZEMAN BUILDERS EXCHANGE

1105 REEVES RD BOZEMAN MT 59718 Phone: (406) 586-7653 exchange@bozemanplanroom.com

BUTTE PLANS EXCHANGE

4801 HOPE RD BUTTE MT 59701 Phone: (406) 782-5433 butteplans@gmail.com

GREAT FALLS BUILDERS EXCHANGE

325 SECOND ST S GREAT FALLS MT 59405 (406) 453-2513 gfbe@greatfallsplans.com

HELENA PLANS CENTER

1530 CEDAR ST. HELENA MT 59601 (406) 457-2679 planex@helenacopycenter.com

FLATHEAD VALLEY PLANS EXCHANGE 2303 HWY 2 EAST KALISPELL MT 59901

(406) 755-5888 planex@kalcopy.com

MISSOULA PLANS EXCHANGE

201 N RUSSELL ST MISSOULA MT 59801 (406) 549-5002 MPE@vemcoinc.com

- 3. Borrowing of Documents
 - 3.1. Contract Documents may be obtained at the office of the Architect/Engineer:

ANDERSON-MONTGOMERY CONSULTING ENGINEERS 1064 N WARREN ST HELENA MT 59601 406 449-3303 <u>adam@a-mce.com</u>

- 3.2. All borrowed Contract Documents shall be returned to the <u>ARCHITECT/ENGINEER</u> within ten (10) calendar days after the bid opening for the deposit refund (if deposit was required). However, if the Contract Documents are not in a condition where they can be reused by the Owner to construct the project, the Owner may at its sole discretion direct the Architect/Engineer to retain the deposit in order to reproduce a replacement set.
- 4. Visits to Site
 - 4.1. Prospective bidders are requested to contact the following for inspection of the site:

RAUL LUCIANI, MAINTENANCE DIRECTOR MONTANA STATE HOSPITAL 317 OROFINO WAY N WARM SPRINGS MT 59756 406 693-7110 raul.luciani@mt.gov

- 4.2. Failure to visit site will not relieve the Contractor of the conditions of the contract.
- 5. Requests for Substitution
 - 5.1. Any requests for product substitution must be made to the Architect/Engineer at least ten (10) <u>calendar days</u> prior to the date of the bid opening for consideration by the Architect/Engineer. Any request for substitution made after this time restriction, including those made after award or during project construction, may be rejected without consideration by either the Architect/Engineer or the Owner.
- 6. Bids/Proposals
 - 6.1. The bidder shall submit his bid on the Bid Proposal Form furnished with the Contract Documents.
 - 6.2. DO NOT send the Contract Documents with the Proposal. The Contract Documents should be returned to the Architect/Engineer. See address in 3.1 above.
 - 6.3. If the project is funded by any portion of federal funds, the following may apply: on certain federally funded projects, a "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion" form must be submitted with the bid proposal. If the debarment form is not included within the Construction Documents, federal funds (if included) do not require the form or are not included in the project and the debarment form is not required.
 - 6.3.1.If federal funds are included and require the "Certification," no award may be made to a Contractor or any subcontractor that is federally debarred, suspended or proposed for debarment in accordance with Public Law 103-355, Section 2455 (31 USC 6101) and Executive Order 12689. The Contractor who is awarded this contract shall certify that neither the contractor, its principals, their subcontractors nor their principals: (1) are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from the award of contracts by any federal department or agency; (2) have within a 3-year period preceding any partially or wholly federally funded contract has been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state, or local) contract or subcontract; been in violation of federal or state antitrust statutes, or been convicted of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property; or otherwise

criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in (2) above; and, (3) have within a 3-year period preceding an award of any partially or wholly federally funded contract, had one or more contracts terminated for cause or default by any federal or state agency.

6.4. Proposals shall be in a sealed envelope and addressed to:

Department of Administration Architecture & Engineering Division Metcalf Building, Room 33 1520 East Sixth Avenue P.O. Box 200103 Helena MT 59620-0103

6.5. The envelope shall state that it contains a "BID PROPOSAL" and indicate the following information:

Name of Project: Location:	UPGRADE WASTE WATER TREATMENT SYSTEM MONTANA STATE HOSPITAL, WARM SPRINGS, MONTANA
A/E Project Number: Name of Bidder:	2011-11-01-03
Acknowledge Addendum Number	

- 6.6. It is the bidder's responsibility to deliver or ensure delivery of the bid proposal to the office of the Architecture & Engineering Division. Proposals received after the scheduled closing time for bids by either the bidder, a delivery service (e.g., Federal Express, U.S. Postal Service, United Parcel Service, etc.), or the state's own mail delivery system, will be rejected. Proposals entitled for consideration must be time-stamped in the Owner's office prior to the closing time for receipt of bids. The official time clock for receipt of bids is the Owner's time and date stamp clock located on the reception desk in the Owner's office. No other clocks, calendars or timepieces are recognized. All bidders are responsible to ensure all bids and fax modifications are received in the Owner's office prior to the scheduled closing time.
- 6.7. If requested on the Bid Proposal Form, any person making a bid to perform the work shall, as a requirement of a responsible bid, set forth the name of each subcontractor specified in the "List of Subcontractors" which is part of the bid proposal. The bidder shall list only one subcontractor for each such portion of work listed. The bidder whose bid is accepted shall not:
 - 6.7.1. Substitute any other subcontractor in place of the subcontractor listed in the original bid, except by specific consent of the Owner. The Owner, at its sole discretion, may grant substitution with consent of the originally listed subcontractor, or in consideration of other factor(s) involved if deemed relevant to the successful performance of the Contract.
 - 6.7.2. Permit any such subcontract to be voluntarily assigned, transferred or allow it to be performed by any party other than the subcontractor listed in the original bid without the consent of the Owner.
- 6.8. Bid Proposals entitled to consideration shall be made in accordance with the following instructions:
 - 6.8.1. Made upon form provided.
 - 6.8.2. All blank spaces properly filled.
 - 6.8.3. All numbers stated in both writing and in figures.
 - 6.8.4. Shall contain no additions, conditional or alternate bids, erasures or other irregularities.
 - 6.8.5. Shall acknowledge receipt of all addenda issued.
- 6.9. Bid Proposals entitled to consideration shall be signed by the proper representative of the firm submitting the proposal as follows:
 - 6.9.1. The principal of a single owner firm.
 - 6.9.2. A principal of a partnership firm.

- 6.9.3. An officer of an incorporated firm, or an agent whose signature is accompanied by a certified copy of the resolution of the Board of Directors authorizing that agent to sign.
- 6.9.4. OR, other persons signing for a single-owner firm or a partnership shall attach a powerof-attorney evidencing his authority to sign for that firm.
- 6.10. UNIT PRICES: When a Bid Proposal Form contains unit prices, any errors discovered in the extension of those unit prices will be corrected by the Owner using the unit price figures. The adjusted extended amount will then be used to determine the correct total bid. Only after the amounts have been checked and adjusted, if necessary, will the valid low bid be determined.
- 6.11. ESTIMATED QUANTITIES: All estimated quantities stipulated in the Bid Proposal and other Contract Documents are approximate and are to be used only as a basis for estimating the probable cost of the work and for the purpose of comparing proposals submitted for the work. It is understood and agreed that the actual amounts of work done, and materials furnished under unit price items may vary from such estimated quantities. The actual quantities will depend on the conditions encountered at the time the work is performed.
- 6.12. Any bidder may modify his bid by fax communication only.
 - 6.12.1. It is the bidder's responsibility to ensure that the entire modification is received at the bid opening location prior to the scheduled closing time for receipt of bids. <u>The modification shall not reveal the bid price</u> but shall only provide the ADDITION or SUBTRACTION from the original proposal.
 - 6.12.2. The Owner is not responsible for the performance of the facsimile/printer machine, maintaining adequate paper levels, toner levels, the telephone connection, quality of the facsimile, or any other factors affecting receipt of the fax. Unreadable or difficult-to-read facsimiles may be rejected at the sole discretion of the Owner.
 - 6.12.3. Changes in the listed subcontractors, if any, shall also be provided.
 - 6.12.4. Bid modifications must be verified by hard copy provided to the Owner within two (2) business days after the bid opening.
 - 6.12.5. Bid modifications shall be directed to fax phone (406) 444-3399.
 - 6.12.6. All facsimiles shall be date and time stamped on the same time-stamp clock in the Owner's office that is used for receipt of bids in order to be considered valid. The Owner may also use the date and time on the automatically generated email notification of facsimile receipt as generated by the State's system. Any date and time indicated at the top of the facsimile on either the bidder's or the Owner's facsimile/printer machine will not be used in determining time of arrival of the modification.
- 6.13. In the event of a discrepancy on the bid proposal between the written (alpha) numbers and the numeric numbers, the lowest figure will prevail.
- 6.14. The Owner reserves the sole right to reject any or all bids and to waive any irregularities or informalities. The Owner also reserves the sole right to determine what constitutes irregularities or informalities and/or what is material and/or immaterial to the bids received.
- 7. Bid Security
 - 7.1. IF THE PROJECT COST IS LESS THAN \$25,000, AT ITS SOLE DISCRETION THE STATE OF MONTANA MAY OR MAY NOT REQUIRE BID SECURITY (18-2-302 MCA).
 - 7.2. All proposals shall be accompanied by a bid security in the amount of 10% of the bid price, as evidence of good faith (18-2-302 MCA).
 - 7.3. Bid security shall be in the form of lawful moneys of the United States, cashier's check, certified check, bank money order or bank draft, bid bond or bonds payable to the State of Montana (18-2-302 MCA).
 - 7.4. If the bidder, to whom a contract is awarded, fails to enter into and execute the proposed contract within fifteen (15) calendar days of award, the bidder shall forfeit the bid security (18-1-204 MCA).
 - 7.5. The bid security of unsuccessful bidders will be returned when the contract has been awarded

to the successful bidder or when all bids have been rejected (18-1-205 MCA).

- 7.6. Execution of and entering into a contract includes providing all necessary insurance certificates, bonds, signed contract and current copy of the construction contractor registration certificate or registration number.
- 7.7. NOTE: PER STATE POLICY, IF CASH, CHECK, MONEY ORDER, OR BANK DRAFT ARE PROVIDED AS BID SECURITY, IT WILL BE DEPOSITED IN THE TREASURY. UNSUCCESSFUL BIDDERS WILL HAVE THEIR SECURITY RETURNED UPON CONTRACT AWARD. THE SUCCESSFUL BIDDER'S SECURITY MAY BE RETURNED UPON ISSUANCE OF NOTICE TO PROCEED.
- 8. Withdrawal of Bids
 - 8.1. Any bidder may withdraw his bid proposal at any time prior to the scheduled closing time for the receipt of bids.
 - 8.2. Once the closing time for the receipt of bids is reached, a bid may not be withdrawn for a period of thirty (30) calendar days.
 - 8.3. The official time clock for receipt of bids and fax modifications is the Owner's time and date stamp clock located on the reception desk in the Owner's office. No other clocks, calendars or timepieces are recognized. All bidders are responsible to ensure all bids and fax modifications are received in the Owner's office prior to the scheduled closing time.
- 9. Interpretation of Contract Documents
 - 9.1. Bidders shall promptly notify the Architect/Engineer of any ambiguity, inconsistency, or error which they may discover upon examination of the Contract Documents or of the site and local conditions.
 - 9.2. Bidders requiring clarification or interpretation of the Contract Documents shall request, in writing, clarification from the Architect/Engineer at least ten (10) calendar days prior to the date set for receipt of bids.
 - 9.3. Any interpretations, corrections, or change in the Contract Documents prior to the bid opening will be made by written addendum issued by the Architect/Engineer. The Architect/Engineer will endeavor to notify all plan holders of any addenda issued but it shall be the responsibility of the individual bidders to insure they have received all addenda prior to the submission of their bid.
 - 9.4. All written addenda issued by the Architect/Engineer will become part of the Contract Documents and all bidders shall be bound by such addenda whether or not received and/or acknowledged by the bidder. No oral or telephone modifications of the Contract Documents will be considered or allowed.
- 10. Award of Bids
 - 10.1. All bids received by the stated hour will be opened and publicly read aloud.
 - 10.2. The Owner reserves the right to reject any and all bids and to waive any informality or irregularity in any bid received. The Owner reserves the right to determine what constitutes material and/or immaterial informalities and/or irregularities.
 - 10.3. The low bid shall be determined on the basis of the lowest Base Bid or the lowest combination of Base Bid and Alternate Bids, accepted in consecutive order.
 - 10.4. The Owner shall award such contract to the lowest responsible bidder (18-1-102 MCA).
 - 10.4.1. The Owner may make such investigations as it deems necessary to determine whether or not any or all bidders are responsible.
 - 10.4.2. The term "responsible" does not refer to pecuniary ability only, nor the ability to tender

sufficient performance and payment bonds.

- 10.4.3. The term "responsible" includes, but is not limited to:
 - 10.4.3.1. Having adequate financial resources to perform the contract or the ability to obtain them.
 - 10.4.3.2. Being able to comply with the required delivery, duration, and performance schedule.
 - 10.4.3.3. Having a satisfactory record of integrity and business ethics.
 - 10.4.3.4. Having the necessary organization, experience, accounting, and operational controls.
 - 10.4.3.5. Having the necessary production, construction, technical equipment, and facilities; and,
 - 10.4.3.6. Having the technical skill, ability, capacity, integrity, performance, experience, lack of claims and disputes, lack of actions on bonds, lack of mediations, arbitrations and/or lawsuits related to construction work or performance, and such like.
- 10.4.4. Bidders shall furnish to the Owner all information and data for this purpose as the Owner may request.
- 10.4.5. The Owner reserves the right to reject any bid if the investigation or evidence of any Bidder fails to satisfy the Owner that such Bidder is properly and adequately qualified to suitably perform and satisfactorily execute the obligations of the Contract and Work defined in the Contract Documents.
- 10.5. The Owner shall award such contract to the lowest responsible bidder without regard to residency except on a reciprocal basis: a resident bidder will be allowed a preference on a contract against the bid of any non-resident bidder from any state or country that enforces a preference for resident bidders. The preference given to resident bidders of the State of Montana must be equal to the preference given in the other state or country (18-1-102, MCA). This does not apply when prohibited by federal requirements.
- 10.6. The Department of Administration may negotiate deductive changes, not to exceed 7% of the total cost of the project, with the lowest responsible bidder when the lowest responsible bids causes the project cost to exceed the appropriation; or with the lowest responsible bidders if multiple contracts will be awarded on the projects when the total of the lowest responsible bids causes the project cost to exceed the appropriation. A bidder is not required to negotiate his bid but is required to honor his bid for the time specified in the bidding documents. The Owner may terminate negotiations at any time (18-2-105(7) MCA).
- 11. Contract
 - 11.1. The sample Standard Form of Contract between Contractor and Owner, as issued by the Owner, will be used as the contracting instrument and is bound within the Contract Documents.
 - 11.2. The form shall be signed by a proper representative of the bidder as defined above in these instructions.
 - 11.3. The Contractor shall also complete and return federal form W-9 along with the Contract.
- 12. Performance, Labor and Material Payment Security
 - 12.1. IF THE PROJECT COST IS LESS THAN \$50,000, AT ITS SOLE DISCRETION THE STATE OF MONTANA MAY OR MAY NOT REQUIRE A PERFORMANCE OR LABOR AND MATERIAL PAYMENT SECURITY (18-2-201 MCA).
 - 12.2. THE CONTRACTOR SHALL PROVIDE BOTH SECURITIES FOR THIS PROJECT AS SPECIFIED BELOW, UNLESS SPECIFICALLY DIRECTED THAT THIS REQUIREMENT HAS BEEN WAIVED ELSEWHERE IN THESE DOCUMENTS.
 - 12.3. The Owner shall require the successful bidder to furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201, MCA).
 - 12.4. The Owner shall require the successful bidder to furnish a Labor and Material Payment Bond in

the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201 MCA).

- 12.5. The bonds shall be executed on forms furnished by the Owner. No other forms will be acceptable.
- 12.6. The bonds shall be signed in compliance with state statutes (33-17-111 MCA).
- 12.7. Bonds shall be secured from a state-licensed bonding company.
- 12.8. Power of Attorney
 - 12.8.1. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.
 - 12.8.2. One original copy shall be furnished with each set of bonds.
 - 12.8.3. Others furnished with a set of bonds may be copies of that original.
- 13. Notice to Proceed
 - 13.1. The successful bidder who is awarded the contract for construction will not be issued a Notice to Proceed until there is a signed Contract, the specified insurance certificates, completed bond forms, federal form W-9, a copy of the bidder's current Construction Contractor Registration Certificate in the Owner's possession. All items are required within fifteen (15) calendar days of contract award made by the Owner.
- 14. Laws and Regulations
 - 14.1. The bidders' attention is directed to the fact that all applicable federal and state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over the project shall apply to the contract throughout and will be deemed to be included in this contract as if bound herein in full.

15. PAYMENTS

15.1. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a Contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.

16. BUY SAFE MONTANA PROVISIONS

16.1. The successful bidder who is awarded the contract for construction shall provide their incident rate, experience modification ratio (EMR) and loss ratio via the Buy-Safe Montana form with the Award documents.

UPGRADE WASTE WATER TREATMENT SYSTEM MONTANA STATE HOSPITAL WARM SPRINGS, MONTANA A/E# 2011-11-01-03

TO: Director, Department of Administration Architecture & Engineering Division 1520 East Sixth Avenue P.O. Box 200103 Helena, Montana 59620-0103

The undersigned, having familiarized himself with the Contract Documents, site, location, and conditions of the Work as prepared by **ANDERSON-MONTGOMERY CONSULTING ENGINEERS, 1064 N WARREN ST., HELENA MT 59601, 406 449-3303,** <u>adam@a-mce.com</u>, by submission of this Bid Proposal, hereby agrees to complete the Work for the total sum as follows:

BASE BID:

(Bid Price in ALPHA notation)
______and _____/100 DOLLARS
\$_______(Bid Price in NUMERIC notation)

ADDITIVE ALTERNATE #1: Non-Potable Water Piping, Hydrants, and Irrigation Stub Out. See Instructions to Bidders, Plans and Specifications, for details.

(Bid Price in ALPHA notation)			
		and	/100 DOLLARS
	\$		
	۰	(Bic	Price in NUMERIC notation)

ADDITIVE ALTERNATE #2: Landscaping, Asphalt Paving, and an Air Compressor. See Instructions to Bidders, Plans and Specifications.

(Bid Price in ALPHA notation)
______and ____/100 DOLLARS
\$______(Bid Price in NUMERIC notation)

LIST OF SUBCONTRACTORS

This section must be completed to meet the requirements of a responsive bid (the Owner still retains the right to determine whether or not this requirements is an irregularity or informality in the bids submitted). If work will be performed by the General Contractor, enter the name of the General Contractor. Listed subcontractors shall be the subcontractor used by the General Contractor as provided in Instructions To Bidders, Paragraph 6.7.

Trade	Subcontractor Name
Mechanical	
Electrical	

If the mechanical subcontract work is bid directly to the General Contractor split between HVAC and plumbing, leave "Mechanical" line blank and list the subcontractors below:

HVAC _____

If Alternates are included in the bid proposal and any of the above-listed subcontractors changes, based on the pricing of the Alternates, the General Contractor shall provide below a listing of the change in subcontractor(s) for each Alternate for each Trade. If no change is listed below for any Alternate(s), the subcontractor listed above shall be the subcontractor used by the General Contractor for the entire Project as provided in Instructions To Bidders, Paragraph 6.7.

Alternate #	Trade	e Subcontractor Name		

This bidder acknowledges receipt of the following addenda:

ADDENDUM #: _____ Dated: _____

ADDENDUM #: _____ Dated: _____

ADDENDUM #: _____ Dated: _____

Company Nam	le:
Signature:	
Print Name:	
Title:	(verify signatory requirements with Instructions To Bidders, Paragraph 6.9)
e-mail Address:	
Phone #:	
Fax #:	
MT Contractor Registration #:	



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

STANDARD FORM OF CONTRACT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION

THIS CONTRACT IS SUBJECT TO ARBITRATION PURSUANT TO THE UNIFORM ARBITRATION ACT, MCA TITLE 27, CHAPTER 5

This **CONTRACT** is made as of:

January 6, 2021

BETWEEN:

ADDRESS CITY, STATE ZIP PHONE / FAX

Hereinafter identified as the "**CONTRACTOR**" and the State of Montana, acting through its Director, Department of Administration, hereinafter identified as the "**OWNER**":

Department of Administration, State of Montana P.O. Box 200103, 1520 East Sixth Avenue Helena, MT 59620-0103

WITNESSETH that the Contractor and the Owner, for the consideration hereinafter named, agree as follows:

ARTICLE 1 – SCOPE OF WORK

The Contractor shall perform all Work as shown in the Contract Documents entitled:

UPGRADE WASTE WATER TREATMENT SYSTEM MONTANA STATE HOSPITAL WARM SPRINGS, MONTANA A/E PROJECT #2011-11-01-03

As prepared by:

ANDERSON-MONTGOMERY CONSULTING ENGINEERS 1064 N WARREN ST HELENA MT 59601 Ph 406 449-3303 adam@a-mce.com

Hereinafter identified as the "ARCHITECT/ENGINEER."

ARTICLE 2 - TIME OF COMPLETION

As time is of the essence in performance, coordination, and completion of the Work contemplated under this Contract, the Work to be performed shall commence on a date set forth by the Owner in a written "Notice To Proceed" and shall be completed on or before:

DECEMBER 31, 2021.

If the Work is not completed within the time specified, the Owner may assess liquidated damages in the amount of:

ONE HUNDRED AND NO/100 DOLLARS (\$100.00) PER CALENDAR DAY OF DELAY.

ARTICLE 3 – CONTRACT SUM

The Owner shall pay the Contractor for performance of the Work, subject to additions and/or deductions by Change Order or damages as provided in the Contract Documents, the Contract Sum of:

[dollars in alpha] DOLLARS ().

ARTICLE 4 – PROGRESS PAYMENTS

The Owner shall make payments on account in accordance with the Contract Documents as follows: Ninety-Five (95%) of the portion of the Contract Sum for labor, materials, and equipment incorporated in the Work and for materials suitably

stored. The Contractor shall be aware that the Owner has thirty-five (35) calendar days upon receipt in which to make approval and payment without being in violation of statute or being subject to the accrual of interest shall, or the need to make written notice or justification to deny payment in whole or in part. The Contractor shall, within seven (7) calendar days following receipt of payment from the Owner, make payment to subcontractor(s).

ARTICLE 5 - FINAL PAYMENT

Final Payment, constituting the entire unpaid balance of the Contract Sum, shall be paid by the Owner to the Contractor when: 1) the Work is completed in accordance with the Contract Documents; 2) the Contract fully performed; 3) a final Form 101, Periodic Estimate for Partial Payment showing the final correct amounts is approved by the Architect/Engineer; 4) a Form 106, "Contractor's Affidavit of Completion, Payment of Debts and Claims, and Release of Liens" is completed and submitted; and 5) a Form 103, "Consent of Surety Company To Final Payment" is completed and submitted.

ARTICLE 6 – CONTRACT DOCUMENTS

The Contract Documents, together with this Contract, form the entire Contract and Agreement between the Contractor and Owner. The Contract Documents, which are totally and completely a part of this Contract as if attached hereto or repeated herein, are enumerated in the General Conditions of the Contract for Construction inclusive of Wage Rates, Reports, and all other items bound with the Specifications and/or Project Manual(s).

ARTICLE 7 – PREVAILING WAGE SCHEDULE

The Contractor and all subcontractors at any tier or level shall, as a minimum, pay the standard prevailing rate of wages schedule (including per diem, fringe benefits for health, welfare, and pension contributions and travel allowance) in effect and as applicable to the district in which the Work is being performed.

ARTICLE 8 - VENUE

In the event of any mediation, arbitration, or litigation concerning any matter or dispute arising out of or related to the Contract, venue shall be the First Judicial District in and for the County of Lewis and Clark, Montana. The Contract shall be interpreted and subject to the laws of the State of Montana.

EXECUTION OF THIS CONTRACT

This Contract is entered into as of the day and year first written above:

Contractor:

Signature

(print name)

Title

Is this company incorporated? Yes _____ No_____

Owner:

DEPARTMENT OF ADMINISTRATION	1
STATE OF MONTANA	

RUSS KATHERMAN Administrator, Architecture & Engineering Division for the DIRECTOR, DEPARTMENT OF ADMINISTRATION

Date



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION

1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

PERFORMANCE BOND #_____

KNOW ALL PERSONS BY THESE PRESENTS, that we:

(Contractor), hereinafter called the Principal, and

(Surety), a corporation licensed to do business as a surety under the laws of the State of Montana, hereinafter called Surety, are held and firmly bound unto the State of Montana in the full and just sum of:

AND 00/100 DOLLARS

to be paid to the State of Montana or its assigns, to which payment we bind ourselves, heirs, executors, administrators, successors and assigns, jointly, severally, firmly by this bond.

WHEREAS, the Principal has entered into a contract with the State of Montana, acting by and through its Director, Department of Administration dated ______ and whereas it is one of the conditions of the award of the contract pursuant to statutes that this bond be executed for the Project entitled:

[PROJECT NAME] [AGENCY NAME] [A/E PROJECT #]

NOW, THEREFORE, the conditions of this obligation are such that if the above Principal as Contractor shall promptly and faithfully perform all of the provisions of the contract, and all obligations thereunder including the specifications, and any alterations provided for, and shall in a manner satisfactory to the State of Montana, complete the work contracted for including any alterations, and shall save harmless the State of Montana from any expense incurred through the failure of the Contractor to complete the work as specified, then this obligation shall be void; otherwise it shall remain in full force and effect.

The surety hereby waives notice of any extension of time and any alterations made in the terms of the contract, unless the cumulative cost of such alterations cause the total project cost to exceed the original contract sum by more than 10%.

FOR STATE USE ONLY:	Contractor:
	Signature
Surety is licensed in MT: Yes No	Print Name
Date Verified:	Date
Verified By:	Surety:
Architecture & Engineering Div. Department of Administration State of Montana	Print Name Date By: Attorney-in-Fact, Seal & Signature Agency Street Address Mailing Address
	Phone Fax



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

LABOR & MATERIAL PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS, that we:

(Contractor), hereinafter called the Principal, and

(Surety), a corporation licensed to do business as a surety under the laws of the State of Montana, hereinafter called Surety, are held and firmly bound unto the State of Montana in the full and just sum of:

AND 00/100 DOLLARS

to be paid to the State of Montana or its assigns, to which payment we bind ourselves, heirs, executors, administrators, successors and assigns, jointly, severally, firmly by this bond.

WHEREAS, the Principal has entered into a contract with the State of Montana, acting by and through its Director, Department of Administration dated ______ and whereas it is one of the conditions of the award of the contract pursuant to statutes that this bond be executed for the Project entitled:

[PROJECT NAME] [AGENCY NAME] [A/E PROJECT #]

NOW, THEREFORE, the conditions of this obligation are such that if the above Principal as Contractor shall promptly and faithfully perform all of the provisions of the contract, and all obligations thereunder including the specifications, and any alterations provided for, and shall in a manner satisfactory to the State of Montana, complete the work contracted for including any alterations, and shall save harmless the State of Montana from any expense incurred through the failure of the Contractor to complete the work as specified, then this obligation shall be void; otherwise it shall remain in full force and effect.

The surety hereby waives notice of any extension of time and any alterations made in the terms of the contract, unless the cumulative cost of such alterations cause the total project cost to exceed the original contract sum by more than 10%.

FOR STATE USE ONLY:	Contractor:
	Signature
Surety is licensed in MT: Yes No	Print Name
Date Verified:	Date
Verified By:	Surety:
Architecture & Engineering Div. Department of Administration	Print Name Date
State of Montana	By:
	Attorney-in-Fact, Seal & Signature
	Agency
	Street Address
	Mailing Address
	Phone Fax



STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

SCHEDULE OF AMOUNTS FOR CONTRACT PAYMENT

 Project Name:
 A/E #:

 Location:
 Date:

DIV. NO.	DESCRIPTION	LABOR COSTS	MATERIAL COSTS	OTHER COSTS	TOTAL ITEM COST
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
					\$ 0.00
	TOTAL COST THIS SHEET	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
TOTA	L COST - ADDITIONAL SHEETS				\$ 0.00
	TOTAL PROJECT COST	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00

This Schedule of Values is a statement made by the Contractor to the Architect/Engineer and Owner that allocates the contract sum among the various portions of the Work and shall form the basis for review of the Contractor's Payment Requests.

Submitted By:	Company/Contractor	Signature	Date
Reviewed By:			
, .	Architect/Engineer	Signature	Date
Approved By:	Architecture & Engineering Division		
	• •	Signature	Date



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103

Phone: 406 444-3104 • Fax: 406 444-3399

PERIODIC ESTIMATE FOR PARTIAL PAYMENT

Project Name:	Contractor:			
Location:	Address:			
	Phone/Fax:	E-mail:	Fax:	

RETAINAGE ADJUSTMENT	
1. Total Retainage to Date:	0.00
2. Less Securities Deposited or Retainage Paid Out:	
3. Retainage Withheld (1 - 2)	0.00

	CONTRACT AMOUNT STATU	IS
1. Original Contract Amount:		
2. Net +/- by Change Order	(Pulls from Change Order Summary)	0.00
3. Contract Amount to Date:		0.00

	CHANGE ORDER SUMMARY				
No.	Date Approved	Additions	Deductions		
	TOTALS:	0.00	0.00		
		NET TOTAL:	0.00		

CONTRACT STATUS			
1. Work in Place (from next page):	(Col D + E Total - Grand Totals Page	2) 0.00	
2. Total Work & Stored Material:	(Col G Total -Grand Totals Page	2) 0.00	
3. Retainage Withheld	5%	0.00	
4. Total Earned Less Retainage:		0.00	
5. Less Pervious Payments:	(Col D - Prior Ret. Total in Grand Totals Page	2) 0.00	
6. Amount Due This Payment:		0.00	
7. Less 1% State Contractor's Tax:	(Contracts >4999.9	0.00	
8. Payment Due Contractor:		0.00	

I hereby certify that this submitted request for payment is correct, thru and just in all respects and that payment or credit has not previously been received. I future warrant and certify by submission of this request that all previous work for which payment has been received is free and clear of all liens, disputes, claims, security interest, encumbrances, or causes of action of any type or kink in favor of the contractor, subcontractors, material suppliers, or other persons or entities and do hereby release the owner from such.

Submitted by:	(Company/Contractor)	(Name)		Date:	
Reviewed by:	(Architect/Engineer)	(Name)		Date:	
	Montana Dept of Administration Architecture and Engineering Division	(Name)		Date:	
FOR OWNER'S USE: Davis-Ba	con certified payroll on file (for federally funded projects only where D-B applies)?		Initials of PM/CM:		Date:

WORK IN PLACE / STORED MATERIALS

Project Name:	Contractor:	A/E No.:	
Location:		Date:	

Pay Estimate No:

В С D Е F G Н А J TOTAL COMPLETED AND CONTRACTOR FROM PREVIOUS APPLICATION MATERIAL PRESENTLY STORED STORED TO DATE ITEM NO. DESCRIPTION OF WORK SCHEDULED VALUE THIS PERIOD BALANCE TO FINISH (C-G) RETAINAGE % (G/C) ITEM NO (D + E) (NOT IN D OR E) (D + E + F) 0.00 0.00 0.00 1 2 0.00 0.00 0.00 0.00 3 0.00 0.00 4 0.00 0.00 0.00 5 0.00 0.00 0.00 6 0.00 0.00 0.00 7 0.00 0.00 0.00 8 0.00 0.00 0.00 9 0.00 0.00 0.00 10 0.00 0.00 0.00 0.00 0.00 0.00 11 12 0.00 0.00 0.00 13 0.00 0.00 0.00 14 0.00 0.00 0.00 0.00 15 0.00 0.00 16 0.00 0.00 0.00 17 0.00 0.00 0.00 18 0.00 0.00 0.00 19 0.00 0.00 0.00 0.00 20 0.00 0.00 21 0.00 0.00 0.00 22 0.00 0.00 0.00 23 0.00 0.00 0.00 24 0.00 0.00 0.00 25 0.00 0.00 0.00 26 0.00 0.00 0.00 27 0.00 0.00 0.00 0.00 0.00 0.00% 0.00 0.00 PAGE TOTALS: 0.00 0.00 0.00 ADDITIONAL PAGE TOTALS: 0.00 0.00 0.00 0.00 0.00 0.00% 0.00 0.00 GRAND TOTALS: 0.00 0.00 0.00 0.00 0.00 0.00 0.00% 0.00

Attach additional sheets as needed.



STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

ACKNOWLEDGEMENT OF SUBCONTRACTORS

Project Name: ______ Location: ______ A/E #: ______ Date: ______

Contractor: ______Address:

TO: DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 EAST SIXTH AVENUE, P.O. BOX 200103 HELENA MT 59620-0103

Listed below are the principal subcontractors proposed on this project. *All subcontracts exceeding \$5,000 are to be listed.* The Contractor certifies that these subcontractors:

- 1. Have been advised of the labor standards and provisions applicable to this project.
- 2. That all provisions incorporated in the Contract between the Owner and the undersigned contractor will be incorporated in the contracts between the Contractor and any Subcontractors.
- 3. Are competent to accomplish the work subcontracted to them.

NAME AND ADDRESS OF SUBCONTRACTORS	REGISTRATION NO.	TYPE OF WORK

NAME AND ADDRESS OF SUBCONTRACTORS	REGISTRATION NO.	TYPE OF WORK	
Submitted By:			
Company/Contractor		Signature	Date
Reviewed By: Architect/Engineer		Signature	Date

Acknowledged By:	Architecture & Engineering	Division
/ tortino ago a D J .	, a child care a Erigine chilg	BIHIEIGH

Signature

Date



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT

59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

CONSENT OF SURETY COMPANY TO FINAL PAYMENT

Project: _____ Location: A/E#: _____

DEPARTMENT OF ADMINISTRATION TO: ARCHITECTURE AND ENGINEERING DIVISION 1520 EAST SIXTH AVENUE, P.O. BOX 200103 HELENA MT 59620-0103

Contractor: Contract Date:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the (Insert name and address of Surety Company)

on bond of (Insert name and address of Contractor)

.Contractor.

,Surety Company,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the Surety Company of any of its obligations to the Montana Department of Administration, Owner, as set forth in the said Surety Company's bond. The Surety agrees to be bound to the warranty period under the same conditions as the Contractor. The warranty is defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project unless otherwise modified in writing as part of the Substantial Completion or Final Acceptance.

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand this Day of ,

Surety Company

Signature of Authorized Representative

Attest: (Seal) Title



STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

CONTRACT CHANGE ORDER

A/E #:	
Chg. Order #:	
Date:	
Phone:	
	Chg. Order #: Date:

The Contractor is hereby directed to make the following changes in the Contract:

ITEM NO.	DESCRIPTION/UNIT BREAKDOWN/UNIT COSTS (Indicate Critical Path Schedule impact for each Item)			COST (Indicate + or -)	
			TOTAL F	ROM PAGE 2	\$ 0.00
			SUBTOTAL (Labor &	Materials) =	\$ 0.00
O&P II	ncluded above: 💽	Calculate O&P 🔘	Overhead & Pro	fit @ <u>15</u> % =	\$ 0.00
		Т	DTAL COST (This Change Or	der Only) =	\$ 0.00

Change In Contract Duration/Time By This Change Order:

No Change Increase Decrease BY CALENDAR DAYS.

NEW CONTRACT COMPLETION DATE:

CONTRACT STATUS				
1. Original Contract Amount				
2. Net Change by Previous Change Order(s)				
3. Current Contract Amount (1+2)	\$ 0.00			
4. This Change Order Total Amount	\$ 0.00			
5. New Contract Amount (3+4)	\$ 0.00			
6. Total Cost of All Change Orders to Date (2+4)	\$ 0.00			

A/E #:
Change Order #:
0

ITEM NO.	DESCRIPTION/UNIT BREAKDOWN/UNIT COSTS (Indicate Critical Path Schedule impact for each Item)	COST (Indicate + or -)
	SUBTOTAL (Labor & Materials) this page only. Carry forward to first page. =	\$ 0.00

JUSTIFICATION FOR CHANGE(S) (To be completed by Architect/Engineer): *Describe the details which mandate the change(s).*

JUSTIFICATION FOR COST ADJUSTMENT (To be completed by Architect/Engineer): Describe the basis used to calculate the cost adjustment.

JUSTIFICATION FOR SCHEDULE ADJUSTMENT (To be completed by Architect/Engineer): Describe the impact of adjustment(s) to the critical path.

APPROVALS

By signature on this change order, the Contractor certifies that th consequential items (including additional time, if any) and is free additional time, disruptions, and impacts) in favor of the Contractor change order and on all previously contracted Work and does he	and clear of any and all claims or disputed or solution or disputed or, subcontractors, material suppliers, or	ites (including, but not limited to, additional costs,
Approved by Contractor:	Ву:	Date:
Recommended by Architect/Engineer:	Ву:	Date:
Reviewed by Agency:	By:	Date:
Surety Consent: SURETY CONSENT IS REQUIRED 10% OF THE ORIGINAL CONTRA		L CHANGE ORDERS (LINE 6) EXCEEDS
The Surety consents to this Contract Change Order a modified or amended per this Change Order. The pri the penalty of the applicable Performance Bond and I By One Hundred Percent (100%) of ALL Change Orders	incipal and the Surety further agree	e that on or after execution of this consent, I by:
Countersigned by Resident Agent:		Date:
Surety:		
Recommended by: A&E Project Manager:		Date:
Accepted by: Montana Dept. of Administration: Architecture & Engineering Division		Date:



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

CONTRACTOR'S AFFIDAVIT OF COMPLETION, PAYMENT OF DEBTS AND CLAIMS, AND RELEASE OF LIENS

Project Name: _____

Location:

A/E #:_____

I CERTIFY to the best of my knowledge and belief that all work has been performed and materials supplied in strict accordance with the terms and conditions of the corresponding contract documents between the STATE OF MONTANA, acting by and through its DIRECTOR, DEPARTMENT OF ADMINISTRATION, hereinafter called the Owner, and

, hereinafter called the CONTRACTOR, for the above referenced project.

I further certify and declare that all bills for materials, supplies, utilities and for all other things furnished or caused to be furnished by the CONTRACTOR and used in the execution of the contract will be fully paid upon receipt of Final Payment and that there are no unpaid obligations, liens, claims, security interests, encumbrances, liabilities and/or demands of State Agencies, subcontractors, materialmen, mechanics, laborers or any others resulting from or arising out of any work done, caused to be done or ordered to be done by the CONTRACTOR under the contract.

In consideration of the prior and final payments made and all payments made for authorized changes, the CONTRACTOR releases and forever discharges the OWNER from any and all obligations, liens, claims, security interests, encumbrances and/or liabilities arising by virtue of the contract and authorized changes between the parties, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the OWNER, arising out of or in any way relating to the contract and authorized changes.

I further certify and agree that the warranty period is defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project unless otherwise modified in writing as part of the Substantial Completion or Final Acceptance.

This statement is made for the purpose of inducing the OWNER to make FINAL PAYMENT under the terms of the contract, relying on the truth and statements contained herein.

(Seal) CONTRACTOR
(Signature) (Title)
Subscribed and sworn to me this ____ Day of _____, ____
(Seal) NOTARY
Notary Public for the State of Montana

My Commission Expires:



STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

CERTIFICATE OF SUBSTANTIAL COMPLETION

Project Name: Project Address: Project Location:			&E #: Date:
Agency: Address: Contact Name: Contact #:			
To:	MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 E. SIXTH AVENUE, P.O. BOX 200103 HELENA MT 59620-0103		
Architect/Enginee	r:		
Contractor:		Contract Date: Contract Award Amount:	

PROJECT OR DESIGNATED PORTION SHALL INCLUDE:

The work performed under this Contract has been reviewed and found to be substantially complete. The Date of Substantial Completion of the Project or portion thereof designated above, which is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below is hereby established as:_____

BASIC PROJECT INFORMATION (required by Risk & Tort Defense Division)	Ν	IEW	REMODEL/F	RENOVATION
Total Square Footage		Sq. Ft.		Sq. Ft.
General Construction Material (e.g. masonry, metal panel, wood, etc.)				
Total Construction Cost				
Fire Sprinklers Installed (yes/no)	Yes	No	Yes	No
Estimated Date of Occupancy (if different from date of Substantial)				
Building Usage:				
Safety Consultation with DLI:	Yes	No	Yes	No
Additional Comments:				

Definition of Date of Substantial Completion

The Date of Substantial Completion of the Work or designated portion thereof is the Date certified by the Architect/Engineer when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy or utilize the Work or designated portion thereof for the use for which it is intended, as expressed in the Contract Documents.

A list of items to be completed or corrected, prepared by the Contractor and verified and amended by the Architect/Engineer, is attached hereto. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all the Work in accordance with the Contract Documents. The warranty period is defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project unless otherwise modified in writing as part of the Substantial Completion or Final Acceptance.

Architect/Engineer	Signature	Date
The Contractor will complete or correct the Work on the list of iten Substantial Completion.	ns attached hereto within days from	the above Date of
	Signature	Date
Contractor	olgilataro	
	Ū	ssession thereof
The Owner accepts the Work or designated portion thereof as su at on	Ū	ossession thereof
The Owner accepts the Work or designated portion thereof as su	Ū	ossession thereof
The Owner accepts the Work or designated portion thereof as su at on	Ū	ossession thereof

The responsibilities of the Owner and the Contractor for security, maintenance, heat, utilities, damage to the Work and insurance will be as follows (use attachments as necessary):



STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

CONSTRUCTION CHANGE DIRECTIVE

Project Name:		A/E #:	
Location:		Date:	_
Contractor:		Change Directive #: CCD-	_
Owner:	MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 EAST SIXTH AVENUE, P. O. BOX 200103 HELENA MT 59620		
Architect/Engineer:		_	

The Contractor is directed to proceed as described below. Proceed with this Work promptly. Costs for the Work (if any) involved and change in Contract Time (if any) will be included in a subsequent Change Order. **Description:**

Attachments: (insert listing of documents that support description)

Lump Sum	based on information provided by the Contr Change in Contract Sum of lot To Exceed	ractor: Fixed Estimated Maximum	Change in Contract Time of Calendar Days.	
Issued By:	Architect / Engineer	Si	gnature	Date
Accepted By:				
	Company / Contractor	Si	gnature	Date
Accepted By: MT	Dept. of Administration, A&E Division			
		Si	gnature	Date



Information Requested:

STATE OF MONTANA

DEPARTMENT OF ADMINISTRATION

ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

REQUEST FOR INFORMATION

Project Name: _ Location: _		A/E #: RFI #: Date:	
To:_		Attention:	
-		-	
From:		Attention:	
-		-	
Trades Affected:_		-	
	dite the Work and avoid or minimize delays in the Work the ation is requested. Please return a response by:	Date Date Rec	e Sent: ceived:

Response:

Response Date:

Respondent:

This RFI is for clarification only. The contractor shall notify the Owner's Representative within 48 hours if he/she feels the response to this RFI constitutes additional work.

Dist	. ما اسا	.4:	
LUS	I MINI	IIIOI	1.
		auor	••

Owner

Engineer

Agency

Architect Contractor

Other___



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION

1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

CERTIFICATE OF FINAL ACCEPTANCE

Project Name: Location:		
To:	MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 E. SIXTH AVENUE, P.O. BOX 200103 HELENA MT 59620-0103	
Architect/Enginee	r:	
Contractor:		Contract Date: Contract Amount:

The Work performed under this Contract has been reviewed and found to be complete and has reached Final Acceptance. The Date of Final Acceptance of the Work is defined as the Date Certified by the Architect/Engineer upon which the Work is fully complete in all aspects, and which the Owner accepts the Contractor's work as complete. The Date of Final Acceptance of the Project, or portion thereof designated above, is also the basis for commencement of the DURATION of applicable warranties required by the Contract Documents. The Warranty Period is defined in the Contract Documents as commencing with Substantial Completion(s) and continuing for one (1) calendar year from the Date of Final Acceptance. This date shall correspond to the date of the Architect/Engineer's approval on the final pay application unless otherwise agreed upon in writing. In the event of a disparity between the date of the Architect/Engineer's approval and this form, if no other written agreement exists as to the date of final acceptance, this form shall constitute such agreement and it shall govern as the date of Final Acceptance.

Date of Substantial Completion:	Date of Final Acceptance:	Date of Warranty Expiration:

Notes:

Architect / Engineer	Signature	Date
Contractor	Signature	Date
State of Montana Department of Administration, Architecture and Engineering Division		
Owner	Signature	Date



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION ARCHITECTURE AND ENGINEERING DIVISION 1520 East Sixth Avenue • P.O. Box 200103 • Helena MT 59620-0103 Phone: 406 444-3104 • Fax: 406 444-3399

Buy-Safe Montana

submits the following Buy-Safe Montana values for A&E review. For assistance, clarification, or the latest industry average rates, visit: https://www.bls.gov/iif/osheval.htm

Incident Rate:		
Industry Average Incident Rate:		
Experience Modification Ratio (EMR):		
Loss Ratio:		
Less than Industry Average Incident Rate -	Yes	No
EMR less than 1.0 -	Yes	No
Loss ratio less than 100% -	Yes	No
Is a Comprehensive Safety Consultation Required? *If all 3 options are responded to as "No," a consultation is required	Yes	No

Explanation of above average incident rate, EMR greater than 1.0, or loss ratio greater than 100%...

Per 3.1.7 – Buy-Safe Montana. The Owner shall review the Buy-Safe Montana form provided by the Bidder under Articles 16 of the Instructions to Bidders. To promote a safe work environment, the Owner encourages an incidence rate less than the latest average for non-residential building construction for Montana as established by the federal Bureau of Labor Statistics for the prior year; an experience modification rating (EMR) less than 1.0; and a loss ratio of less than 100%. The Contractor with a greater-than-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100% shall schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before the Owner grants Substantial Completion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit http://erd.dli.mt.gov/safety-health/onsite-consultation.

Name

Date



STATE OF MONTANA DEPARTMENT OF ADMINISTRATION

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GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

(Form Revision Date: April 2020)

ARTICLE 1 – GENERAL PROVISIONS

1.1. BASIC DEFINITIONS

1.1.1. CONTRACT DOCUMENTS. The Contract Documents consist of the Contract between Owner and Contractor (hereinafter the "Contract"), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Contract and Modifications issued after execution of the Contract. A Modification is: (1) a written amendment to the Contract signed by both parties; (2) a Change Order; (3) a Construction Change Directive; or, (4) a written order for a minor change in the Work issued by the Architect/Engineer. The Contract Documents shall include the bidding documents and any alterations made thereto by addenda. In the event of a conflict, discrepancy, contradiction, or inconsistency within the Contract Documents and for the resolution of same, the following order of hierarchy and control shall apply and prevail:

1) Contract; 2) Addenda; 3) Supplementary General Conditions; 4) General Conditions; 5) Specifications; 6) Drawings; 7) Instructions to Bidders; 8) Invitation To Bid; 9) Sample Forms.

- 1.1.1.1. If a conflict, discrepancy, contradiction, or inconsistency occurs within or between the Specifications and the Drawings, resolution shall be controlled by the following:
 - 1.1.1.1.1. As between figures, dimensions, or numbers given on drawings and any scaled measurements, the figures, dimensions, or numbers shall govern;
 - 1.1.1.1.2. As between large scale drawings and small scale drawings, the larger scale drawings shall govern;
 - 1.1.1.1.3. As between the technical specifications and drawings; the technical specifications shall govern.
 - 1.1.1.1.4. Shop Drawings and Submittals: Shop drawings and other submittals from the Contractor, subcontractors, or suppliers do not constitute a part of the Contract Documents.
- 1.1.1.2. The Contractor acknowledges, understands and agrees that the Contract Documents cannot be changed except as provided herein by the terms of the Contract. No act(s), action(s), omission(s), or course of dealing(s) by the Owner or Architect/Engineer with the Contractor shall alter the requirements of the Contract Documents and that alteration can be accomplished only through a written Modification process defined herein.
- 1.1.2. THE DRAWINGS. The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, intent, location, and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.
- 1.1.3. THE SPECIFICATIONS. The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.
- 1.1.4. THE CONTRACT. The entire Contract for Construction is formed by the Contract Documents. The Contract represents the entire, complete, and integrated agreement between the Owner and Contract

hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between: (1) the Architect/Engineer and Contractor; (2) the Owner and any Subcontractor, Sub-subcontractor, or Supplier; (3) the Owner and Architect/Engineer; or, (4) between any persons or entities other than the Owner and Contractor. However, the Architect/Engineer shall at all times be permitted and entitled to performance and enforcement of its obligations under the Contract intended to facilitate performance of the Architect/Engineer's duties.

- 1.1.5. THE WORK. The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to completely fulfill the Contract and the Contractor's obligations. The Work may constitute the whole or a part of the Project.
- 1.1.6. THE PROJECT. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.
- 1.1.7. TIME. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day of a duration or time period shall be determined as the day following the current day of any event or notice starting a specified duration. All durations in the Contract Documents are calendar days unless specifically stated otherwise.

1.2. CORRELATION, INTER-RELATIONSHIP, AND INTENT OF THE CONTRACT DOCUMENTS

- 1.2.1. The intent of the Contract Documents is to include all items and all effort necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary and inter-related, and what is required by one shall be as binding as if required by all. Performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.
- 1.2.2. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. It is the Contractor's responsibility to control the Work under the Contract.
- 1.2.3. Unless otherwise stated in the Contract Documents, words which have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

1.3. CAPITALIZATION

1.3.1. Terms capitalized in these General Conditions include those which are: (1) specifically defined; and, (2) the titles of numbered articles and identified references to Paragraphs, Subparagraphs and Clauses in the document.

1.4. INTERPRETATION

1.4.1. In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

1.5. EXECUTION OF THE CONTRACT AND CONTRACT DOCUMENTS

1.5.1. The Contract shall be signed by the Owner and Contractor. Execution of the Contract by the Contractor constitutes the complete and irrevocable binding of the Contractor and his Surety to the Owner for complete performance of the Work and fulfillment of all obligations. By execution of the Contract, the Contractor acknowledges that it has reviewed and familiarized itself with all aspects of the Contract Documents and agrees to be bound by the terms and conditions contained therein.

- 1.5.2. Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.
- 1.5.3. The Contractor acknowledges that it has taken all reasonable actions necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to: (1) conditions bearing upon transportation, disposal, handling, and storage of materials; (2) the availability of labor, water, gas, electric power, phone service, and roads; (3) uncertainties of weather, river stages, tides, or similar physical conditions at the site; (4) the conformation, topography, and conditions of the ground; and, (5) the character of equipment and facilities needed for performance of the Work. The Contractor also acknowledges that it has satisfied itself as to the character, guality, and guantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory geotechnical work done by the Owner, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the action described and acknowledged in this paragraph will not relieve the Contractor from responsibility for properly ascertaining and estimating the difficulty and cost of successfully performing the Work or for proceeding to successfully perform the Work without additional expense to the Owner.
- 1.5.4. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Owner, nor does the Owner assume responsibility for any understanding reached or representation made by any of its officers, agents, or employees concerning conditions which can affect the Work unless that understanding or representation is expressly stated in the Contract Documents.
 - 1.5.4.1. Performance of any portion of the Work beyond that required for complying with the specifications and all other requirements of the Contract, shall be deemed to be for the convenience of the Contractor and shall be at the Contractor's sole expense.
 - 1.5.4.2. There shall be no increase in the contract price or time allowed for performance which is for the convenience of the Contractor.

1.6. OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER INSTRUMENTS OF SERVICE

The Drawings, Specifications and other documents, including those in electronic form, prepared by the 1.6.1. Architect/Engineer and the Architect/Engineer's consultants are Instruments of Service through which the Work to be executed by the Contractor is described. The Contractor may retain one record set. Neither the Contractor nor any Subcontractor, Sub-subcontractor or material or equipment supplier shall own or claim a copyright in the Drawings, Specifications and other documents prepared by the Architect/Engineer or the Architect/Engineer's consultants. Unless otherwise indicated, the Architect/Engineer and the Architect/Engineer's consultants shall be deemed the authors of them and will retain all common law, statutory and other reserved rights, in addition to the copyrights except as defined in the Owner's Contract with the Architect/Engineer. All copies of Instruments of Service, except the Contractor's record set, shall be returned or suitably accounted for to the Architect/Engineer upon completion of the Work. The Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants, and copies thereof furnished to the Contractor, are for use solely with respect to this Project. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or material or equipment supplier on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect/Engineer, and the Architect/Engineer's consultants. The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this authorization shall bear the statutory copyright notice, if any, shown on the Drawings Specifications and other documents prepared by the Architect/Engineer and the Architect/Engineer's consultants. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect/Engineer's or Architect/Engineer's consultants' copyrights or other reserved rights.

1.6.2. Owner's Disclaimer of Warranty: The Owner has requested the Architect/Engineer prepare the Contract Documents for the Project which are adequate for bidding and constructing the Project. However, the Owner makes no representation, guarantee, or warranty of any nature whatsoever to the Contractor concerning such documents. The Contractor hereby acknowledges and represents that it has not, does not, and will not rely upon any such representation, guarantee, or warranty have been or are hereby made.

ARTICLE 2 – THE OWNER

2.1. THE STATE OF MONTANA

- 2.1.1. The Owner is the State of Montana and is the sole entity to be identified as Owner in the Contract and as referred to throughout the Contract Documents as if singular in number.
- 2.1.2. Except as otherwise provided in Subparagraph 4.2.1, the Architect/Engineer does not have authority to bind the Owner. The observations and participations of the Owner or its authorized representative do not alleviate any responsibility on the part of the Contractor. The Owner reserves the right to observe the work and make comment. Any action or lack of action by the Owner shall not be construed as approval of the Contractor's performance.
- 2.1.3. The Owner reserves the right to require the Contractor, all sub-contractors and material suppliers to provide lien releases at any time. The Owner reserves the right to withhold progress payments until such lien releases are received for all work for which prior progress payments have been made. Upon the Owner's demand for lien releases (either verbally or written), the Contractor, all sub-contractors and material suppliers shall provide such releases with every subsequent application for payment through Final Acceptance of the Project.
- 2.1.4. Except for permits and fees, including those required under Subparagraph 3.7.1, which are the responsibility of the Contractor under the Contract Documents, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.
- 2.1.5. Information or services required of the Owner by the Contract Documents shall be furnished by the Owner with reasonable promptness. Any other information or services relevant to the Contractor's performance of the Work under the Owner's control shall be furnished by the Owner after receipt from the Contractor of a written request for such information or services.
- 2.1.6. Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, such copies of Drawings and Specifications as are reasonably necessary for execution of the Work.

2.2. OWNER'S RIGHT TO STOP WORK

2.2.1. If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents as required by Paragraph 12.2 or persistently fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated. However, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Subparagraph 6.1.3. The issuance of a stop work order by the Owner shall not give rise to a claim by the Contractor or any subcontractor for additional cost, time, or other adjustment.

2.3. OWNER'S RIGHT TO CARRY OUT THE WORK

2.3.1. If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may after such seven-day period give the Contractor a second written notice to correct such deficiencies within a three-day period. If the Contractor within such three-day period after receipt of such second notice fails to commence and continue to correct any deficiencies, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be

issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and increased costs, and compensation for the Architect/Engineer's additional services made necessary by such default, neglect, or failure. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

2.4. OWNER'S RIGHT TO PERSONNEL

- 2.4.1. The Owner reserves the right to have the Contractor and/or subcontractors remove person(s) and/or personnel from any and all work on the project with cause but without cost to the Owner. Such requests from the Owner may be made verbally or in writing and may be done directly with the Contractor or indirectly through the Architect/Engineer. Cause may be, but not limited to, any of the following: incompetence, poor workmanship, poor scheduling abilities, poor coordination, disruption to the facility or others, poor management, causes delay or delays, disruption of the Project, will not strictly adhere to facility procedures and Project requirements either knowingly or unknowingly, insubordination, drug/alcohol use, possession of contraband, belligerent acts or actions, etc. The Contractor shall provide replacement person(s) and/or personnel acceptable to the Owner at no cost to the Owner.
- 2.4.2. Any issue or circumstance relating to or resulting out of this clause shall not be construed or interpreted to be interference with or impacting upon the Contractor's responsibilities and liabilities under the Contract Documents.
- 2.4.3. Person(s) and/or personnel who do not perform in accordance with the Contract Documents, shall be deemed to have provided the Owner with cause to have such persons removed from any and all involvement in the Work.
- 2.4.4. The Contractor agrees to indemnify and hold harmless the Owner from any and all causes of action, demands, claims, damages, awards, attorneys' fees, and other costs brought against the Owner and/or Architect/Engineer by any and all person(s) or personnel as a result of actions under this clause.

ARTICLE 3 – THE CONTRACTOR

3.1. <u>GENERAL</u>

- 3.1.1. The Contractor is the person or entity identified as such in the Contract and is referred to throughout the Contract Documents as if singular in number. The term "Contractor" means the Contractor or the Contractor's authorized representative.
- 3.1.2. Construction Contractor Registration: The Contractor is required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. A bidder must demonstrate that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work. If the prevailing bidder cannot or does not register in time for the Owner to execute the Contract within fifteen (15) days of the date on the notice of award, the Owner may award, at its sole discretion, to the next lowest responsible bidder who meets this requirement. The Owner will not execute a contract for construction nor issue a Notice to Proceed to a Contractor who is not registered per 39-9-401(a) MCA. It is solely the Contractor's responsibility to ensure that all Subcontractors are registered in accordance with Title 39, Chapter 9, MCA.
- 3.1.3. The Owner's engagement of the Contractor is based upon the Contractor's representations by submission of a bid to the Owner that it:
 - 3.1.3.1. has the requisite skills, judgment, capacity, expertise, and financial ability to perform the Work;
 - 3.1.3.2. is experienced in the type of labor and services the Owner is engaging the Contractor to perform;
 - 3.1.3.3. is authorized, licensed and registered to perform the type of labor and services for which it is being engaged in the State and locality in which the Project is located;

- 3.1.3.4. is qualified, willing and able to perform the labor and services for the Project in the manner and scope defined in the Contract Documents; and,
- 3.1.3.5. has the expertise and ability to provide labor and services that will meet the Owner's objectives, intent and requirements, and will comply with the requirements of all governmental, public, and quasi-public authorities and agencies having or asserting jurisdiction over the Project.
- 3.1.4. The Contractor shall perform the Work in accordance with the Contract Documents.
- 3.1.5. The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect/Engineer in the Architect/Engineer's administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.
- 3.1.6. Quality Control (i.e. ensuring compliance with the Contract Documents) and Quality Assurance (i.e. confirming compliance with the Contract Documents) are the responsibility of the Contractor. Testing, observations, and/or inspections performed or provided by the Owner are solely for the Owner's own purposes and are for the benefit of the Owner. The Owner is not liable or responsible in any form or fashion to the Contractor regarding quality assurance or extent of such assurances. The Contractor shall not, under any circumstances, rely upon the Owner's testing or inspections as a substitute or in lieu of its own Quality Control or Assurance programs.
- Buy-Safe Montana Provision: The Owner shall review the Buy-Safe Montana Form provided by the Bidder 3.1.7. under Articles 16 of the Instructions to Bidders. To promote a safe work environment, the Owner encourages an incidence rate less than the latest average for non-residential building construction for Montana as established by the federal Bureau of Labor Statistics for the prior year; an experience modification rating (EMR) less than 1.0; and a loss ratio of less than 100%. The Contractor with a greaterthan-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100% shall schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before the Owner grants Substantial Completion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit http://erd.dli.mt.gov/safety-health/onsite-consultation.

3.2. REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

- 3.2.1. Since the Contract Documents are complementary and inter-related, before starting each portion of the Work, the Contractor shall carefully study and compare the various Drawings and other Contract Documents relative to that portion of the Work, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions affecting the Work. These obligations are for the purpose of facilitating construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents. However, any errors, inconsistencies or omissions discovered by the Contractor shall be reported promptly to the Architect/Engineer as a request for information in such form as the Architect/Engineer may require.
- 3.2.2. Any errors or omissions noted by the Contractor during this review shall be reported promptly to the Architect/Engineer, but it is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.
- 3.2.3. If the Contractor believes that additional cost or time is involved because of clarifications or instructions issued by the Architect/Engineer in response to the Contractor's notices or requests for information pursuant to Subparagraphs 3.2.1 and 3.2.2, the Contractor shall make Claims as provided in Subparagraphs 4.3.4 and 4.3.5. If the Contractor fails to perform the obligations of Subparagraphs 3.2.1 and 3.2.2, the Contractor shall make claims as provided in 3.2.2, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. The Contractor shall not be liable to the Owner or Architect/Engineer for damages resulting from errors, inconsistencies, or omissions in the Contract Documents or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized such error, inconsistency, omission or difference and failed to report it to the Architect/Engineer.

- 3.2.4. Except as otherwise expressly provided in this Contract, the Contractor assumes all risks, liabilities, costs, and consequences of performing any effort or work in accordance with any written or oral order (including but not limited to direction, instruction, interpretation, or determination) of a person not authorized in writing by the Owner to issue such an order.
- 3.2.5. By entering into this Contract, the Contractor acknowledges that it has informed itself fully regarding the requirements of the Drawings and Specifications, the General Conditions, the Supplementary General Conditions, all other documents comprising a part of the Contract Documents and all applicable laws, building codes, ordinances and regulations. Contractor hereby expressly acknowledges, guarantees, and warrants to the Owner that:
 - 3.2.5.1. the Contract Documents are sufficient in detail and scope to enable Contractor to construct the finished project;
 - 3.2.5.2. no additional or further work should be required by Owner at the time of Owner's acceptance of the Work; and,
 - 3.2.5.3. when the Contractor's work is finished and the Owner accepts, the Work will be complete and fit for the purpose intended by the Contract Documents. This acknowledgment and guarantee does not imply that the Contractor is assuming responsibilities of the Architect/Engineer.
- 3.2.6. Sufficiency of Contract Documents: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has received, carefully reviewed, and evaluated all aspects of the Contract Documents and agrees that said Documents are adequate, consistent, coordinated, and sufficient for bidding and constructing the Work requested, intended, conceived, and contemplated therein.
 - 3.2.6.1. The Contractor further acknowledges its continuing duty to review and evaluate the Contract Documents during the performance of its services and shall immediately notify the Architect/Engineer of any problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions it discovers in the Contract Documents and the Work to be constructed; and, any variances it discovers between the Contract Documents and applicable laws, statutes, building codes, rules or regulations.
 - 3.2.6.2. If the Contractor performs any Work which it knows or should have known due to its experience, ability, qualifications, and expertise in the construction industry, that involves problems, conflicts, defects, deficiencies, inconsistencies, errors, or omissions in the Contract Documents and the Work to be constructed and, any variances between the Contract Documents and applicable laws, statutes, building codes, rules or regulations, without prior written notification to the Architect/Engineer and without prior authorization to proceed from the Architect/Engineer, the Contractor shall be responsible for and bear the costs and delays (including costs of any delay) of performing such Work and all corrective actions as directed by the Architect/Engineer.
 - 3.2.6.3. Any and all claims resulting from the Contractor's failure, including those of any subcontractor or supplier, to carefully review, evaluate, and become familiar with all aspects of the Contract Documents shall be deemed void and waived by the Contractor.
- 3.2.7. Sufficiency of Site Conditions: Prior to submission of its bid, and in all events prior to and upon signing the Contract, the Contractor certifies, warrants and guarantees that it has visited, carefully reviewed, evaluated, and become familiar with all aspects of the site and local conditions at which the Project is to be constructed. The Contractor agrees that the Contract Documents are an adequate, consistent, coordinated, and sufficient representation of the site and local conditions for the Work.
 - 3.2.7.1. The Contractor has reviewed and become familiar with all aspects with the Site Survey and Geotechnical Report for the Project and has a full understanding of the information provided therein.
 - 3.2.7.2. If the Work involves modifications, renovations, or remodeling of an existing structure(s) or other man-made feature(s), the Contractor certifies, warrants and guarantees that it has

reviewed, evaluated, and become familiar with all available as-built and record drawings, plans and specifications, and has thoroughly inspected and become familiar with the structure(s) or man-made feature(s).

3.2.7.3. Any and all claims resulting from the Contractor's failure, including those of any subcontractor or supplier, to visit, carefully review, evaluate, and become familiar with all aspects of the site, available geotechnical information, and local conditions at which the Project is to be constructed shall be deemed void and waived by the Contractor.

3.3. SUPERVISION AND CONSTRUCTION PROCEDURES

- 3.3.1. The Contractor shall supervise and direct the Work using the Contractor's best skill and attention recognizing that time and quality are of the essence of the Work. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. It is the responsibility of and incumbent upon the Contractor to ensure, confirm, coordinate, inspect and oversee all Work (which is inclusive of but not limited to all submittals, change orders, schedules, workmanship, and appropriate staffing with enough competent and qualified personnel) so that the Work is not impacted in terms of any delays, costs, damages, or additional time, or effort on the part Architect/Engineer or Owner. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Architect/Engineer and shall not proceed with that portion of the Work without further written instructions from the Architect/Engineer. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Architect/Engineer or Owner as appropriate shall be solely responsible for any resulting loss or damage. The Contractor will be required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and shall propose any alternative procedure which the Contractor will warrant and guarantee. The Contractor is required to: review any specified construction or installation procedure; advise the Architect/Engineer if the specified procedure deviates from good construction practice; to advise the Architect/Engineer if following the procedure will affect any warranties, including the Contractor's general warranty, or of any objections the Contractor may have to the procedure and to propose any alternative procedure which the Contractor will warrant.
- 3.3.2. The Contractor shall furnish management, supervision, coordination, labor and services that: (1) expeditiously, economically, and properly completes the Work; (2) comply with all requirements of the Contract Documents; and, (3) are performed in a quality workmanlike manner and in accordance with the standards currently practiced by persons and entities performing or providing comparable management, supervision, labor and services on projects of similar size, complexity, cost, and nature to this Project. However, the standards currently practiced within the construction industry shall not relieve the Contractor of the responsibility to perform the Work to the level of quality, detail, and excellence defined and intended by the Contract Documents as interpreted by the Architect/Engineer.
- 3.3.3. All services and labor rendered by the Contractor, including any subcontractors or suppliers, shall be performed under the immediate supervision at the site of persons possessing expertise and the requisite knowledge in the discipline or trade of service being rendered. The Contractor shall maintain such supervision and personnel at all times that the Contractor's personnel, subcontractors, and/or suppliers are at the site. The Contractor shall never be absent from the site during performance of any portion of the Work by any entity under the supervision and direction of the Contractor. Full time attendance by the Contractor from Notice to Proceed through Final Acceptance is an explicit requirement of this Contract.
- 3.3.4. The Contractor shall be responsible to the Owner for acts, damages, errors, and omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.

3.3.5. The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

3.4. LABOR, WAGES, AND MATERIALS

- 3.4.1. Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, permits, licenses, goods, products, equipment, tools, construction equipment and machinery, water, heat, all utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work in accordance with the Contract Documents, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.
- 3.4.2. The Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect/Engineer and in accordance with a Change Order. This opportunity to request substitutions does not negate or waive any requirement for the Contractor to follow a pre-bidding "prior approval" requirement nor obligate the Owner to approve any substitution request.
- 3.4.3. The Contractor shall enforce strict discipline, appropriate behavior, and good order among the Contractor's employees, subcontractors at every tier and level, and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.
- 3.4.4. Prevailing Wages and Montana Residents.
 - 3.4.4.1. The Contractor and all subcontractors at any level or tier of the Work shall give preference to the employment of bona fide Montana residents in the performance of the Work and shall pay the standard prevailing rate of wages, including fringe benefits for health and welfare and pension contributions and travel allowance provisions in effect and applicable to the county or locality in which the work is being performed. (18-2-403, MCA)
 - 3.4.4.2. At least 50% of the workers, as defined by the Department of Labor & Industry (DOLI), must be bona fide Montana residents. (18-2-401, 18-2-402, MCA)
 - 3.4.4.3. Indian Employment Preference within the Boundaries of an Indian Reservation. All contractors that are awarded a state agency construction contract within the exterior boundaries of an Indian Reservation shall extend a hiring preference to qualified Indians as provided herein:
 - 3.4.4.3.1. "State agency" means a department, office, board, bureau, commission, agency, or other instrumentality of the executive or judicial branches of the government of this State. "Indian" means a person who is enrolled or who is a lineal descendent of a person enrolled in an enrollment listing of the Bureau of Indian Affairs or in the enrollment listing of a recognized Indian tribe domiciled in the United States.
 - 3.4.4.3.2. Qualified Indians Employment Criteria: An Indian shall be qualified for employment in a permanent, temporary, or seasonal position if he or she has substantially equal qualifications for any position and resides on the reservation where the construction contract is to be performed.
 - 3.4.4.3.3. Non-Applicability: The Indian Employment Preference Policy does not apply to a project partially funded with federal-aid money from the United States Department of Transportation or when residency preference laws are specifically prohibited by federal law. It does not apply to independent contractors and their employees, student interns, elected officials, or appointed positions.
 - 3.4.4.4. The Commissioner of The Montana Department of Labor and Industry (DOLI) has established the standard prevailing rate of wages in accordance with 18-2-401 and 18-2-402, MCA. A copy of the Rates entitled "State of Montana, Prevailing Wage Rates" are bound herein. The Commissioner of the Montana DOLI has established the resident requirements in accordance with 18-2-409, MCA. The Contractor and all subcontractors at any level or tier of the Work shall direct any and all questions concerning prevailing wage and Montana resident issues for all aspects of the Work to DOLI.

- 3.4.4.5. The Contractor and all subcontractors at any tier or level of the Work, and as determined by the Montana DOLI, shall classify all workers in the project in accordance with the State of Montana, Prevailing Wage Rates. In the event the Contractor is unable to classify a worker in accordance with these rates he shall contact DOLI for a determination of the classification and the prevailing wage rate to be paid.
- 3.4.4.6. The Contractor and all subcontractors at any tier or level of the Work shall be responsible for obtaining wage rates for all workers prior to their performing any work on the project. The Contractor is required to pay and insure that its subcontractors at any tier or level and others also pay the prevailing wage determined by the DOLI, insofar as required by Title 18 of the MCA and the pertinent rules and standards of DOLI.
- 3.4.4.7. It is not the responsibility of the Owner to determine who classifies as a subcontractor, subsubcontractor, material man, supplier, or any other person involved in any aspect of the Work at any tier or level. All such determinations shall be the sole responsibility of the Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project at any tier or level. The Contractor, subcontractors, sub-subcontractors, material men, suppliers and others involved in the project shall indemnify and hold harmless the Owner from all claims, attorneys' fees, damages and/or awards involving prevailing wage or Montana resident issues. Any changes to wages or penalties for failure to pay the correct wages will be the sole responsibility of the Contractor and/or his subcontractors and no further charges or claims shall be made to the Owner. If the parties mutually agree or an arbitrator or court determines that any change in wages is due and any part is attributable to the Owner, the Owner's sole liability shall be for the amount of wages ordered only and not for other expenses, charges, penalties, overhead, profit or other mark-ups.
- 3.4.4.8. In accordance with 18-2-422(1) MCA, each job classification's standard prevailing wage rate, including fringe benefits, that the contractors and employers shall pay during construction of the project is included herein by both reference to DOLI's "Building" or 'Heavy/Highway" schedules and as part of these Contract Documents.
- 3.4.4.9. The Contractor and every employer, including all subcontractors at any tier or level, is required by 18-2-422(2) MCA to maintain payroll records in a manner readily capable of being certified for submission under 18-2-423 MCA, for a period of not less than 3 years after the contractor's, subcontractor's, or employer's completion of work on the project or the Final Acceptance by the Owner, whichever is later.
- 3.4.4.10. Each contractor is required by 18-2-422(3) MCA to post in a visible and accessible location a statement of all wages and fringe benefits in compliance with 18-2-423.

3.5. WARRANTY AND GUARANTEE

- 3.5.1. The Contractor warrants to the Owner and Architect/Engineer that materials and equipment furnished under the Contract will be new and of good quality unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective and rejected. The Contractor's warranty excludes remedy for damage or defect caused by abuse, modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect/Engineer, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.
- 3.5.2. The Contractor shall and does hereby warrant and guarantee all work, workmanship, and materials for the full warranty period as specified in the Contract Documents. The warranty period shall be defined as commencing with Substantial Completion (or with each Substantial Completion if there is more than one) of the Project, or any portion thereof, and continuing for one (1) calendar year from the date of Final Acceptance of the entire project by the Owner. The date of Final Acceptance shall be the date of the Architect/Engineer's signature on the final request for payment unless otherwise agreed upon in writing for the entire project or any portion thereof, by the Owner, Architect/Engineer and Contractor.

- 3.5.3. In addition to the one (1) calendar year warranty and guarantee specified in this herein above, the Contractor warrants and guarantees all materials and workmanship for the roofing system for a period of two (2) calendar years from the date of Final Acceptance. This warranty shall cover all labor and materials for roof and roofing finish systems (e.g. flashing, terminations, parapet caps, etc.) repairs from moisture penetration and/or defects in workmanship.
- 3.5.4. Manufacturer and product warranties and guarantees, as provided by the manufacturer or as specified in the Contract Documents, are in addition to the Contractor's warranty.

3.6. <u>TAXES</u>

- 3.6.1. The Contractor is responsible for and shall pay all sales, consumer, use, and similar taxes for the Work provided by the Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.
- 3.6.2. In compliance with 15-50-206 MCA, the Contractor will have 1% of his gross receipts withheld by the Owner from all payments due and sent to the Montana Department of Revenue. Each subcontractor who performs work greater than \$5,000 shall have 1% of its gross receipts withheld by the Contractor and sent to the Montana Department of Revenue. The Contractor shall notify the Department of Revenue on the Department's prescribed form.

3.7. PERMITS, FEES, AND NOTICES

- 3.7.1. Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit and other permits and governmental fees, licenses and inspections necessary for proper execution and completion of the Work which are customarily secured after execution of the Contract, including but not limited to, the building permit fee, electrical, plumbing, sewer connection fee and mechanical permit fee, and any required impact fees and which are legally required when bids are received or negotiations concluded.
- 3.7.2. The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations and lawful orders of public authorities applicable to performance of the Work.
- 3.7.3. If the Contractor performs Work knowing it to be contrary to laws, statutes, ordinances, building codes, and rules and regulations, and does so without providing notice to the Architect/Engineer and Owner, the Contractor shall assume responsibility for such Work and shall bear the costs attributable to correction. The Contractor shall be solely responsible to insure that all work it performs is in full compliance with all prevailing and applicable codes and regulations.
- 3.7.4. Incident Reporting: The Contractor shall immediately notify the Owner and Architect/Engineer, both orally and in writing, of the nature and details of all incidents which may adversely affect the quality or progress of the Work, including, but not limited to, union disputes, accidents, delays, damages to Work, and other significant occurrences. Such notices are in addition to any other notices required regarding claims.

3.8. ALLOWANCES

- 3.8.1. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct.
- 3.8.2. Unless otherwise provided in the Contract Documents:
 - 3.8.2.1. allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
 - 3.8.2.2. Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included by the Contractor in the Contract Sum but not in the allowances;

- 3.8.2.3. whenever costs are more than or less than stated allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect: (1) the difference between actual costs and the allowances under Clause 3.8.2.1; and, (2) changes in Contractor's costs under Clause 3.8.2.2.
- 3.8.3. Materials and equipment under an allowance shall be selected by the Owner.

3.9. CONTRACTOR'S PERSONNEL

- 3.9.1. The Contractor shall employ competent personnel, supervisors, project managers, project engineers, project superintendent, and all others who shall be assigned to the Work throughout its duration. Contractor's personnel extend to those employed by the Contractor whether at the site or not. The Owner shall have right to review and approve or reject all replacement of Contractor's personnel. All personnel assigned by the Contractor to the Work shall possess the requisite experience, skills, abilities, knowledge, and integrity to perform the Work.
- 3.9.2. The superintendent and others as assigned shall be in attendance at the Project site during the performance of any and all Work. The superintendent shall represent the Contractor. All communications given to the Contractor's personnel such as the project manager or the superintendent, whether verbal, electronic or written, shall be as binding as if given to the Contractor.
- 3.9.3. It is the Contractor's responsibility to appropriately staff, manage, supervise and direct the Work which is inclusive of the performance, acts, and actions of his personnel and subcontractors. As such, the Contractor further agrees to indemnify and hold harmless the Owner and the Architect/Engineer, and to protect and defend both from and against all claims, attorneys' fees, demands, causes of action of any kind or character, including the cost of defense thereof, arising in favor of or against the Owner, Architect/Engineer, Contractor, their agents, employees, or any third parties on account of the performance, behavior, acts or actions of the Contractor's personnel or subcontractors.
- 3.9.4. Prior to the commencement of any work, the Contractor shall prepare and submit a personnel listing and organizational chart in a format acceptable to the Owner which lists by name, phone number (including cell phone), job category, and responsibility the Contractor's key/primary personnel who will work on the Project. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference.
- 3.9.5. The Contractor shall immediately remove for the duration of the Project, any person making an inappropriate racial, sexual, or ethnic comment, statement, joke, or gesture toward any other individual.
- 3.9.6. The Contractor shall immediately remove for the duration of the Project, any person who is incompetent, careless, disruptive, or not working in harmony with others.

3.10. CONSTRUCTION SCHEDULES

- 3.10.1. The Contractor shall, promptly after being awarded the Contract, prepare and submit for the Owner's and Architect/Engineer's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and per the requirements of the Contract Documents, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The Contractor's schedule shall be in the "Critical Path Method" and shall show the Critical Path of the Work in sufficient detail to evaluate the Contractor's progress. A request for time extension by the Contractor will not be allowed unless a change in the Work is approved by the Owner and materially affects the Critical Path. It is the Contractor's responsibility to demonstrate that any time extensions requests materially affect the Critical Path.
- 3.10.2. The Contractor shall prepare and keep current, for the Architect/Engineer's approval, a schedule of submittals which is coordinated with the Contractor's Construction Schedule and allows the Architect/Engineer reasonable time to review submittals.

- 3.10.3. The Contractor shall perform the Work in accordance with the most recent schedule submitted to the Owner and Architect/Engineer.
- 3.10.4. The Contractor's operations (including but not limited to the Contractor's forces employed, sequences of operations, and methods of operation) at all times during the performance of the contract shall be: (a) subject to the review of the Owner or the Architect/Engineer; and, (b) sufficient to insure the completion of the Work within the specified performance period.
- 3.10.5. The Critical Path Method Construction Schedule prepared by the Contractor must be in a form that is acceptable to both the Architect/Engineer and the Owner.
 - 3.10.5.1. The Schedule shall show the estimated progress of the entire Project through the individual time periods allowed for completion of each discipline, trade, phase, section, and aspect of the Work. The Contractor shall provide written reports of all logic and resource loading data with the Schedule and with all updates to the Schedule.
 - 3.10.5.2. The Schedule shall show percent complete, progress to date, project work, and projected time to complete the work for all activities. The percent complete and minor schedule changes, including additions of activities, change orders, construction change directives, changes to sequences of activities and significant changes in activity demands must be shown by a revised Schedule. A written report providing details about the changes and what actions are anticipated to get the work completed in the contractual time period shall be submitted with the revised schedule.
 - 3.10.5.3. The Construction Schedule shall include coordinate dates for performance of all divisions of the Work, including shipping and delivery, off-site requirements and tasks, so the Work can be completed in a timely and orderly fashion consistent with the required dates of Substantial Completion and Final Acceptance.
 - 3.10.5.4. The Construction Schedule shall include: (i) the required commencement date, the required dates of Substantial Completion(s) and Final Acceptance for the complete Project and all phases (if any); (ii) any guideline and milestone dates required by the Owner or the Contract Documents; (iii) subcontractor and supplier schedules; (iv) a submittal schedule which allows sufficient time for review and action by the Architect/Engineer; (v) the complete sequence of all construction activities with start and completion dates; and, (vi) required decision dates.
 - 3.10.5.5. By receiving, reviewing, and/or commenting on the Construction Schedule or any portion thereof (including logic and resource loading), neither the Owner or Architect/Engineer assume any of the Contractor's responsibility or liability that the Schedule be coordinated or complete, or for timely and orderly completion of the Work.
 - 3.10.5.6. Receiving, reviewing, and/or commenting on the Schedule, any portion thereof, or any revision thereof, does not constitute an approval, acknowledgement, or acceptance of any duration, dates, milestones, or performance indicated therein.
 - 3.10.5.7. A printout of the Schedule's logic showing all activities and all resource loading is required with the Schedule and with all updates to the Schedule.
- 3.10.6. The Contractor shall review and compare, at a minimum on a weekly basis, the actual status of the Work against its Construction Schedule.
- 3.10.7. The Contractor shall routinely, frequently, and periodically (but not less than monthly) update and/or revise its Construction Schedule to show actual progress of the Work through the date of the update or revision, projected level of completion of each remaining activity, activities modified since the previous update or revision, and major changes in scope or logic. The updated/revised Schedule shall be accompanied by a narrative report which: (1) states and explains any modifications of the critical path, if any, including any changes in logic; (2) defines problem areas and lists areas of anticipated delays; (3) explains the anticipated impact the change in the critical path or problems and delays will have on the entire Schedule and the completion of the Work; (4) provides corrective action taken or proposed; and,

(5) states how problems or delays will be resolved in order to deliver the Work by the required phasing milestones (if any), Substantial Completion(s), and Final Acceptance dates.

- 3.10.8. Delay in Performance: If at any time the Contractor anticipates that performance of the Work will be delayed or has been delayed, the Contractor shall: (1) immediately notify the Architect/Engineer by separate and distinct correspondence of the probable cause and effect of the delay, and possible alternatives to minimize the delay; and, (2) take all corrective action reasonably necessary to deliver the Work by the required dates. Nothing in this paragraph or the Contract Documents shall be construed by the Contractor as a granting by the Architect/Engineer or Owner of constructive acceleration. The results of failure to anticipate delays, or to timely notify the Owner and Architect/Engineer of an anticipated or real delay, are entirely the responsibility of the Contractor whether compensable or not.
- 3.10.9. Early Completion: The Contractor may attempt to achieve Substantial Completion(s) on or before the date(s) required in the Contract. However, such early completion shall be for the Contractor's sole convenience and shall not create any real or implied additional rights to Contractor or impose any additional obligations on the Owner or Architect/Engineer. The Owner will not be liable for nor pay any additional compensation of any kind to the Contractor for achieving Substantial Completion(s) or Final Acceptance prior to the required dates as set forth in the Contract. The Owner will not be liable for nor pay any additional compensation of any kind should there by any cause whatsoever that the Contractor is not able to achieve Substantial Completion(s) earlier than the contractually required dates of Substantial Completion(s) or Final Acceptance.
- 3.10.10. Float in Schedule. Any and all float time in the Contractor's schedule, regardless of the path or activity, shall accrue to the benefit of the Owner and the Work, and not to the Contractor. Float also includes any difference shown between any early completion dates shown on the Contractor's Schedule for any phasing milestone(s), Substantial Completion(s) or Final Acceptance and the dates or durations as required by the Contract Documents.
- 3.10.11. Modification of Required Substantial Completion(s) or Final Acceptance Dates: Modification of the required dates shall be accomplished only by duly authorized, accepted, and approved change orders stating the new date(s) with specificity on the change order form. All rights, duties, and obligations, including but not limited to the Contractor's liability for actual, delay, and/or liquidated damages, shall be determined in relation to the date(s) as modified.

3.11. DOCUMENTATION AND AS-BUILT CONDITIONS AT THE SITE

- 3.11.1. The Contractor shall maintain at the site for the Owner one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and accurately marked to record current field changes and selections made during construction, and one record copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Architect/Engineer or Owner at any time and shall be delivered to the Architect/Engineer for submittal to the Owner upon completion of the Work.
- 3.11.2. The Owner shall not be required to process final payment until all documentation and data required by the Contract Documents is submitted to and approved by the Architect/Engineer including, but not limited to, the As-Built Drawings. The Owner will not process any final request for payment until the Architect/Engineer has received and verified that the Contractor has performed the requirements pertaining to the as-built drawings.
- 3.11.3. The as-built drawings shall be neatly and clearly marked during construction to record all deviations, variations, changes, and alterations as they occur during construction along with such supplementary notes and details necessary to clearly and accurately represent the as-built condition. The as-built drawings shall be available at all times to the Owner, Architect/Engineer and Architect/Engineer's consultants.

3.12. SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.1. Definitions:

- 3.12.1.1. Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
- 3.12.1.2. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
- 3.12.1.3. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.
- 3.12.2. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required by the Contract Documents the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents. Review by the Architect/Engineer is subject to the limitations of Subparagraph 4.2.7. Informational submittals upon which the Architect/Engineer is not expected to take responsive action may be so identified in the Contract Documents. Submittals which are not required by the Contract Documents may be returned by the Architect/Engineer without action.
- 3.12.3. The Contractor shall review, approve, and submit to the Architect/Engineer, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents within sixty (60) calendar days of being issued the Notice To Proceed unless noted otherwise and shall do so in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors. Any and all items submitted by the Contractor which are not marked as reviewed for compliance with the Contract Documents and approved by the Contractor, or in the opinion of the Architect/Engineer, have not been reviewed for compliance by the Contractor even if marked as such, may be returned by the Architect/Engineer without action and shall not result in any accusation or claim for delay or cost by the Contractor. Any submittal that, in the opinion of the Architect/Engineer, is incomplete in any area or detail may be rejected and returned to the Contractor. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all submittals are complete, accurate, and in conformance to the Contract Documents prior to submission.
- 3.12.4. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents and guarantees to the Architect/Engineer and Owner that the Contractor has determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.
- 3.12.5. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Architect/Engineer. Should the Contractor, Subcontractors or Subsubcontractors install, construct, erect or perform any portion of the Work without approval of any requisite submittal, the Contractor shall bear the costs, responsibility, and delay for removal, replacement, and/or correction of any and all items, material, and /or labor.
- 3.12.6. The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect/Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Architect/Engineer in writing of such deviation at the time of submittal and: (1) the Architect/Engineer has given written approval to the specific deviation as a minor change in the Work; or, (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect/Engineer's approval thereof.
- 3.12.7. The Contractor shall direct specific attention, in writing or on re-submitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect/Engineer on previous submittals. In the absence of such written notice the Architect/Engineer's approval of a re-submission shall not apply to such revisions.

- 3.12.8. The Contractor shall not be required to provide professional services which constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect/Engineer will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect/Engineer. The Owner and the Architect/Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided the Owner and Architect/Engineer have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this subparagraph, the Architect/Engineer will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents but shall be responsible and held liable for review and verification of all performance or design criteria as required by Paragraph 3.2.
- 3.12.9. Unless noted otherwise in the Contract Documents, the Contractor shall submit to the Architect/Engineer within sixty (60) days from the date of the Notice To Proceed a minimum of six (6) complete copies of all shop/setting drawings, schedules, cut sheets, products, product data, and samples required for the complete Work. Copies shall be reviewed, marked, stamped and approved on each and every copy by the Contractor prior to submission to the Architect/Engineer or they shall be returned without review or action. The Architect/Engineer shall review with reasonable promptness, making corrections, rejections, or other actions as appropriate. The Architect/Engineer's approval or actions on shop/setting drawings, schedules, cut sheets, product data, or samples shall not relieve the Contractor from responsibility for, nor deviating from, the requirements of the plans and specifications. Any deviations from the plans and specifications requested or made by the Contractor shall be brought promptly to the attention of the Architect/Engineer.
- 3.12.10. Cost for Re-Submissions: the Contractor is responsible for ensuring that all shop drawings, product data, samples, and submittals contain all information required by the Contract Documents to allow the Architect/Engineer to take action. The Contractor shall pay the Architect/Engineer's cost for any resubmission of any rejected item. Such costs shall be deducted from the contract sum by Change Order. The Contractor agrees that any action taken by the Architect/Engineer is solely in the Architect/Engineer's discretion and is non-negotiable for the purposes of the Architect/Engineer's cost recovery for multiple (i.e. more than one) review.

3.13. USE OF SITE

- 3.13.1. The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.
- 3.13.2. The Contractor shall not damage, endanger, compromise or destroy any part of the Project or the site, including but not limited to work performed by others, monuments, stakes, bench marks, survey points, utilities, existing features or structures. The Contractor shall be fully and exclusively responsible for and bare all costs and delays (including and costs of delay) for any damage, endangerment, compromise, or destruction of any part of the Project or site.

3.14. CUTTING AND PATCHING

3.14.1. The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

3.14.2. The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

3.15. CLEAN UP AND SITE CONTROL

- 3.15.1. The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract during performance of the Work and at the direction of the Owner or Architect/Engineer. At completion of the Work, the Contractor shall remove from and about the Project waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials.
- 3.15.2. If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the cost thereof shall be charged to the Contractor.

3.16. ACCESS TO WORK

3.16.1. The Contractor shall provide the Owner and Architect/Engineer access to the Work at all times wherever located.

3.17. ROYALTIES, PATENTS AND COPYRIGHTS

3.17.1. The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect/Engineer harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect/Engineer. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect/Engineer.

3.18. INDEMNIFICATION

- 3.18.1. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect/Engineer, Architect/Engineer's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Paragraph. The Contractor agrees that it will defend, protect, indemnify and save harmless the State of Montana and the Owner against and from all claims, liabilities, demands, causes of action, judgments (including costs and reasonable attorneys' fees), and losses from any cause whatever (including patent, trademark and copyright infringement) except the Owner's sole or partial negligence. This includes any suits, claims, actions, losses, costs, damages of any kind, including the State and Owner's legal expenses, arising out of, in connection with, or incidental to the Contract, but does not include any such suits, claims, actions, losses, costs or damages which are the result of the negligent acts, actions, losses, costs, or damages which are acts, omissions or misconduct of the Owner if they do not arise out of, depend upon or relate to a negligent act, omission or misconduct of the Contractor in whole or in part.
- 3.18.2. In claims against any person or entity indemnified under this Paragraph 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Subparagraph 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 – ADMINISTRATION OF THE CONSTRUCTION CONTRACT

4.1. THE ARCHITECT/ENGINEER

- 4.1.1. The Architect/Engineer is the person lawfully licensed to practice or an entity lawfully practicing identified as such in the Agreement with the Owner and is referred to throughout the Contract Documents as if singular in number. The term "Architect/Engineer" means the Architect/Engineer's duly authorized representative.
- 4.1.2. Duties, responsibilities and limitations of authority of the Architect/Engineer as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner.
- 4.1.3. If the employment of the Architect/Engineer is terminated, the Owner shall employ a new Architect/Engineer at the sole choice and discretion of the Owner, whose status under the Contract Documents shall be that of the former Architect/Engineer.

4.2. ARCHITECT/ENGINEER'S ADMINISTRATION OF THE CONSTRUCTION CONTRACT

- 4.2.1. The Architect/Engineer will provide administration of the Contract as described in the Contract Documents, and will be an Owner's representative throughout the complete duration of the Project, including the warranty period. The Architect/Engineer will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with the Architect/Engineer Contract.
- 4.2.2. The Architect/Engineer, as a representative of the Owner, will visit the site at intervals appropriate to the stage of the Contractor's operations to: (1) become generally familiar with and to keep the Owner informed about the progress and quality of the portion of the Work completed; (2) endeavor to guard the Owner against defects and deficiencies in the Work; and, (3) to determine in general if the Work is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Owner and Architect/Engineer will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Contractor's Work. The Owner and Architect/Engineer will neither have control over or charge of, nor be responsible for, the construction means, methods, techniques, sequences or procedures, for the safety of any person involved in the work, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.
- 4.2.3. The Architect/Engineer will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect/Engineer will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.
- 4.2.4. Communications Facilitating Contract Administration. Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Architect/Engineer about matters arising out of or relating to the Contract. Communications by and with the Architect/Engineer's consultants shall be through the Architect/Engineer. Communications by and with Subcontractors and material suppliers shall be through the Contractor to the Architect/Engineer. Communications by and with separate contractors shall be through the Owner to the Architect/Engineer.
- 4.2.5. Based on the Architect/Engineer's evaluations of the Contractor's Applications for Payment, the Architect/Engineer will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts. The Contractor is fully aware that the Owner (i.e. the State of Montana) has established a billing cycle for processing payments in Article 9 of these General Conditions. The Contractor and all Subcontractors are subject to all provisions of Title 28, Chapter 2, Part 21 MCA regarding all aspects of the Work.
- 4.2.6. The Architect/Engineer will have authority to reject Work that does not conform to the Contract Documents. Whenever the Architect/Engineer considers it necessary or advisable, the Architect/Engineer

will have authority to require inspection or testing of the Work in accordance with the General Conditions and any applicable technical specification requirements, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Architect/Engineer nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect/Engineer to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

- 4.2.7. The Architect/Engineer will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect/Engineer's action will be taken with such reasonable promptness as to cause no delay in the Work or in the activities of the Owner, Contractor or separate contractors, while allowing sufficient time in the Architect/Engineer's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect/Engineer's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Paragraphs 3.3, 3.5 and 3.12. The Architect/Engineer's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Architect/Engineer, of any construction means, methods, techniques, sequences or procedures. The Architect/Engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.
- 4.2.8. The Architect/Engineer will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Paragraph 7.4.
- 4.2.9. The Architect/Engineer will conduct inspections to determine the date or dates of Substantial Completion(s) and the date of Final Acceptance, will receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and will issue a final Certificate for Payment upon compliance with the requirements of the Contract Documents.
- 4.2.10. If the Owner and Architect/Engineer agree, the Architect/Engineer will provide one or more project representatives to assist in carrying out the Architect/Engineer's responsibilities. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in the Owner's Agreement with the Architect/Engineer.
- 4.2.11. The Architect/Engineer will interpret and decide matters concerning performance under and requirements of the Contract Documents on written request of either the Owner or Contractor. The Architect/Engineer's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If no agreement is made concerning the time within which interpretations required of the Architect/Engineer shall be furnished in compliance with this Paragraph 4.2, then delay shall not be recognized on account of failure by the Architect/Engineer to furnish such interpretations until 15 days after written request is made for them.
- 4.2.12. Interpretations and decisions of the Architect/Engineer will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and initial decisions, the Architect/Engineer will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will render such interpretations and decisions in good faith.
- 4.2.13. The Architect/Engineer's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.
- 4.2.14. The Architect/Engineer's or Owner's observations or inspections do not alleviate any responsibility on the part of the Contractor. The Architect/Engineer and the Owner reserves the right to observe and inspection the work and make comment. Action or lack of action following observation or inspection is not to be construed as approval of Contractor's performance.

4.3. CLAIMS AND DISPUTES

- 4.3.1. Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extensions of time or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes, controversies, and matters in question between the Owner and Contractor arising out of or relating to the Contract. Claims must be initiated by written notice. The responsibility to substantiate Claims shall rest solely with the party making the Claim.
 - 4.3.1.1. Time Limits on Claims. Claims by either party must be initiated within 21 calendar days after occurrence of the event giving rise to such claim. The following shall apply to the initiation of a claim:
 - 4.3.1.1.1. A written notice of a claim must be provided to the Architect/Engineer and the other party within 21 calendar days after the occurrence of the event or the claim is waived by the claiming party and void in its entirety.
 - 4.3.1.1.2. Claims must be initiated by separate, clear, and distinct written notice within the 21 calendar day time frame to the Architect/Engineer and the other party and must contain the notarized statement in Sub-Paragraph 4.3.1.5 when the claim is made by the Contractor. Discussions in any form with the Architect/Engineer or Owner, whether at the site or not, do not constitute initiation of a claim. Notes in project meeting minutes, email correspondence, change order proposals, or any other form of documentation does not constitute initiation of a claim. The written notice must be a separate and distinct correspondence provided in hardcopy to both the Architect/Engineer and Owner and must delineate the specific event and outline the causes and reasons for the claim whether or not cost or time have been fully determined. Written remarks or notes of a generic nature are invalid in their entirety. Comments made at progress meetings, project site visits, inspections, emails, voice mails, and other such communications do not meet the requirement of providing notice of claim.
 - 4.3.1.1.3. Physical Injury or Physical Damage. Should the Owner or Contractor suffer physical injury or physical damage to person or property because of any error, omission, or act of the other party or others for whose acts the other party is legally and contractually liable, claim will be made in writing to the other party within a reasonable time of the first observance of such physical injury or physical damage but in no case beyond 30 calendar days of the first observance. The notice shall provide sufficient detail to enable the other party to investigate the matter. The provisions of this paragraph shall not be construed as a substitute for or a waiver of the provisions of any applicable statute of limitations or repose. In all such cases, the indemnification provisions of the Contract shall be effectual and the Contractor's insurance shall be primary and in full effect.
 - 4.3.1.2. All Claims must contain sufficient justification and substantiation with the written notice or they may be rejected without consideration by the Architect/Engineer or other party with no additional impact or consequence to the Contract Sum, Contract Time, or matter(s) in question in the Claim.
 - 4.3.1.3. If additional compensation is claimed, the exact amount claimed and a breakdown of that amount into the following categories shall be provided with each and every claim:
 - 4.3.1.3.1. Direct costs (as listed in Subparagraph 7.3.9.1 through 7.3.9.5);
 - 4.3.1.3.2. Indirect costs (as defined in Paragraph 7.2.5); and,
 - 4.3.1.3.3. Consequential items (i.e. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution) for the change.
 - 4.3.1.4. If additional time is claimed the following shall be provided with each and every claim:
 - 4.3.1.4.1. The specific number of days and specific dates for which the additional time is sought;
 - 4.3.1.4.2. The specific reasons, causes, and/or effects whereby the Contractor believes that additional time should be granted; and,

- 4.3.1.4.3. The Contractor shall provide analyses, documentation, and justification of its claim for additional time in accordance with the latest Critical Path Method schedule in use at the time of event giving rise to the claim.
- 4.3.1.5. With each and every claim, the Contractor shall submit to the Architect/Engineer and Owner a notarized statement containing the following language:

"Under penalty of law (including perjury and/or false/fraudulent claims against the State), the undersigned,

(Name)	(Title)
Of (Company)	(Date)

hereby certifies, warrants, and guarantees that this claim made for Work on this Contract is a true statement of the costs, adjustments and/or time sought and is fully documented and supported under the contract between the parties.

(Signature)

(Date)"

- 4.3.2. Continuing Contract Performance.
 - 4.3.2.1. Pending final resolution of a Claim except as otherwise agreed in writing or as provided in Subparagraph 9.7.1 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents on the portion of the Work not involved in a Claim.
- 4.3.3. Claims for Cost or Time for Concealed or Unknown Conditions.
 - 4.3.3.1. If conditions are encountered at the site which are: (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents; or, (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the observing party shall be given to the other party promptly before conditions are disturbed.
 - 4.3.3.2. The Architect/Engineer will promptly investigate such conditions and, if they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect/Engineer determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect/Engineer shall so notify the Owner and Contractor in writing, stating the reasons. Claims by either party in opposition to such determination must be made within 21 days after the date of the Architect/Engineer's decision.
 - 4.3.3.3. If the conditions encountered are materially different, the Contract Sum and Contract Time shall be equitably adjusted, but if the Owner and Contractor cannot agree on an adjustment in the Contract Sum or Contract Time, the adjustment shall be referred to the Architect/Engineer for initial determination, subject to further proceedings pursuant to Paragraph 4.4.
 - 4.3.3.4. Nothing in this paragraph shall relieve the Contactor of its obligation to adequately and sufficiently investigate, research, and examine the site, the site survey, topographical information, and the geotechnical information available whether included by reference or fully incorporated in the Contract Documents.
- 4.3.4. Claims for Additional Cost.

- 4.3.4.1. If the Contractor wishes to make Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Paragraph 10.6.
- 4.3.4.2. If the Contractor believes additional cost is involved for reasons including but not limited to: (1) a written interpretation from the Architect/Engineer; (2) an order by the Owner to stop the Work solely for the Owner's convenience or where the Contractor was not at least partially at fault; (3) a written order for a minor change in the Work issued by the Architect/Engineer; (4) failure of payment by the Owner per the terms of the Contract; (5) termination of the Contract by the Owner; or, (6) other reasonable grounds, Claim must be filed in accordance with this Paragraph 4.3.
- 4.3.5. Claims for Additional Time
 - 4.3.5.1. If the Contractor wishes to make Claim for an increase in the Contract Time, written notice as specified in these General Conditions shall be provided along with the notarized certification. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay for the same event or cause only one Claim is necessary. However, separate and distinct written notice is required for each separate event.
 - 4.3.5.2. Weather Delays:
 - 4.3.5.2.1. If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction activities.
 - 4.3.5.2.2. Inclement or adverse weather shall not be a prima facie reason for the granting of an extension of time, and the Contractor shall make every effort to continue work under prevailing conditions. The Owner may grant an extension of time if an unavoidable delay occurs as a result of inclement/severe/adverse weather and such shall then be classified as a "Delay Day". Any and all delay days granted by the Owner are and shall be non-compensable in any manner or form. The Contractor shall comply with the notice requirements concerning instances of inclement/severe/adverse weather before the Owner will consider a time extension. Each day of inclement/severe/adverse weather shall be subject to the notice requirements.
 - 4.3.5.2.3. An "inclement", "severe", or "adverse" weather delay day is defined as a day on which the Contractor is prevented by weather or conditions caused by weather resulting immediately there from, which directly impact the current controlling critical-path operation or operations, and which prevent the Contractor from proceeding with at least 75% of the normal labor and equipment force engaged on such critical path operation or operations for at least 60% of the total daily time being currently spent on the controlling operation or operations.
 - 4.3.5.2.4. The Contractor shall consider normal/typical/seasonal weather days and conditions caused by normal/typical/seasonal weather days for the location of the Work in the planning and scheduling of the Work to ensure completion within the Contract Time. No time extensions will be granted for the Contractor's failure to consider and account for such weather days and conditions caused by such weather for the Contract Time in which the Work is to be accomplished.
 - 4.3.5.2.5. A "normal", "typical", or "seasonal" weather day shall be defined as weather that can be reasonably anticipated to occur at the location of the Work for each particular month involved in the Contract Time. Each month involved shall not be considered individually as it relates to claims for additional time due to inclement/adverse/severe weather but shall consider the entire Contract Time as it compares to normal/typical/seasonal weather that is reasonably anticipated to occur. Normal/typical/seasonal weather days shall be based upon U.S. National

Weather Service climatic data for the location of the Work or the nearest location where such data is available.

- 4.3.5.2.6. The Contractor is solely responsible to document, prepare and present all data and justification for claiming a weather delay day. Any and all claims for weather delay days shall be tied directly to the current critical-path operation or operations on the day of the instance or event which shall be delineated and described on the Critical-Path Schedule and shall be provided with any and all claims. The Contractor is solely responsible to indicate and document why the weather delay day(s) claimed are beyond those weather days which are reasonably anticipated to occur for the Contract Time. Incomplete or inaccurate claims, as determined by the Architect/Engineer or Owner, may be returned without consideration or comment.
- 4.3.5.3. Where the Contractor is prevented from completing any part of the Work with specified durations or phases due to delay beyond the control of both the Owner and the Contractor, an extension of the contract time or phase duration in an equal amount to the time lost due to such delay shall be the Contractor's sole and exclusive remedy for such delay.
- 4.3.5.4. Delays attributable to and/or within the control of subcontractors and suppliers are deemed to be within the control of the Contractor.
- 4.3.5.5. In no event shall the Owner be liable to the Contractor, any subcontractor, any supplier, Contractor's surety, or any other person or organization, for damages or costs arising out of or resulting from: (1) delays caused by or within the control of the Contractor which include but are not limited to labor issues or labor strikes on the Project, federal, state, or local jurisdiction enforcement actions related directly to the Contractor's Work (e.g. safety or code violations, etc.); or, (2) delays beyond the control of both parties including but not limited to fires, floods, earthquakes, abnormal weather conditions, acts of God, nationwide material shortages, actions or inaction by utility owners, emergency declarations by federal, state, or local officials enacted in the immediate vicinity of the project, or other contractors performing work for the Owner.
- 4.3.6. Claims for Consequential Damages
 - 4.3.6.1. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes:
 - 4.3.6.1.1. damages incurred by the Owner for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and,
 - 4.3.6.1.2. damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, income, and for loss of profit.
 - 4.3.6.2. This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this waiver of consequential damages shall be deemed to preclude an award of liquidated or actual damages, when applicable, in accordance with the requirements of the Contract Documents.

4.4. RESOLUTION OF CLAIMS, DISPUTES, AND CONTROVERSIES

4.4.1. Decision of Architect/Engineer. Claims, including those alleging an error or omission by the Architect/Engineer, shall be referred initially to the Architect/Engineer for decision. A decision by the Architect/Engineer shall be required as a condition precedent to mediation, arbitration or litigation of all Claims between the Contractor and Owner arising prior to the date of Final Acceptance, unless 30 days have passed after the Claim has been referred to the Architect/Engineer with no decision having been rendered by the Architect/Engineer. The Architect/Engineer will not decide disputes between the Contractor and persons or entities other than the Owner. Any Claim arising out of or related to the Contract, except those already waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, pending compliance with Subparagraph 4.4.5, be subject to mediation, arbitration, or the institution of

legal or equitable proceedings. Claims waived in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4, and 9.10.5 are deemed settled, resolved, and completed.

- 4.4.2. The Architect/Engineer will review Claims and within ten (10) days of the receipt of the Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party; (2) reject the Claim in whole or in part; (3) approve the Claim; (4) suggest a compromise; or (5) advise the parties that the Architect/Engineer is unable to resolve the Claim if the Architect/Engineer lacks sufficient information to evaluate the merits of the Claim or if the Architect/Engineer concludes that, in the Architect/Engineer's sole discretion, it would be inappropriate for the Architect/Engineer to resolve the Claim.
- 4.4.3. If the Architect/Engineer requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond within ten (10) days after receipt of such request and shall either provide a response on the requested supporting data, advise the Architect/Engineer when the response or supporting data will be furnished, or advise the Architect/Engineer that no supporting data will be furnished. Upon either no response or receipt of the response or supporting data, the Architect/Engineer will either reject or approve the Claim in whole or in part.
- 4.4.4. The Architect/Engineer will approve or reject Claims by written decision, which shall state the reasons therefore and which shall notify the parties of any change in the Contract Sum or Contract Time or both. The approval or rejection of a Claim by the Architect/Engineer shall be final and binding on the parties but subject to mediation and arbitration.
- 4.4.5. When 30 days have passed upon submission of a Claim without decision or action by the Architect/Engineer, or the Architect/Engineer has rendered a decision or taken any of the actions identified in Subparagraph 4.4.2, a demand for arbitration of a Claim covered by such decision or action must be made within 30 days after the date of expiration of Subparagraph 4.4.1 or within 30 days of the Architect/Engineer's decision or action. Failure to demand arbitration within said 30 day period shall result in the Architect/Engineer's decision becoming final and binding upon the Owner and Contractor whenever such decision is rendered.
- 4.4.6. If the Architect/Engineer renders a decision after arbitration proceedings have been initiated, such decision may be entered as evidence but shall not supersede arbitration proceedings unless the decision is acceptable to all parties concerned.
- 4.4.7. Upon receipt of a Claim against the Contractor or at any time thereafter, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Architect/Engineer or the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.
- 4.4.8. A Claim subject to or related to liens or bonds shall be governed by applicable law regarding notices, filing deadlines, and resolution of such Claim prior to any resolution of such Claim by the Architect/Engineer, by mediation, or by arbitration, except for claims made by the Owner against the Contractor's bonds.

4.5. MEDIATION

- 4.5.1. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5 shall, after initial decision by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to mediation as a condition precedent to arbitration or the institution of legal or equitable proceedings by either party.
- 4.5.2. The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association currently in effect and/or those rules specified in the contract documents or separately agreed upon between the parties. Construction Industry Mediation Rule M-2 (filing with AAA) is void. The parties shall mutually agree upon a mediator who shall then take the place of AAA in the Construction Industry Mediation Rules. The parties must mutually agree to use AAA and no filing of a request for mediation shall be made to AAA by either party until such mutual agreement has been made.

Request for mediation shall be filed in writing with the other party to the Contract and with the American Arbitration Association. The request may be made concurrently with the filing of a demand for arbitration but, in such event, mediation shall proceed in advance of arbitration or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order.

4.5.3. The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

4.6. ARBITRATION

- 4.6.1. Any controversy or Claim arising out of or related to this Contract or the breach thereof shall be settled by arbitration in accordance with the Montana Uniform Arbitration Act (MUAA). To the extent it does not conflict with the MUAA, the Construction Industry Arbitration Rules of the American Arbitration Association shall apply except as modified herein. The parties to the arbitration shall bear their own costs and expenses for participating in the arbitration. Costs of the Arbitration panel shall be borne equally between the parties except those costs awarded by the Arbitration panel (including costs for the arbitration itself).
- 4.6.2. Prior to the arbitration hearing all parties to the arbitration may conduct discovery subject to the provisions of Montana Rules of Civil Procedure. The arbitration panel may award actual damages incurred if a party fails to provide full disclosure under any discovery request. If a party claims a right of information privilege protected by law, the party must submit that claim to the arbitration panel for a ruling, before failing to provide information requested under discovery or the arbitration panel may award actual damages.
- 4.6.3. The venue for all arbitration proceedings required by this Contract shall be the seat of the county in which the work occurs or the First Judicial District, Lewis & Clack County, as determined solely by the Owner. Arbitration shall be conducted by a panel comprised of three members with one selected by the Contractor, one selected by the Owner, and one selected by mutual agreement of the Owner and the Contractor.
- 4.6.4. Any Claim arising out of or related to the Contract, except Claims relating to aesthetic effect and except those waived as provided for in Subparagraphs 4.3.6, 7.2.6, 7.3.8, 9.10.4 and 9.10.5, shall, after decision or action by the Architect/Engineer or 30 days after submission of the Claim to the Architect/Engineer, be subject to arbitration provided a demand for arbitration is made within the time frame provided in Subparagraph 4.4.5. If such demand is not made with the specified time frame, the Architect/Engineer's decision or action is final. Prior to arbitration, the parties shall endeavor to resolve disputes by mediation in accordance with the provisions of Paragraph 4.5.
- 4.6.5. Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association currently in effect and/or those rules specified in the Contract Documents or separately agreed upon between the parties. Construction Industry Arbitration Rule R-3 (filing with AAA) is void. The parties shall mutually agree upon an arbitrator or arbitrators who shall then take the place of AAA in the Construction Industry Arbitration Rules. The parties must mutually agree to use AAA and no filing of a demand for arbitration shall be made to AAA by either party until such mutual agreement has been made. The demand for arbitration shall be filed in writing with the other party to the Contract and a copy shall be filed with the Architect/Engineer.
- 4.6.6. A demand for arbitration shall be made within the time limits specified in Subparagraphs 4.4.5 and in no event shall it be made after the date when institution of legal or equitable proceedings based on such Claim would be barred by the applicable statute of limitations as determined pursuant to Paragraph 13.7.
- 4.6.7. Pending final resolution of a Claim including arbitration, unless otherwise mutually agreed in writing, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract on Work or amounts not in dispute.
- 4.6.8. **Limitation on Consolidation or Joinder**. Arbitration arising out of or relating to the Contract may include by consolidation or joinder the Architect/Engineer, the Architect/Engineer's employees or consultants,

except by written consent containing specific reference to the Agreement and signed by the Architect/Engineer, Owner, Contractor and any other person or entity sought to be joined. No arbitration shall include, by consolidation or joinder or in any other manner, parties other than the Owner, Architect/Engineer, Contractor, a separate contractor as described in Article 6 and other persons substantially involved in a common question of fact or law whose presence is required if complete relief is to be accorded in arbitration. No person or entity other than the Owner, Architect/Engineer, Contractor as described in Article 6 shall be included as an original third party or additional third party to an arbitration whose interest or responsibility is insubstantial. The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

- 4.6.9. **Claims and Timely Assertion of Claims**. The party filing a demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.
- 4.6.10. **Judgment on Final Award**. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof. The parties agree that the costs of the arbitrator(s') compensation and expenses shall be borne equally. The parties further agree that the arbitrator(s) shall have authority to award to either party some or all of the costs and expenses involved, including attorney's fees.

ARTICLE 5 – SUBCONTRACTORS

5.1. DEFINITIONS

5.1.1. A Subcontractor is a person or entity who has a direct or indirect contract at any tier or level with the Contractor or any Subcontractor to the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

5.2. AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

- 5.2.1. Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract and in no instance later than (30) days after award of the Contract, shall furnish in writing to the Owner through the Architect/Engineer the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Architect/Engineer will promptly reply to the Contractor in writing stating whether or not the Owner or the Architect/Engineer, after due investigation, has reasonable objection to any such proposed person or entity.
- 5.2.2. The Contractor shall not contract with a proposed person or entity to which the Owner or Architect/Engineer has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.
- 5.2.3. If the Owner or Architect/Engineer has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect/Engineer has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.
- 5.2.4. The Contractor shall not change a Subcontractor, person or entity previously selected if the Owner or Architect/Engineer makes reasonable objection to such substitute. The Contractor shall not change or substitute for a Subcontractor who was required to be listed on the bid without first getting the approval of the Owner.

5.2.5. Buy-Safe Montana Provision: Before commencement of each subcontractor's portion of the Work, the Contractor shall obtain each subcontractor's incidence rate, experience modification rate, and loss ratio. The Contractor shall endeavor--but is not required--to use subcontractors whose incidence rate is less than the latest average for non-residential building construction for Montana as established by the Federal Bureau of Labor Statistics for the prior year; whose experience modification rating (EMR) is less than 1.0; and whose loss ratio is less than 100%. Contractor shall require any of its subcontractors who, based on the safety information that the Contractor obtains, have greater-than-average incidence rate, an EMR greater than 1.0, and a loss ratio of more than 100%, to schedule and obtain a Comprehensive Safety Consultation from the Montana Department of Labor & Industry, Employment Relations Division, Safety Bureau before substantial completion of each such subcontractor's portion of the Work. For assistance in obtaining the Comprehensive Safety Consultation, visit http://erd.dli.mt.gov/safety-health/onsite-consultation.

5.3. SUBCONTRACTUAL RELATIONS

- 5.3.1. By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect/Engineer. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect/Engineer under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement which may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.
- 5.3.2. Upon written request by the Owner, the Contractor shall require its subcontractors to provide to it performance and payment securities for their portion of the Work in the types and form defined in statute (18-2-201 and 18-2-203 MCA) for all sub-contractual agreements.
- 5.3.3. The Contractor shall prepare a Subcontractors' and Suppliers' chart in CSI division format acceptable to the Owner which lists by name, all contact information, job category, and responsibility the Contractor's Subcontractors (at all tiers or levels) and Suppliers with a pecuniary interest in the Project of greater than \$5,000.00. The Contractor shall not enter into any agreement with any subcontractor or supplier to which the Owner raises a timely objection. The Contractor shall promptly inform the Owner in writing of any proposed replacements, the reasons therefore, and the name and qualifications of any proposed replacements. The Owner shall have the right to reject any proposed replacements without cost or claim being made by the Contractor. The chart shall be provided to the Owner at the time of the pre-construction conference but no less than 30 days after award of the Contract.
- 5.3.4. All Contractors and Subcontractors to this contract must comply with all Montana Department of Labor and Industry requirements, regulations, rules, and statutes.
- 5.3.5. In accordance with 39-51-1104 MCA, any Contractor who is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, who contracts with any Subcontractor who also is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, shall withhold sufficient money on the contract to guarantee that all taxes, penalties, and interest are paid upon completion of the contract.
 - 5.3.5.1. It is the duty of any Subcontractor who is or becomes an employer under the provisions of Title 39, Chapter 51 of Montana Code Annotated, to furnish the Contractor with a certification issued by the Montana Department of Labor and Industry, prior to final payment stating that said

Subcontractor is current and in full compliance with the provisions of Montana Department of Labor and Industry.

- 5.3.5.2. Failure to comply shall render the Contractor directly liable for all taxes, penalties, and interest due from the Subcontractor, and the Montana Department of Labor and Industry has all of the remedies of collection against the Contractor under the provisions of Title 39, Chapter 51 of Montana Code Annotated, as though the services in question were performed directly for the Contractor.
- 5.3.6. In compliance with state statutes, the Contractor will have the 1% Gross Receipts Tax withheld from all payments. Each "Public Contractor" includes all Subcontractors with contracts greater than \$5,000 each. The Contractor and all Subcontractors will withhold said 1% from payments made to all Subcontractors with contracts greater than \$5,000.00 and make it payable to the Montana Department of Revenue. The Contractor and all Subcontractors shall also submit documentation of all contracts greater than \$5,000.00 to the Montana Department of Revenue on the Department's prescribed form.
- **5.3.7.** Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

5.4. CONTINGENT ASSIGNMENT OF SUBCONTRACTS

- 5.4.1. Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner provided that:
 - 5.4.1.1. assignment is effective only after termination of the Contract by the Owner for cause pursuant to Paragraph 14.2 and only for those subcontract agreements which the Owner accepts by notifying the Subcontractor and Contractor in writing; and,
 - 5.4.1.2. assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.
- 5.4.2. Upon such assignment, if the Work has been suspended for more than 30 days as a result of the Contractor's default, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension. Such adjustment shall be at the expense of the Contractor.
- 5.4.3. The Contractor shall engage each of its subcontractors and suppliers with written contracts that preserve and protect the rights of the Owner and include the acknowledgement and agreement of each subcontractor and supplier that the Owner is a third-party beneficiary of their sub-contractual and supplier agreements. The Contractor's agreements shall require that in the event of default by the Contractor or termination of the Contractor, and upon request of the Owner, the Contractor's subcontractors and suppliers will perform services for the Owner.
- 5.4.4. Construction Contractor Registration: All Subcontractors at any tier or level are required to be registered with the Department of Labor and Industry under 39-9-201 and 39-9-204 MCA prior to the Contract being executed by the Owner. Subcontractors shall demonstrate to the Contractor that it has registered or promises that it will register immediately upon notice of award and prior to the commencement of any work.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

6.1. OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

6.1.1. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims

that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Paragraph 4.3.

- 6.1.2. When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.
- 6.1.3. The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules when directed to do so. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.
- 6.1.4. Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights which apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

6.2. MUTUAL RESPONSIBILITY

- 6.2.1. The Contractor shall afford the Owner and separate contractors reasonable opportunity' for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.
- 6.2.2. If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Architect/Engineer apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.
- 6.2.3. The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.
- 6.2.4. The Contractor shall promptly remedy damage wrongfully caused by the Contractor to completed or partially completed construction or to property of the Owner or separate contractors as provided in Paragraph 12.2.
- 6.2.5. The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Subparagraph 3.14.

6.3. OWNER'S RIGHT TO CLEAN UP

6.3.1. If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect/Engineer will determine the responsibility of those involved and allocate the cost accordingly.

ARTICLE 7 – CHANGES IN THE WORK

7.1. <u>GENERAL</u>

- 7.1.1. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive, or order for a minor change in the Work subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Minor changes as ordered by the Architect/Engineer has the definition provided in Paragraph 7.4
- 7.1.2. A Change Order shall be based upon agreement among the Owner, Contractor, and Architect/Engineer; a Construction Change Directive requires agreement by the Owner and Architect/Engineer and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect/Engineer alone.
- 7.1.3. Changes in the Work shall be performed under applicable provisions of the Contract Documents and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.
- 7.1.4. No act, omission, or course of dealing, shall alter the requirement that Change Orders or Construction Change Directives shall be in writing and signed by the Owner, and that Change Orders and Construction Change Directives are the exclusive method for effecting any adjustment to the Contract. The Contractor understands and agrees that neither the Contract Sum nor the Contract Time can be changed by implication, oral agreement, verbal directive, or unsigned Change Order.

7.2. CHANGE ORDERS

- 7.2.1. A Change Order is a written instrument prepared by the Architect/Engineer and signed by the Owner, Contractor and Architect/Engineer, stating their agreement upon all of the following:
 - 7.2.1.1. change in the Work;
 - 7.2.1.2. the amount of the adjustment, if any, in the Contract Sum; and,
 - 7.2.1.3. the extent of the adjustment, if any, in the Contract Time.
- 7.2.2. The cost or credit to the Owner resulting from a change in the Work shall be determined as follows:
 - 7.2.2.1. Per the limitations of this Subparagraph, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive; or,
 - 7.2.2.2. By one of the methods in Subparagraph 7.3.4, or as determined by the Architect/Engineer per Subparagraph 7.3.9, plus a 5% allowance for overhead and a 10% allowance for profit. The allowances for overhead and for profit are limited to the percentages as specified herein unless they are determined to be unreasonable by the Architect/Engineer (not the Contractor) per Subparagraph 7.3.9 for each Change Order or Construction Change Directive.
 - 7.2.2.3. The Contractor's proposed increase or decrease in cost shall be limited to costs listed in Subparagraph 7.3.9.1 through 7.3.9.5.
- 7.2.3. The Contractor shall not submit any Change Order, response to requested cost proposals, or requested changes which are incomplete and do not contain full breakdown and supporting documentation in the following three areas:
 - 7.2.3.1. Direct costs (only those listed in Subparagraph 7.3.9.1 through 7.3.9.5 are allowable);
 - 7.2.3.2. Indirect costs (limited as a percentage on each Change Order per Supplementary General Conditions, Paragraph 7.2.2); and
 - 7.2.3.3. Consequential items (e.g. time extensions, credits, logic, reasonableness, impacts, disruptions, dilution).

- 7.2.4. Any Change Order, responses to requested proposals, or requested changes submitted by the Contractor which, in the opinion of the Architect/Engineer, are incomplete, may be rejected and returned to the Contractor without comment. It is the responsibility of and incumbent upon the Contractor to ensure and confirm that all Change Orders, responses to requested proposals, or requested changes are complete prior to submission.
- 7.2.5. Overhead, applicable to all areas and sections of the Contract Documents, means "Indirect Costs" as referenced in Subparagraph 7.2.3.2. Indirect costs are inclusive of, but not limited to, the following: home office overhead; off-site supervision; home office project management; change order and/or proposal preparation, design, research, negotiation and associated travel; effects of disruption and dilution of management and supervision off-site; time delays; coordination of trades; postage and shipping; and, effective increase in guarantee and warranty durations. Indirect costs applicable to any and all changes in the work, either through Change Order or Construction Change Directive, are limited to the percentage allowance for overhead in Subparagraph 7.2.2.
- 7.2.6. By signature on any Change Order, the Contractor certifies that the signed Change Order is complete and includes all direct costs, indirect costs and consequential items (including additional time, if any) and is free and clear of all claims or disputes (including, but not limited to, claims for additional costs, additional time, disruptions, and/or impacts) in favor of the Contractor, subcontractors, material suppliers, or other persons or entities concerning the signed change order and on all previously contracted Work and does release the Owner from such claims or demands.
- 7.2.7. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Change Order shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes which affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time, shall not result in an increase in the Contract Time.
- 7.2.8. Supervision means on-site, field supervision and not home office overhead, off-site management or offsite supervision.
- 7.2.9. Labor means those persons engaged in construction occupations as defined in Montana Prevailing Wage Rates for Building Construction or Heavy/Highway as bound in the Contract Documents and does not include design, engineering, superintendence, management, on-site field supervision, home office or other off-site management, off-site supervision, office or clerical work.

7.3. CONSTRUCTION CHANGE DIRECTIVES

- 7.3.1. A Construction Change Directive is a written order prepared by the Architect/Engineer directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.
- 7.3.2. Any and all changes or adjustments to the Contract Time requested or claimed by the Contractor as a result of a Construction Change Directive, shall require documentation and justification for the adjustment by a Critical Path Method analysis of the Contractor's most recent Critical Path Schedule in use prior to the change. Changes that affect or concern activities containing float or slack time (i.e. not on the critical path) and which can be accomplished within such float or slack time shall not result in an increase in the Contract Time.
- 7.3.3. A Construction Change Directive shall be used in the absence of agreement on the terms of a Change Order.
- 7.3.4. If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:
 - 7.3.4.1. mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;

- 7.3.4.2. unit prices stated in the Contract Documents or subsequently agreed upon;
- 7.3.4.3. cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee;
- 7.3.4.4. By actual cost as shown by the Contractor's and Subcontractor's itemized invoices; or
- 7.3.4.5. as provided in Subparagraph 7.3.9.
- 7.3.5. Costs shall be limited to the following: cost of materials, including cost of delivery; cost of labor, including social security, old age and unemployment insurance and fringe benefits under collective bargaining agreements; workers' compensation insurance; bond premiums; and rental value of power tools and equipment.
- 7.3.6. Overhead and profit allowances shall be limited on all Construction Change Directives to those identified in 7.2.2.
- 7.3.7. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect/Engineer of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.
- 7.3.8. A Construction Change Directive signed by the Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.
- 7.3.9. If the Contractor does not respond or disagrees with the method for adjustment in the Contract Sum in writing within seven (7) calendar days, the method and the adjustment made shall be determined by the Architect/Engineer on the basis of reasonable expenditures and/or savings of those performing the Work directly attributable to the change including, in the case of an increase in the Contract Sum, plus an allowance for overhead and profit as listed under Subparagraph 7.2.2. In such case, and also under Clause 7.3.4.3, the Contractor shall keep and present, in such form as the Architect/Engineer may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Subparagraph 7.3.9 shall be limited to the following:
 - 7.3.9.1. costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance as determined by the Prevailing Wage Schedules referenced in the Contract Documents;
 - 7.3.9.2. costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
 - 7.3.9.3. rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
 - 7.3.9.4. costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
 - 7.3.9.5. additional costs of field supervision and field office personnel directly attributable to the change.
- 7.3.10. The amount of credit to be allowed by the Contractor to the Owner for a deletion or change which results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect/Engineer. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.
- 7.3.11. Pending final determination of the total cost of a Construction Change Directive to the Owner, amounts not in dispute for such changes in the Work shall be included in Applications for Payment accompanied

by a Change Order indicating the parties' agreement with part or all of such costs. For any portion of such cost that remains in dispute, the Architect/Engineer will make an interim determination for purposes of monthly certification for payment for those costs. That determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a claim in accordance with Article 4.

7.3.12. When the Owner and Contractor agree with the determination made by the Architect/Engineer concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and shall be recorded by preparation and execution of an appropriate Change Order.

7.4. MINOR CHANGES IN THE WORK

7.4.1. The Architect/Engineer will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

<u>ARTICLE 8 – TIME</u>

8.1. **DEFINITIONS**

- 8.1.1. Time is of the essence in performance, coordination, and completion of the Work contemplated herein. The Owner may suffer damages if the Work is not completed as specified herein. When any duration or time period is referred to in the Contract Documents by days, the first day shall be determined as the day following the current day of any event or notice starting a specified duration.
- 8.1.2. Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.
- 8.1.3. The date of commencement of the Work is the date established in the NOTICE TO PROCEED AS ISSUED BY THE OWNER.
- 8.1.4. The date the Contractor reaches Substantial Completion is the date certified by the Architect/Engineer in accordance with Paragraph 9.8.
- 8.1.5. The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.
- 8.1.6. Liquidated Damages. The Owner may suffer loss if the project is not substantially complete on the date set forth in the contract documents. The Contractor and his surety shall be liable for and shall pay to the Owner the sums hereinafter stipulated as liquidated damages for each calendar day of delay until the work is substantially complete: **ONE HUNDRED AND NO/100 DOLLARS (\$100.00).**
- 8.1.7. The Contractor shall not be charged liquidated or actual damages when delay in completion of the Work is due to:
 - 8.1.7.1. Any preference, priority or allocation order issued by the government;
 - 8.1.7.2. Unforeseeable cause beyond the control and without the fault or negligence of the Contractor, such as acts of God or of the public enemy, fires, floods, epidemics, quarantine restrictions, freight embargoes, and unusually severe weather. All such occurrences resulting in delay must be documented and approved by Change Order; or,
 - 8.1.7.3. Any delays of Subcontractors or suppliers occasioned by any of the causes specified in 8.1.7.1 and 8.1.7.2 of this article.
- 8.1.8. The Contractor is completely obligated and responsible to provide written notice of each day of delay as provided for in Paragraph 4.3.

8.1.9. Contract Time. All work shall reach Substantial Completion on or before: <u>DECEMBER 31, 2021.</u> The Owner will issue a written NOTICE TO PROCEED and finalized contract.

8.2. PROGRESS AND COMPLETION

- 8.2.1. Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Contract, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.
- 8.2.2. The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the date on the Notice to Proceed and in no case prior to the effective date of insurance required by Article 11 to be furnished by the Contractor. The date of commencement of the Work shall not be changed by the effective date of such insurance.
- 8.2.3. The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.
- 8.2.4. If the Contractor falls behind the latest construction schedule by more than 14 calendar days through its own actions or inaction, neglect, inexperience, lack of oversight and management of the Work including that of any Subcontractors, written notice to the Owner and Architect/Engineer shall be provided within three (3) days with explanation of how the Contractor intends to get back on schedule. Response to getting back on schedule consists of providing a sufficient number of qualified workers and/or proper materials or an acceptably reorganized schedule to regain the lost time in a manner acceptable to the Owner.

8.3. DELAYS AND EXTENSIONS OF TIME

- 8.3.1. If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Architect/Engineer, or of an employee of either, or of a separate contractor employed by the Owner, or by changes ordered in the Work, or by fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, or by delay authorized by the Owner pending mediation and arbitration, or by other causes which the Architect/Engineer determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect/Engineer may determine.
- 8.3.2. Claims relating to time shall be made in accordance with applicable provisions of Paragraph 4.3.
- 8.3.3. This Paragraph 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

PAYMENTS AND COMPLETION

9.1. CONTRACT SUM

9.1.1. The Contract Sum is stated in the Contract and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

9.2. SCHEDULE OF VALUES

9.2.1. Before the first Application for Payment, the Contractor shall submit to the Architect/Engineer a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Architect/Engineer may require. This schedule, unless objected to by the Architect/Engineer, shall be used as a basis for reviewing the Contractor's Applications for Payment.

9.3. APPLICATIONS FOR PAYMENT

9.3.1. The Contractor shall submit to the Architect/Engineer an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be signed and supported by such data substantiating the Contractor's right to payment as the Owner or Architect/Engineer may

require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage if provided for in the Contract Documents.

- 9.3.2. NOTICE OF APPROVAL OF PAYMENT REQUEST PROVISION. Per Title 28, Chapter 2, Part 21, this contract allows the Owner to change the number of days to approve a Contractor's payment request. This contract allows the Owner to approve the Contractor's payment request within thirty-five (35) calendar days after it is received by the Owner without being subject to the accrual of interest.
- 9.3.3. As provided in Subparagraph 7.3.11, such applications may include requests for payment on account of changes in the Work which have been properly authorized by Construction Change Directives, or by interim determinations of the Architect/Engineer, but not yet included in Change Orders.
- 9.3.4. Applications for payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay to a Subcontractor or material supplier.
- 9.3.5. Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.
- 9.3.6. The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.
- 9.3.7. Until the work is complete, the Owner will pay 95% of the amount due the Contractor on account of progress payments.
 - 9.3.7.1. If the Work and its progress are not in accordance with all or any part, piece, or portion of the Contract Documents, the Owner may, at its sole discretion and without claim by the Contractor, increase the amount held as retainage to whatever level deemed necessary to effectuate performance and progress of the Work, for anticipated repairs, warranties or completion of the Work by the Contractor or through the letting of other contracts. The Contractor will not be entitled to additional costs, expenses, fees, time, and such like, in the event the Owner increases the amount held as retainage due to non-compliance and/or non-performance with all or any part, piece, or portion of the Contract Documents.
 - 9.3.7.2. Prior to the first application for payment, the Contractor shall submit the following information on the appropriate forms:
 - 9.3.7.2.1. Schedule of Amounts for Contract Payment (Form 100): This form shall contain a breakdown of the labor, material and other costs associated with the various portions of the work and shall be the basis for the progress payments to the Contractor. The use of electronic method shall be in the Owner's format.
 - 9.3.7.2.2. Project/Progress Schedule: If no Schedule (or revised Schedule) is provided with each and every Periodic Estimates for Partial Payment, the Architect/Engineer and/or Owner may return the pay request, or hold it, and may choose not pay for any portion of the Work until the appropriate Schedule, indicating all changes, revisions and updates, is provided. No claim for additional costs or interests will be made by the Contractor or any subcontractor on account of holding or non-payment of the Periodic Estimate for Partial Payment request.
 - 9.3.7.3. Progress Payments

- 9.3.7.3.1. Periodic Estimates for Partial Payment shall be on a form provided by the Owner (Form 101) and submitted to the Architect/Engineer for payment by the Owner. Payment shall be requested for the labor and material incorporated in the work to date and for materials suitably stored, less the aggregate of previous payments, the retainage, and the 1% gross receipts tax.
- 9.3.7.3.2. The Contractor, by submission of any partial pay request, certifies that every request for partial payment is correct, true and just in all respects and that payment or credit had not previously been received. The Contractor further warrants and certifies, by submission of any partial pay request, that all previous work for which payment has been received is free and clear of all liens, disputes, claims, security interests, encumbrances, or causes of action of any type or kind in favor of the Contractor, subcontractors, material suppliers or other persons or entities and does release the Owner from such.
- 9.3.7.3.3. Progress payments do not constitute official acceptance of any portion of the work or materials whether stored on or off-site.
- 9.3.7.3.4. In compliance with 15-50-206 MCA, the Contractor will have 1% of his gross receipts withheld by the Owner from all payments due. Each subcontractor who performs work greater than \$5,000 shall have 1% of its gross receipts withheld by the Contractor. The Contractor shall notify the Department of Revenue on the department's prescribed forms.
- 9.3.7.4. The Contractor may submit obligations/securities in a form specified in 18-1-301 Montana Code Annotated (MCA) to be held by a Financial Institution in lieu of retainage by the Owner. The Owner will establish the amount that would otherwise be held as retainage. Should the Contractor choose to submit obligations/securities in lieu of retainage, the Owner will require the Financial Institution to execute the Owner's "Account Agreement for Deposit of Obligations Other Than Retainage" (Form 120) prior to submission of any obligations/securities in accordance with 18-1-302 MCA. The Contractor must extend the opportunity to participate in all obligations/securities in lieu of retainage on a pro rata basis to all subcontractors involved in the project and shall be solely responsible for the management and administration of same. The Owner assumes no liability or responsibility from or to the Contractor or Subcontractors regarding the latter's participation.
- **9.3.7.5.** The Contractor shall maintain a monthly billing cycle.

9.4. CERTIFICATES FOR PAYMENT

- 9.4.1. The Architect/Engineer will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect/Engineer determines is properly due, or notify the Contractor and Owner in writing of the Architect/Engineer's reasons for withholding certification in whole or in part as provided in Subparagraph 9.5.1. For the purposes of this paragraph regarding certification of payment, electronic mail and/or notes provided through the use of an electronic approval system shall constitute written notice.
- 9.4.2. The issuance of a Certificate for Payment will constitute a representation by the Architect/Engineer to the Owner, based on the Architect/Engineer's evaluation of the Work and the data comprising the Application for Payment, that the Work has progressed to the point indicated and that, to the best of the Architect/Engineer's knowledge, information and belief, the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect/Engineer. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect/Engineer has: (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences or procedures; (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or, (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

9.5. DECISIONS TO WITHHOLD CERTIFICATION

- 9.5.1. The Architect/Engineer may withhold or reject a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect/Engineer's opinion the representations to the Owner required by Subparagraph 9.4.2 cannot be made. If the Architect/Engineer is unable to certify payment in the amount of the Application, the Architect/Engineer will notify the Contractor and Owner as provided in Subparagraph 9.4.1. If the Contractor and Architect/Engineer cannot agree on a revised amount, the Architect/Engineer will promptly issue a Certificate for Payment for the amount for which the Architect/Engineer is able to make such representations to the Owner. The Architect/Engineer may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect/Engineer's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Subparagraph 3.3.4, because of:
 - 9.5.1.1. defective Work not remedied;
 - 9.5.1.2. third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
 - 9.5.1.3. failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
 - 9.5.1.4. reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
 - 9.5.1.5. damage to the Owner or another contractor;
 - 9.5.1.6. reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or,
 - 9.5.1.7. persistent failure to carry out the Work in accordance with the Contract Documents.
- 9.5.2. When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.
- 9.5.3. Owner's Right to Refuse Payment: The Architect/Engineer's approval, or partial approval, of the Contractor's request for payment shall not preclude or prevent the Owner from exercising any of its remedies under this Contract. The Owner shall have right to refuse to make payment(s) to the Contractor due to:
 - 9.5.3.1. the Contractor's failure to perform the Work in compliance with the Contract Documents;
 - 9.5.3.2. the Contractor's failure to correct any defective or damaged Work;
 - 9.5.3.3. the Contractor's failure to accurately represent the Work performed in the pay request;
 - 9.5.3.4. the Contractor's performance of its Work at a rate or in a manner that, in the Owner's opinion, is likely to result in the Work, or any portion thereof, to be delayed;
 - 9.5.3.5. the Contractor's failure to use funds previously paid to it by the Owner to pay for the Contractor's Work-related obligations including, but not limited to, subcontractors and suppliers on this Project;
 - 9.5.3.6. claims made, or anticipated by the Owner to be made, against the Owner or its property;
 - 9.5.3.7. inclusion in the pay request of any amounts in dispute or part of a claim;
 - 9.5.3.8. Damage or loss caused by the Contractor, including its subcontractors and suppliers; or,

9.5.3.9. The Contractor's failure or refusal to perform its obligations to the Owner.

9.6. PROGRESS PAYMENTS

- 9.6.1. After the Architect/Engineer has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents or the Owner may take any action the Owner deems necessary under Subparagraph 9.5.3.
- 9.6.2. The Contractor shall promptly pay each Subcontractor in accordance with Title 28, Chapter 2, Part 21, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's portion of the Work, the amount to which said Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of such Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.
- 9.6.3. The Contractor is prohibited from holding higher amounts in retainage on any Subcontractor than the Owner is holding from the Contractor.
- 9.6.4. The Architect/Engineer will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect/Engineer and Owner on account of portions of the Work done by such Subcontractor.
- 9.6.5. Neither the Owner nor Architect/Engineer shall have an obligation to pay, or to see to the payment of, money to a Subcontractor except as may otherwise be required by law.
- 9.6.6. Payment to material suppliers shall be treated in a manner similar to that provided in Subparagraphs 9.6.2, 9.6.3, 9.6.4, and 9.6.5.
- 9.6.7. A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.
- 9.6.8. Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

9.7. FAILURE OF PAYMENT

9.7.1. If the Owner does not approve payment to the Contractor within thirty-five (35) calendar days after the receipt of a certified Application for Payment, then the Contractor may, upon seven additional days' written notice to the Owner and Architect/Engineer, suspend the Work until payment of the amount owing has been received. Nothing in the Subparagraph shall limit the Owner's rights and options as provided in Subparagraph 9.5.3. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

9.8. SUBSTANTIAL COMPLETION

- 9.8.1. Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.
- 9.8.2. When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect/Engineer a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item

on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

- 9.8.3. Upon receipt of the Contractor's list, the Architect/Engineer will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect/Engineer's Inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect/Engineer. In such case, the Contractor shall then submit a request for another inspection by the Architect/Engineer to determine Substantial Completion.
- 9.8.4. The Contractor shall ensure the project is substantially complete prior to requesting any inspection by the Architect/Engineer so that no more than one (1) inspection is necessary to determine Substantial Completion for all or any portion of the Work. If the Contractor does not perform adequate inspections to develop a comprehensive list as required in Subparagraph 9.8.2 and does not complete or correct such items upon discovery or notification, the Contractor shall be responsible and pay for the costs of the Architect/Engineer's additional inspections to determine Substantial Completion.
- 9.8.5. When the Work or designated portion thereof is substantially complete, the Architect/Engineer will prepare a Certificate of Substantial Completion which shall establish the date of Substantial Completion and which shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance. After issuance of the Certificate of Substantial Completion, the Contractor shall finish and complete all remaining items within thirty (30) calendar days of the date on the Certificate. The Architect/Engineer shall identify and fix the time for completion of specific items which may be excluded from the thirty (30) calendar day time limit. Failure to complete any items within the specified time frames may be deemed by the Owner as default of the contract on the part of the Contractor.
- 9.8.6. The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety if there are claims or past payment issues, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

9.9. PARTIAL OCCUPANCY OR USE

- 9.9.1. The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect/Engineer as provided under Subparagraph 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect/Engineer.
- 9.9.2. Immediately prior to such partial occupancy or use, the Owner, Contractor and Architect/Engineer shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.
- 9.9.3. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

9.10. FINAL COMPLETION AND FINAL PAYMENT

- 9.10.1. Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect/Engineer will promptly make such inspection and, when the Architect/Engineer finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect/Engineer will approve the Contractor's final Certificate for Payment stating that to the best of the Architect/Engineer's knowledge, information and belief, and on the basis of the Architect/Engineer's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect/Engineer's signature on the Contractor's final Certificate for Payment will constitute a further representation that conditions listed in Subparagraph 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.
- 9.10.2. Neither final payment nor any remaining retainage shall become due until the Contractor submits to the Architect/Engineer:
 - 9.10.2.1. completed Contractor's Affidavit of Completion, Payment of Debts and Claims, and Release of Liens (Form 106) that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied;
 - 9.10.2.2. a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner;
 - 9.10.2.3. a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents
 - 9.10.2.4. Consent of Surety Company to Final Payment (Form 103); and,
 - 9.10.2.5. if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner.
- 9.10.3. The Contractor and his surety accepts and assumes responsibility, liability, and costs for and agrees to defend and hold harmless the Owner for and against any and all actions as a result of the Owner making final payment.
- 9.10.4. By submitting any Application for Payment to the Architect/Engineer the Contractor and his surety certify and declare that all bills for materials, supplies, utilities and for all other things furnished or caused to be furnished by the Contractor and all Subcontractors and used in the execution of the Contract will be fully paid upon receipt of Final Payment and that there are no unpaid obligations, liens, claims, security interests, encumbrances, liabilities and/or demands of State Agencies, subcontractors, suppliers, mechanics, laborers or any others resulting from or arising out of any work done, caused to be done or ordered to be done by the Contractor under the contract.
- 9.10.5. In consideration of the prior payments and the final payment made and all payments made for authorized changes, the Contractor releases and forever discharges the Owner from any and all obligations, liens, claims, security interests, encumbrances and/or liabilities arising by virtue of the contract and authorized changes between the parties, either verbal or in writing, and any and all claims and demands of every kind and character whatsoever against the Owner, arising out of or in any way relating to the contract and authorized changes.
- 9.10.6. The date of Final Payment by the Owner shall constitute Final Acceptance of the Work. The determining date for the expiration of the warranty period shall be as specified in Paragraphs 3.5 and 12.2.2.
- 9.10.7. If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect/Engineer so confirms, the Owner shall, upon application by the Contractor and certification by the Architect/Engineer, and without terminating the Contract, make payment of the balance due for that

portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect/Engineer prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

9.10.8. The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

9.10.8.1. liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;

- 9.10.8.2. failure of the Work to comply with the requirements of the Contract Documents; or,
- 9.10.8.3. terms of special warranties required by the Contract Documents.
- 9.10.9. Acceptance of final payment by the Contractor, a Subcontractor, or material supplier, shall constitute a waiver of any and all obligations, liens, claims, security interests, encumbrances and/or liabilities against the Owner except those previously made in writing per the requirements of Paragraph 4.3 and as yet unsettled at the time of submission of the final Application for Payment.
- 9.10.10. The Owner's issuance of Final Payment does not constitute a waiver or release of any kind regarding any past, current, or future claim the Owner may have against the Contractor and/or the surety.

ARTICLE 10 - PROTECTION OF PERSONS AND PROPERTY

10.1. <u>SAFETY</u>

- 10.1.1. **Importance of Safety**. The Contractor and all Subcontractors (at any tier or level) recognize that safety is paramount at all times. The Contractor shall perform the work in a safe manner with the highest regard for safety of its employees and all other individuals and property at the work site. Contractor shall maintain its tools, equipment, and vehicles in a safe operating condition and take all other actions necessary to provide a safe working environment for performance of work required under this Contract. The Contractor is solely responsible for the means, methods, techniques, sequences and procedures for coordinating and constructing the Work, including all site safety, safety precautions, safety programs, and safety compliance with OSHA and all other governing bodies.
- 10.1.2. Particular Safeguards. (a). The Contractor shall erect and maintain, as required by Paragraphs 10.1.1 and 10.1.3, safeguards for safety and protection, including posting danger signs and other warnings against hazards, installing suitable barriers and lighting, promulgating safety regulations, and providing notification to all parties who may be impacted by the Contractor's operations. (b) When use or storage of explosives or other Hazardous Materials/Substances (defined below) or equipment are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel. (c) The Contractor shall not encumber or load or permit any part of the construction site to be encumbered or loaded so as to endanger the safety of any person(s).
- 10.1.3. **Compliance with Safety Laws**. Contractor represents and warrants to Owner that it knows and understands all federal, state and local safety statutes, rules, and regulations (Laws) related to the work under this Contract. Contractor shall comply with these Laws. Contractor shall keep all material data safety sheets on site and available at all times.
- 10.1.4. **Remedy property damage**. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor of any tier or level, or anyone employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Paragraph 3.18.
- 10.1.5. **Designation of Safety Representative.** Unless the Contractor designates, in writing to the Owner and the Architect/Engineer, another responsible member of the Contractor's organization as the Safety Representative, the Contractor's superintendent is the Safety Representative. The Safety Representative is defined as that member of the Contractor's organization responsible for all safety under this Contract.

10.1.6. **Release/Indemnity of Owner and Architect/Engineer**. The Contractor agrees that the Owner and Architect/Engineer are not responsible for safety at the work site and releases them from all obligations and liability regarding safety at the work site The Contractor shall indemnify and defend the Owner and the Architect/Engineer against and from all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses (including but not limited to court costs and reasonable attorney fees), arising from injuries and death to any persons and damage to real and personal property arising from, in connection with, or incidental to Contractor's safety responsibilities under this Contract.

10.2. HAZARDOUS MATERIALS/SUBSTANCES

- 10.2.1. "Hazardous Materials/Substances" means any substance: (a) the presence of which requires investigation, or remediation under any federal, state or local statute, rule, regulation, ordinance, order, policy or common law; (b) that is or becomes defined as "hazardous waste," "hazardous substance," pollutant, or contaminant under any federal, state or local statute, rule, regulation, or ordinance or amendments thereto; (c) that is toxic, explosive, corrosive flammable, or otherwise hazardous and is or becomes regulated by any government authority, agency, board, commission or instrumentality of the United States, the state of Montana or any political subdivision thereof; (d) gasoline, diesel fuel or other petroleum hydrocarbons; (e) containing contains polychlorinated biphenyls (PCBs) or asbestos; or (f) the presence of which causes or threatens to cause a nuisance or trespass on the work site or adjacent property.
- 10.2.2. The Contractor is solely responsible for all compliance with all regulations, requirements, and procedures governing Hazardous Materials/Substances at the Work Site or that Contractor brings on the site. The Contractor is solely responsible for remediation, costs, damages, loss, and/or expenses for all Hazardous Materials/Substances brought to the site. The Contractor shall not and is strictly prohibited from purchasing and/or installing any asbestos-containing materials or products as part of the Work. Should the Contractor do so, the Contractor shall be solely responsible for the immediate remediation and all costs, damages, loss, and/or expenses per Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.
- 10.2.3. If the Contractor encounters Hazardous Materials/Substances during the course of the Work, whether or not identified in the Contract Documents, Work, the Contractor agrees that:
 - 10.2.3.1. Encountering any Hazardous Materials/Substances during performance of the Work does not necessarily mean a change in conditions has occurred, nor is it evidence that the Contractor is due additional Contract Time or an increase in the Contract Sum. If encountering Hazardous Materials/Substances is determined to be a change in conditions to the Contract Documents, Paragraph 4.3 and Article 7 apply in determining any additional compensation or extension of time claimed by the Contractor.
 - 10.2.3.2. The Contractor is solely responsible for securing the Work in accordance with this Article 10 involving any Hazardous Materials/Substances against unlawful, unregulated, or improper intrusion, disturbance, or removal. The Contractor shall implement protections and take protective actions throughout the performance of the Work to prevent exposure to workers, occupants, and contamination of the site or area.
 - 10.2.3.3. If the Contractor is unable to or fails to properly secure the Work against unlawful, unregulated, or improper intrusion, disturbance, or removal of Hazardous Materials/Substances, the Contractor shall immediately implement protections and take protective actions, up to and including stopping Work in the area or on the item affected, to prevent exposure to workers, occupants, and contamination of the site or area. The Contractor shall immediately notify the Owner and Architect in writing giving details of the failure and the corrective actions taken. If the condition is an emergency and notice cannot be provided in writing, then Contractor shall orally and immediately notify the Owner and Architect/Engineer of the condition followed by a full written explanation. In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss.
 - 10.2.3.4. If the Contractor notifies the Owner and takes precautions in accordance with this Article 10 upon encountering materials/substances suspected of containing asbestos or polychlorinated biphenyls that are unidentified in the Contract Documents, the Owner shall verify if the

unidentified material or substance contains asbestos or polychlorinated biphenyls and shall arrange for the removal or other measures as necessary to allow the Contractor to proceed with the Work. The Contract Time may be extended as appropriate if the Work affected is on the critical path and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs as provided in Article 7. Should the Contractor fail to notify the Owner upon encountering asbestos, polychlorinated biphenyls, or materials/substances suspected of containing asbestos or polychlorinated biphenyls, that are unidentified in the Contract Documents, the Contractor is solely responsible for all mitigation in accordance with Paragraphs 10.1.6, 10.2.2, 10.2.3, and 10.2.4.

10.2.4. The Contractor shall indemnify, hold harmless, and defend the Owner from and against all claims, liabilities, fines, penalties, orders, causes of action, judgments, losses, costs and expenses, including but not limited to court costs and reasonable attorneys' fees, arising from, in connection with, or incidental to the Contractor's handling, disposal, encountering, or release of Hazardous Materials/Substances.

10.3. UTILITIES

- 10.3.1. Underground Utilities: Buried utilities, including, but not limited to, electricity, gas, steam, air, water, telephone, sewer, irrigation, broadband coaxial computer cable, and fiber optic cables are very vulnerable and damage could result in loss of service. The telephone, broadband and fiber optic cables are especially sensitive and the slightest damage to these components will result in disruption of the operations of the campus.
- 10.3.2. "One Call" must be notified by phone and in writing at least 72 hours (3 business days) prior to digging to arrange and assist in the location of buried utilities in the field. (Dial 811). The Contractor shall mark the boundary of the work area. The boundary area shall be indicated with white paint and white flags. In winter, pink paint and flags will be accepted.
- 10.3.3. After buried utilities have been located, the Contractor shall be responsible for any utilities damaged while digging. Such responsibility shall include all necessary care including hand digging. Contractor's responsibility shall also include maintaining markings after initial locate. The area for such responsibility, unless otherwise indicated, shall extend 24 inches to either side of the marked center line of a buried utility line.
- 10.3.4. The Contractor's responsibility shall include repair or replacement of damaged utilities. The Contractor will also be responsible for all costs associated with reterminations and recertification.
- 10.3.5. Any buried utilities exposed by the operations of the Contractor shall be marked on the plans and adequately protected by the Contractor. If any buried utilities not located are exposed, the Contractor shall immediately contact the Owner and the Architect/Engineer. If, after exposing an unlocated buried utility, the Contractor continues digging without notifying Owner and Architect/Engineer and further damages the utility, the Contractor will be fully and solely responsible.
- 10.3.6. Damage to irrigation systems during seasons of no irrigation that are not immediately and adequately repaired and tested will require the Contractor to return when the system is in service to complete the repair.
- 10.3.7. In the event of a planned interruption of any existing utility service, the Contractor shall make arrangements with Owner at least 72 hours (3 business days) in advance. Shutdowns of the broadband or fiber optic cables will normally require 5 working days' notice to the Owner. The Contractor shall bear all costs associated with the interruptions and restorations of service.

ARTICLE 11 - INSURANCE AND BONDS

11.1. CONTRACTOR'S LIABILITY INSURANCE

11.1.1. The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the State of Montana with a rating no less than "A-", such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the

Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- 11.1.1.1. claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;
- 11.1.1.2. claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- 11.1.1.3. claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- 11.1.1.4. claims for damages insured by usual personal injury liability coverage;
- 11.1.1.5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting there from;
- 11.1.1.6. claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- 11.1.1.7. claims for bodily injury or property damage arising out of completed operations; and,
- 11.1.1.8. claims involving contractual liability insurance applicable to the Contractor's obligations under Paragraph 3.18.
- 11.1.2. The insurance required by Subparagraph 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from date of commencement of the Work until termination of any coverage required to be maintained after final payment.
- 11.1.3. Certificates of insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. These certificates and the insurance policies required by this Paragraph 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire at any time prior to Final Acceptance and then not until at least 30 days' prior written notice has been given to the Owner. If any of the foregoing insurance coverages are required to remain in force after final payment, an additional certificate evidencing continuation of such coverage shall be submitted with the final Application for Payment as required by Subparagraph 9.10.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.
- 11.1.4. At the request of the Owner, the Contractor shall provide copies of all insurance policies to the Owner.

11.2. INSURANCE, GENERAL REQUIREMENTS

- 11.2.1. The Contractor shall maintain for the duration of the contract, at its cost and expense, insurance against claims for injuries to persons or damages to property, including contractual liability, which may arise from or in connection with the performance of the Work by the Contractor, its agents, employees, representatives, assigns, or subcontractors. The Contractor is responsible for all deductibles regardless of policy or level of coverage. The Owner reserves the right to demand, and the Contractor agrees to provide, copies of any and all policies at any time.
- 11.2.2. Hold Harmless and Indemnification: The Contractor shall protect, defend, and save the state, its elected and appointed officials, agents, and employees, while acting within the scope of their duties as such, harmless from and against all claims, liabilities, demands, causes of action, and judgments whatsoever (including the cost of defense and reasonable attorney fees): 1) arising in favor of or asserted by third parties on account of damage to property, personal injury, or death which injury, death, or damage; or, 2) arising out of or resulting from performance or failure to perform, or omissions of services, or in any way results from the negligent acts or omissions of the Contractor, its agents, agents, or subcontractors.

- 11.2.3. Contractor's Insurance: insurance required under all sections herein shall be in effect for the duration of the contract that extends through the warranty period. Insurance required herein shall be provided by insurance policies issued only by insurance companies currently authorized to do business in the state of Montana. No Contractor or Sub-contractor shall commence any Work under this contract until all required insurance has been obtained. During the term of this contract, the Contractor shall, not less than thirty days prior to the expiration date of any policy for which a certificate of insurance is required, deliver to the Owner a certificate of insurance with respect to the renewal insurance policy. The Contractor shall furnish one copy of insurance certificates of insurance herein required, which shall specifically set forth evidence of all coverage required by these contract documents and which shall be signed by authorized representatives of the insurance company or companies evidencing that insurance as required herein is in force and will not be canceled, limited or restricted without thirty days' written notice by certified mail to the contractor and the Owner. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. Additionally, all certificates shall include the project name and A/E project number.
- 11.2.4. Certificates of Insurance and Endorsements. All certificates of insurance and the additional insured endorsements are to be received by the state prior to issuance of the Notice to Proceed. The contractor is responsible to ensure that all policies and coverages contain the necessary endorsements for the State being listed as an additional insured. The state reserves the right to require complete copies of all insurance policies at any time to verify coverage. The contractor shall notify the state within 30 days of any material change in coverage.

11.3. WORKERS' COMPENSATION INSURANCE

11.3.1. The Contractor shall carry **Workers' Compensation Insurance**. Such Workers' Compensation Insurance shall protect the Contractor from claims made by his own employees, the employees of any Sub-contractor, and also claims made by anyone directly or indirectly employed by the Contractor or Sub-contractor. The Contractor shall require each Sub-contractor similarly to provide Workers' Compensation Insurance.

11.4. COMMERCIAL GENERAL LIABILITY INSURANCE

- 11.4.1. Each Contractor shall carry per occurrence coverage **Commercial General Liability Insurance** including coverage for premises; operations; independent contractor's protective; products and completed operations; products and materials stored off-site; broad form property damage and comprehensive automobile liability insurance with not less than the following limits of liability:
 - 11.4.1.1. \$1,000,000 per occurrence; aggregate limit of \$2,000,000;
- 11.4.2. The **Commercial General and Automobile Liability Insurance** shall provide coverage for both bodily injury, including accidental death, sickness, disease, occupational sickness or disease, personal injury liability coverage and property damage which may arise out of the work under this contract, or operations incidental thereto, whether such work and operations be by the Contractor or by any Subcontractor or by anyone directly or indirectly employed by the Contractor or by Sub-contractor, or by anyone for whose acts any of them may be liable. The Contractor shall maintain the liability insurance required herein for a period of not less than one year after final payment or anytime the Contractor goes on to the location of the project.
- 11.4.3. The Contractor's liability insurance policies shall list the STATE OF MONTANA as an additional insured. **AN ADDITIONAL INSURED ENDORSEMENT DOCUMENT SHALL BE SUBMITTED WITH THE CERTIFICATES OF INSURANCE**. The STATE OF MONTANA includes its officers, elected and appointed officials, employees and volunteers and political subdivisions thereof. Should the Contractor not be able to list the state as an additional insured, the Contractor shall purchase a per occurrence Owner's/Contractor's Protective Policy (OCP) with the STATE OF MONTANA as the insured party in the same occurrence and aggregate limits as that indicated above for the Contractor's Commercial General Liability Policy.
- 11.4.4. Property damage liability insurance shall be written without any exclusion for injury to or destruction of any building, structure, wires, conduits, pipes, or other property above or below the surface of the ground

arising out of the blasting, explosion, pile driving, excavation, filling, grading or from the moving, shoring, underpinning, raising, or demolition of any building or structure or structural support thereof.

11.4.5. The Contractor's insurance coverage shall be PRIMARY insurance as respects the State, its officers, elected and appointed officials, employees and volunteers. Any insurance or self-insurance maintained by the state, its officers, elected and appointed officials, employees and volunteers shall be excess of the Contractor's insurance and shall not contribute to it. NO WAIVERS OF SUBROGATION OR ENDORSEMENTS LIMITING, TRANSFERRING, OR OTHERWISE INDEMNIFYING LIABLE OR RESPONSIBLE PARTIES OF THE CONTRACTOR OR ANY SUBCONTRACTOR WILL BE ACCEPTED.

11.5. PROPERTY INSURANCE (ALL RISK)

- 11.5.1. New Construction (for projects involving new construction): At its sole cost and expense, the contractor shall keep the building and all other improvements on the premises insured throughout the term of the agreement against the following hazards:
 - 11.5.1.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map, http://rmtd.mt.gov/Portal/62/aboutus/publications/files/NEHRP.pdf in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire insurance policies. Certificates of Insurance MUST indicate earthquake coverage if coverage is required per the above referenced map.
 - 11.5.1.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.
 - 11.5.1.3. Loss or damage by explosion of steam boilers, pressure vessels, and oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.
- 11.5.2. Building Renovation (for projects involving building renovation or remodeling):
 - 11.5.2.1. The contractor shall purchase and maintain Builder's Risk/Installation insurance on a "special causes of loss" form (so called "all risk") for the cost of the work and any subsequent modifications and change orders. The contractor is not responsible for insuring the existing structure for Builder's Risk/Installation insurance.
 - 11.5.2.2. At its sole cost and expense, the contractor shall insure all property construction on the premises throughout the term of the agreement against the following hazards:
 - 11.5.2.2.1. Loss or damage by fire and such other risks (including earthquake damage for those areas with a shaking level at 10g or above as indicated on the seismic map at http://rmtd.mt.gov/Portal/62/aboutus/publications/files/NEHRP.pdf in an amount sufficient to permit such insurance to be written at all times on a replacement cost basis. This may be insured against by attachment of standard form extended coverage endorsement to fire policies. <u>Certificates of Insurance MUST indicate</u> earthquake coverage if coverage is required per the above referenced map.
 - 11.5.2.2.2. Loss or damage from leakage or sprinkler systems now or hereafter installed in any building on the premises.
 - 11.5.2.2.3. Loss or damage by explosion of steam boilers, pressure vessels, oil or gasoline storage tanks, or similar apparatus now or hereafter installed in a building or buildings on the premises.

11.6. ASBESTOS ABATEMENT INSURANCE

11.6.1. If Asbestos Abatement is identified as part of the Work under this contract, the Contractor or any subcontractor involved in asbestos abatement shall purchase and maintain Asbestos Liability Insurance for coverage of bodily injury, sickness, disease, death, damages, claims, errors or omissions regarding the asbestos portion of the work <u>in addition to</u> the CGL Insurance by reason of any negligence

in part or in whole, error or omission committed or alleged to have been committed by the Contractor or anyone for whom the Contractor is legally liable.

11.6.2. Such insurance shall be in "per occurrence" form and shall clearly state on the certificate that asbestos work is included in the following limits:

11.6.2.1. **\$1,000,000** per occurrence; aggregate limit of **\$2,000,000**.

11.6.3. Asbestos Liability Insurance as carried by the asbestos abatement subcontractor in these limits in lieu of the Contractor's coverage is acceptable provided the Contractor and the State of Montana are named as additional insureds and that the abatement subcontractor's insurance is PRIMARY as respects both the Owner and the Contractor. If the Contractor or any other subcontractor encounters asbestos, all operations shall be suspended until abatement with the associated air monitoring clearances are accomplished. The certificate of coverage shall be provided by the asbestos abatement subcontractor to both the Contractor and the Owner.

11.7. <u>PERFORMANCE BOND AND LABOR & MATERIAL PAYMENT BOND (BOTH ARE REQUIRED ON THIS PROJECT)</u>

- 11.7.1. The Contract shall furnish a Performance Bond in the amount of 100% of the contract price as security for the faithful performance of his contract (18-2-201 MCA). The Contractor shall also furnish a Labor and Material Payment Bond in the amount of 100% of the contract price as security for the payment of all persons performing labor and furnishing materials in connection therewith (18-2-201MCA). The bonds shall be executed on forms furnished by the Owner and no other forms or endorsements will be acceptable. The bonds shall be signed in compliance with state statutes (33-17-1111 MCA). Bonds shall be secured from a state licensed bonding company. Power of Attorney is required with each bond. Attorneys-in-fact who sign contract bonds must file with each bond a certified and effectively dated copy of their power of attorney:
 - 11.7.1.1. one original copy shall be furnished with each set of bonds.
 - 11.7.1.2. Others furnished with a set of bonds may be copies of that original.
- 11.7.2. The Owner reserves the right at any time during the performance of Work to require bonding of Subcontractors provided by the General Contractor. Should this occur, the Owner will cover the direct cost. This shall not be construed as to in any way affect the relationship between the General Contractor and his Subcontractors.
- 11.7.3. Surety must have an endorsement stating that their guarantee of Contractor's performance automatically covers the additional contract time added to a Contractor's contract by Change Order.
- 11.7.4. A change in the Contractor's organization shall not constitute grounds for Surety to claim a discharge of their liability and requires an endorsement from Surety so stating.
- 11.7.5. Except as noted below, the Contractor is required to notify Surety of any increase in the contract amount resulting from a Change Order within 48 hours of signing and submitting a Change Order and shall submit a copy of Surety's written acknowledgment and consent to Owner before a Change Order can be approved. The Surety's written acknowledgment and consent on the Change Order form shall also satisfy this consent requirement.
 - 11.7.5.1. Surety consent shall not be required on Change Order(s) which, in the aggregate total amount of all Changes Orders, increase the original contract amount by less than 10%. However, the Contractor is still required to notify Surety of any increase in contract amount resulting from a Change Order(s) within 48 hours of signing and submitting every Change Order.
 - 11.7.5.2. Surety is fully obligated to the Owner for the full contract amount, inclusive of all Change Orders, regardless of whether or not written acknowledgement and consent is received and regardless of whether or not the aggregate total of all Change Orders is more or less than 10% of the original contract amount.

- 11.7.5.3. A fax with hard copy to follow of Surety's written acknowledgment and consent is acceptable. If hard copy is not received by Owner before Application for Payment on any portion or all of said Change Order, it will not be accepted by Owner for payment.
- 11.7.6. The Surety must take action within 30 days of notice of default on the part of the Contractor or of any claim on bonds made by the Owner or any Subcontractor or supplier.

ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK

12.1. UNCOVERING OF WORK

- 12.1.1. If a portion of the Work is covered contrary to the Architect/Engineer's request or to requirements specifically expressed in the Contract Documents, it must, if required in writing by the Architect/Engineer, be uncovered for the Architect/Engineer's examination and be replaced at the Contractor's expense without change in the Contract Time.
- 12.1.2. If a portion of the Work has been covered which the Architect/Engineer has not specifically requested to examine prior to it being covered, the Architect/Engineer may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

12.2. CORRECTION OF WORK

12.2.1. BEFORE OR AFTER SUBSTANTIAL COMPLETION

- 12.2.1.1. The Contractor shall promptly correct Work that fails to conform to the requirements of the Contract Documents or that is rejected by the Architect/Engineer, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections and compensation for the Architect/Engineer's services and expenses made necessary thereby, shall be at the Contractor's expense. The Contractor is responsible to discover and correct all defective work and shall not rely upon the Architect/Engineer's or Owner's observations.
- 12.2.1.2. Rejection and Correction of Work in Progress. During the course of the Work, the Contractor shall inspect and promptly reject any Work that:
 - 12.2.1.2.1. does not conform to the Construction Documents; or,
 - 12.2.1.2.2. does not comply with any applicable law, statute, building code, rule or regulation of any governmental, public and quasi-public authorities, and agencies having jurisdiction over the Project.
- 12.2.1.3. The Contractor shall promptly correct or require the correction of all rejected Work, whether observed before or after Substantial Completion. The Contractor shall bear all costs of correcting such Work, including additional testing, inspections, and compensation for all services and expenses necessitated by such corrective action.

12.2.2. AFTER SUBSTANTIAL COMPLETION AND AFTER FINAL ACCEPTANCE

12.2.2.1. In addition to the Contractor's obligations under Paragraph 3.5, if, within one year after the date of Final Acceptance of the Work or designated portion thereof or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition The Owner shall give such notice promptly after discovery of the contractor and give the Contractor an opportunity to make the correction, the Owner waives

the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect/Engineer, the Owner may correct it in accordance with Paragraph 2.3.

- 12.2.2.1.1. The Contractor shall remedy any and all deficiencies due to faulty materials or workmanship and pay for any damage to other work resulting there from, which shall appear within the period of Substantial Completion through one (1) year from the date of Final Acceptance in accordance with the terms and conditions of the Contract and with any special guarantees or warranties provided in the Contract Documents. The Owner shall give notice of observed deficiencies with reasonable promptness. All questions, claims or disputes arising under this Article shall be decided by the Architect/Engineer. All manufacturer, product and supplier warranties are in addition to this Contractor warranty.
- 12.2.2.1.2. The Contractor shall respond within seven (7) days after notice of observed deficiencies has been given and he shall proceed to immediately remedy these deficiencies.
- 12.2.2.1.3. Should the Contractor fail to respond to the notice or not remedy those deficiencies; the Owner shall have this work corrected at the expense of the Contractor.
- 12.2.2.1.4. Latent defects shall be in addition to those identified above and shall be the responsibility of the Contractor per the statute of limitations for a written contract (27-2-208 MCA) starting from the date of Final Acceptance.
- 12.2.2.2. The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work.
- 12.2.2.3. The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Paragraph 12.2.
- 12.2.3. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.
- 12.2.4. The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.
- 12.2.5. Nothing contained in this Paragraph 12.2 shall be construed to establish a period of limitation with respect to other obligations which the Contractor might have under the Contract Documents. Establishment of the one-year period for correction of Work as described in Subparagraph 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

12.3. ACCEPTANCE OF NONCONFORMING WORK

12.3.1. If the Owner prefers to accept Work which is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

13.1. GOVERNING LAW

13.1.1. The Contract shall be governed by the laws of the State of Montana and venue for all legal proceedings shall be the First Judicial District, Lewis & Clark County.

13.2. SUCCESSORS AND ASSIGNS

13.2.1. The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to the other party hereto and to partners, successors, assigns and legal representatives of such other party in respect to covenants, agreements and obligations contained in the Contract Documents. Neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempt to make such assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

13.3. WRITTEN NOTICE

13.3.1. Written notice shall be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or if delivered at or sent by registered or certified mail to the last business address known to the party giving notice.

13.4. RIGHTS AND REMEDIES

- 13.4.1. Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.
- 13.4.2. No action or failure to act by the Owner, Architect/Engineer or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

13.5. TESTS AND INSPECTIONS

- 13.5.1. Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations or orders of public authorities having jurisdiction shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect/Engineer timely notice of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. The Owner shall bear costs of tests, inspections or approvals which do not become requirements until after bids are received or negotiations concluded.
- 13.5.2. If the Architect/Engineer, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Subparagraph 13.5.1, the Architect/Engineer will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect/Engineer of when and where tests and inspections are to be made so that the Architect/Engineer may be present for such procedures. Such costs, except as provided in Subparagraph 13.5.3 shall be at the Owner's expense.
- 13.5.3. If such procedures for testing, inspection or approval under Subparagraphs 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Architect/Engineer's services and expenses shall be at the Contractor's expense.
- 13.5.4. Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect/Engineer.
- 13.5.5. If the Architect/Engineer is to observe tests, inspections or approvals required by the Contract Documents, the Architect/Engineer will do so promptly and, where practicable, at the normal place of testing.
- 13.5.6. Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

13.6. <u>INTEREST</u>

13.6.1. Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at such rate as the parties may agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

13.7. COMMENCEMENT OF STATUTORY LIMITATION PERIOD

- 13.7.1. As between the Owner and Contractor:
 - 13.7.1.1. **Before Substantial Completion.** As to acts or failures to act occurring prior to the relevant date of Substantial Completion, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than such date of Substantial Completion;
 - 13.7.1.2. **Between Substantial Completion and Final Certificate for Payment.** As to acts or failures to act occurring subsequent to the relevant date of Substantial Completion and prior to issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of issuance of the final Certificate for Payment; and,
 - 13.7.1.3. After Final Payment. As to acts or failures to act occurring after the relevant date of issuance of the final Certificate for Payment, any applicable statute of limitations shall commence to run and any alleged cause of action shall be deemed to have accrued in any and all events not later than the date of any act or failure to act by the Contractor pursuant to any Warranty provided under Paragraph 3.5, the date of any correction of the Work or failure to correct the Work by the Contractor under Paragraph 12.2, or the date of actual commission of any other act or failure to perform any duty or obligation by the Contractor or Owner, whichever occurs last.

13.8. PAYROLL AND BASIC RECORDS

13.8.1. Payrolls and basic records pertaining to the project shall be kept on a generally recognized accounting basis and shall be available to the Owner, Legislative Auditor, the Legislative Fiscal Analyst or his authorized representative at mutually convenient times. Accounting records shall be kept by the Contractor for a period of three years after the date of the Owner's Final Acceptance of the Project.

ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT

14.1. TERMINATION BY THE CONTRACTOR

- 14.1.1. The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:
 - 14.1.1.1. issuance of an order of a court or other public authority having jurisdiction which requires all Work to be stopped; or,
 - 14.1.1.2. an act of government, such as a declaration of national emergency which requires all Work to be stopped.
- 14.1.2. The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Paragraph 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

- 14.1.3. If one of the reasons described in Subparagraph 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner and Architect/Engineer, terminate the Contract and recover from the Owner payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead and profit but not damages.
- 14.1.4. If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has persistently failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner and the Architect/Engineer, terminate the Contract and recover from the Owner as provided in Subparagraph 14.1.3.

14.2. TERMINATION BY THE OWNER FOR CAUSE

- 14.2.1. The Owner may terminate the Contract if the Contractor:
 - 14.2.1.1. persistently or repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
 - 14.2.1.2. fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
 - 14.2.1.3. persistently disregards laws, ordinances, or rules, regulations or orders of a public authority having jurisdiction; or,
 - 14.2.1.4. otherwise is guilty of any breach of a provision of the Contract Documents.
- 14.2.2. When any of the above reasons exist, the Owner, upon certification by the Architect/Engineer that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:
 - 14.2.2.1. take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
 - 14.2.2.2. accept assignment of subcontracts pursuant to Paragraph 5.4; and,
 - 14.2.2.3. finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.
- 14.2.3. When the Owner terminates the Contract for one of the reasons stated in Subparagraph 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.
- 14.2.4. If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect/Engineer's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect/Engineer, upon application, and this obligation for payment shall survive termination of the Contract.

14.3. SUSPENSION BY THE OWNER FOR CONVENIENCE

- 14.3.1. The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.
- 14.3.2. The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Subparagraph 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:

- 14.3.2.1. that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or,
- 14.3.2.2. that an equitable adjustment is made or denied under another provision of the Contract.

14.4. TERMINATION BY THE OWNER FOR CONVENIENCE

- 14.4.1. The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.
- 14.4.2. Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall:
 - 14.4.2.1. cease operations as directed by the Owner in the notice;
 - 14.4.2.2. take actions necessary, or that the Owner may direct, for the protection and preservation of the Work, and;
 - 14.4.2.3. except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.
- 14.4.3. In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed. The Contractor shall provide a full and complete itemized accounting of all costs.

ARTICLE 15 – EQUAL OPPORTUNITY

- **15.1.** The Contractor and all Sub-contractors shall not discriminate against any employee or applicant for employment because of race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability and shall comply with all Federal and State laws concerning fair labor standards and hiring practices. The Contractor shall ensure that applicants are employed, and that employees are treated during employment, without regard to race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability.
- **15.2.** Such action shall include, but not be limited to the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the policies of non-discrimination.
- **15.3.** The Contractor and all Sub-contractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants will receive consideration for employment without regard to race, color, sex, pregnancy, childbirth or medical conditions related to pregnancy or childbirth, political or religious affiliation or ideas, culture, creed, social origin or condition, genetic information, sexual orientation, gender identity or expression, national origin, ancestry, age, disability, military service or veteran status, or marital status, or physical or mental disability.

[END OF GENERAL CONDITIONS]

MONTANA PREVAILING WAGE RATES FOR HEAVY CONSTRUCTION SERVICES 2021

Effective: January 1, 2021

Steve Bullock, Governor State of Montana

Brenda Nordlund, Acting Commissioner Department of Labor & Industry

To obtain copies of prevailing wage rate schedules, or for information relating to public works projects and payment of prevailing wage rates, visit ERD at <u>www.mtwagehourbopa.com</u> or contact:

Employment Relations Division Montana Department of Labor and Industry P. O. Box 201503 Helena, MT 59620-1503 Phone 406-444-6543

The department welcomes questions, comments, and suggestions from the public. In addition, we'll do our best to provide information in an accessible format, upon request, in compliance with the Americans with Disabilities Act.

MONTANA PREVAILING WAGE REQUIREMENTS

The Commissioner of the Department of Labor and Industry, in accordance with Sections 18-2-401 and 18-2-402 of the Montana Code Annotated (MCA), has determined the standard prevailing rate of wages for the occupations listed in this publication.

The wages specified herein control the prevailing rate of wages for the purposes of Section 18-2-401, et seq., MCA. It is required each employer pay (as a minimum) the rate of wages, including fringe benefits, travel allowance, zone pay and per diem applicable to the district in which the work is being performed as provided in the attached wage determinations.

All Montana Prevailing Wage Rates are available on the internet at <u>www.mtwagehourbopa.com</u> or by contacting the department at (406) 444-6543.

In addition, this publication provides general information concerning compliance with Montana's Prevailing Wage Law and the payment of prevailing wages. For detailed compliance information relating to public works contracts and payment of prevailing wage rates, please consult the regulations on the internet at <u>www.mtwagehourbopa.com</u> or contact the department at (406) 444-6543.

BRENDA NORDLUND Acting Commissioner Department of Labor and Industry State of Montana

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A. Date of Publication January 4, 2021

B. Definition of Heavy Construction

The Administrative Rules of Montana (ARM), 24.17.501(4) - (4)(a), states "Heavy construction projects include, but are not limited to, those projects that are not properly classified as either 'building construction', or 'highway construction.'

Heavy construction projects include, but are not limited to, antenna towers, bridges (major bridges designed for commercial navigation), breakwaters, caissons (other than building or highway), canals, channels, channel cut-offs, chemical complexes or facilities (other than buildings), cofferdams, coke ovens, dams, demolition (not incidental to construction), dikes, docks, drainage projects, dredging projects, electrification projects (outdoor), fish hatcheries, flood control projects, industrial incinerators (other than building), irrigation projects, jetties, kilns, land drainage (not incidental to other construction), land leveling (not incidental to other construction), land reclamation, levees, locks and waterways, oil refineries (other than buildings), pipe lines, ponds, pumping stations (prefabricated drop-in units – not buildings), railroad construction, reservoirs, revetments, sewage collection and disposal lines, sewers (sanitary, storm, etc.), shoreline maintenance, ski tows, storage tanks, swimming pools (outdoor), subways (other than buildings), tipples, tunnels, unsheltered piers and wharves, viaducts (other than highway), water mains, waterway construction, water supply lines (not incidental to building), water and sewage treatment plants (other than buildings) and wells."

C. Definition of Public Works Contract

Section 18-2-401(11)(a), MCA defines "public works contract" as "...a contract for construction services let by the state, county, municipality, school district, or political subdivision or for nonconstruction services let by the state, county, municipality, or political subdivision in which the total cost of the contract is in excess of \$25,000...".

D. Prevailing Wage Schedule

This publication covers only Heavy Construction occupations and rates in the specific localities mentioned herein. These rates will remain in effect until superseded by a more current publication. Current prevailing wage rate schedules for Building Construction, Highway Construction and Nonconstruction Services occupations can be found on the internet at www.mtwagehourbopa.com or by contacting the department at (406) 444-6543.

E. Rates to Use for Projects

ARM, 24.17.127(1)(c), states "The wage rates applicable to a particular public works project are those in effect at the time the bid specifications are advertised."

F. Wage Rate Adjustments for Multiyear Contracts

Section 18-2-417, MCA states:

"(1) Any public works contract that by the terms of the original contract calls for more than 30 months to fully perform must include a provision to adjust, as provided in subsection (2), the standard prevailing rate of wages to be paid to the workers performing the contract.

(2) The standard prevailing rate of wages paid to workers under a contract subject to this section must be adjusted 12 months after the date of the award of the public works contract. The amount of the adjustment must be a 3% increase. The adjustment must be made and applied every 12 months for the term of the contract.

(3) Any increase in the standard rate of prevailing wages for workers under this section is the sole responsibility of the contractor and any subcontractors and not the contracting agency."

G. Fringe Benefits

Section 18-2-412, MCA states:

"(1) To fulfill the obligation...a contractor or subcontractor may:

(a) pay the amount of fringe benefits and the basic hourly rate of pay that is part of the standard prevailing rate of wages directly to the worker or employee in cash;

(b) make an irrevocable contribution to a trustee or a third person pursuant to a fringe benefit fund, plan, or program that meets the requirements of the Employee Retirement Income Security Act of 1974 or that is a bona fide program approved by the U.S. department of labor; or

(c) make payments using any combination of methods set forth in subsections (1)(a) and (1)(b) so that the aggregate of payments and contributions is not less than the standard prevailing rate of wages, including fringe benefits and travel allowances, applicable to the district for the particular type of work being performed.

(2) The fringe benefit fund, plan, or program described in subsection (1)(b) must provide benefits to workers or employees for health care, pensions on retirement or death, life insurance, disability and sickness insurance, or bona fide programs that meet the requirements of the Employee Retirement Income Security Act of 1974 or that are approved by the U. S. department of labor."

Fringe benefits are paid for all hours worked (straight time and overtime hours). However, fringe benefits are not to be considered a part of the hourly rate of pay for calculating overtime, unless there is a collectively bargained agreement in effect that specifies otherwise.

H. Dispatch City

ARM, 24.17.103(11), defines dispatch city as "...the courthouse in the city from the following list which is closest to the center of the job: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula."

I. Zone Pay

Zone pay is not travel pay. ARM, 24.17.103(24), defines zone pay as "...an amount added to the base pay; the combined sum then becomes the new base wage rate to be paid for all hours worked on the project. Zone pay must be determined by measuring the road miles one way over the shortest practical maintained route from the dispatch city to the center of the job." See section H above for a list of dispatch cities.

J. Computing Travel Benefits

ARM, 24.17.103(22), states " 'Travel pay,' also referred to as 'travel allowance,' is and must be paid for travel both to and from the job site, except those with special provisions listed under the classification. The rate is determined by measuring the road miles one direction over the shortest practical maintained route from the dispatch city or the employee's home, whichever is closer, to the center of the job." See section H above for a list of dispatch cities.

K. Per Diem

ARM, 24.17.103(18), states " 'Per diem' typically covers costs associated with board and lodging expenses. Per diem is paid when an employee is required to work at a location outside the daily commuting distance and is required to stay at that location overnight or longer."

L. Apprentices

Wage rates for apprentices registered in approved federal or state apprenticeship programs are contained in those programs. Additionally, Section 18-2-416(2), MCA states, "...The full amount of any applicable fringe benefits must be paid to the apprentice while the apprentice is working on the public works contract." Apprentices not registered in approved federal or state apprenticeship programs will be paid the appropriate journey level prevailing wage rate when working on a public works contract.

M. Posting Notice of Prevailing Wages

Section 18-2-406, MCA, provides that contractors, subcontractors, and employers who are "...performing work or providing construction services under public works contracts, as provided in this part, shall post in a prominent and accessible site on the project or staging area, not later than the first day of work and continuing for the entire duration of the project, a legible statement of all wages and fringe benefits to be paid to the employees."

N. Employment Preference

Sections 18-2-403 and 18-2-409, MCA require contractors to give preference to the employment of bona fide Montana residents in the performance of work on public works contracts.

O. Projects of a Mixed Nature

Section 18-2-408, MCA states:

"(1) The contracting agency shall determine, based on the preponderance of labor hours to be worked, whether the public works construction services project is classified as a highway construction project, a heavy construction project, or a building construction project.

(2) Once the project has been classified, employees in each trade classification who are working on that project must be paid at the rate for that project classification"

P. Occupations Definitions

You can find definitions for these occupations on the following Bureau of Labor Statistics website: <u>http://www.bls.gov/oes/current/oes_stru.htm</u>

Q. Welder Rates

Welders receive the rate prescribed for the craft performing an operation to which welding is incidental.

R. Foreman Rates

Rates are no longer set for foremen. However, if a foreman performs journey level work, the foreman must be paid at least the journey level rate.

S. Proper Classification for Pipefitter and Laborer/Pipelayer Work on Water and Waste Water Treatment Plants

The proper classification for the following work is Pipefitter, when it is performed inside a building structure or performed at a location which will later be inside of a building: Joining steel pipe larger than 12 inches in diameter with bolted flange connections that has been pre-fabricated off site and does not require any modification such as cutting, grinding, welding, or other fabrication in order to be installed. All other work previously classified as pipefitter remains in that classification. The proper classification for that work when it is at a location that will always be outside a building is Pipelayer, which is under the Laborer Group 3 classification.

WAGE RATES

BOILERMAKERS

Wage	
\$33.17	

Duties Include:

Construct, assemble, maintain, and repair stationary steam boilers, boiler house auxiliaries, process vessels, pressure vessels and penstocks. Bulk storage tanks and bolted steel tanks.

Benefit

\$30.88

Travel: All Districts 0-120 mi. free zone >120 mi. federal mileage rate/mi.

Special Provision: Travel is paid only at the beginning and end of the job.

Per Diem: All Districts

0-70 mi. free zone >70-120 mi. \$65.00/day >120 mi. \$80.00/day

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BRICK, BLOCK, AND STONE MASONS

Wage	Benefit
\$35.28	\$15.69

Duties Include:

Lays out, lays, cuts, installs, and finishes all brick, structural tile, refractory materials, precast units, concrete, cinder, glass, gypsum, terra cotta block, and all other natural and artificial masonry products to construct or repair walls, partitions, stacks, furnaces, or other structures.

Sets stone to build stone structures such as piers, walls, and abutments, and lays walks, curbstones, or special types of masonry for vats, tanks, and floors. May set, cut, and dress ornamental and structural stone in buildings. This classification is tended by Tender to Masons Trades: Brick and Stonemason, Mortar Mixer, Hod Carrier

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CARPENTERS

Wage	
\$32.00	

Benefit \$13.57

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Travel: 0-20 mi. free zone >20-35 mi. \$30.00/day >35-55 mi. \$35.00/day >55 mi. \$77.00/day

Zone Pay: 0-30 mi. free zone >30-60 mi. base pay + \$4.00/hr. >60 mi. base pay + \$6.00/hr.

CEMENT MASONS AND CONCRETE FINISHERS

No Rate Established

Duties Include:

Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, or curbs. Align forms for sidewalks, curbs, or gutters.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 1

Wage	Benefit
\$28.21	\$13.65

This group includes but is not limited to:

Air Compressor; Auto Fine Grader; Belt Finishing; Boring Machine (Small); Cement Silo; Crane, A-Frame Truck Crane; Crusher Conveyor; DW-10, 15, and 20 Tractor Roller; Farm Tractor; Forklift; Form Grader; Front-End Loader, under 1 cu. vd; Oiler, Heavy Duty Drills; Herman Nelson Heater; Mucking Machine: Oiler, All Except Cranes/Shovels: Pumpman.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 2

Wage	Benefit
\$29.33	\$13.65

This group includes but is not limited to:

Air Doctor; Backhoe\Excavator\Shovel, up to and incl. 3 cu. yds; Bit Grinder; Bitunimous Paving Travel Plant; Boring Machine, Large; Broom, Self-Propelled; Concrete Travel Batcher: Concrete Float & Spreader: Concrete Bucket Dispatcher: Concrete Finish Machine: Concrete Conveyor: Distributor: Dozer, Rubber-Tired, Push, & Side Boom: Elevating Grader\Gradall; Field Equipment Serviceman; Front-End Loader, 1 cu. vd up to and incl. 5 cu. vds; Grade Setter; Heavy Duty Drills, All Types; Hoist\Tugger, All; Hydralift Forklifts & Similar; Industrial Locomotive; Motor Patrol (except finish); Mountain Skidder; Oiler, Cranes\Shovels; Pavement Breaker, EMSCO; Power Saw, Self-Propelled; Pugmill; Pumpcrete\Grout Machine; Punch Truck; Roller, other than Asphalt; Roller, Sheepsfoot (Self-Propelled); Roller, 25 tons and over; Ross Carrier; Rotomill, under 6 ft; Trenching Machine; Washing /Screening Plant

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Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$2.95/hr. >60 mi. base pay + \$4.75/hr.

Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.50/hr. >60 mi. base pay + \$5.50/hr.

Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.50/hr. >60 mi. base pay + \$5.50/hr.

CONSTRUCTION EQUIPMENT OPERATORS GROUP 3

Wage	Benefit
\$29.75	\$13.65

This group includes but is not limited to:

Asphalt Paving Machine; Asphalt Screed; Backhoe\Excavator\Shovel, over 3 cu. yds; Cableway Highline; Concrete Batch Plant; Concrete Curing Machine; Concrete Pump; Cranes, Creter; Cranes, Electric Overhead; Cranes, 24 tons and under; Curb Machine\Slip Form Paver; Finish Dozer; Front-End Loader, over 5 cu. yds; Mechanic\Welder; Pioneer Dozer; Roller Asphalt (Breakdown & Finish); Rotomill, over 6 ft; Scraper, Single, Twin, or Pulling Belly-Dump; YO-YO Cat.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 4

Wage \$30.75

Benefit \$13.65

This group includes but is not limited to:

Asphalt\Hot Plant Operator; Cranes, 25 tons up to and incl. 44 tons; Crusher Operator; Finish Motor Patrol; Finish Scraper.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 5

Wage \$31.75

This group includes but is not limited to: Cranes, 45 tons up to and incl. 74 tons.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 6

Wage \$32.75

Benefit \$13.65

Benefit

\$13.65

This group includes but is not limited to:

Cranes, 75 tons up to and incl. 149 tons; Cranes, Whirley (All).

Zone Pay: 0-30 mi. free zone >30-60 mi. base pay + \$3.50/hr. >60 mi. base pay + \$5.50/hr.

>30-60 mi. base pay + \$3.50/hr.

>60 mi. base pay + \$5.50/hr.

Zone Pay: 0-30 mi. free zone >30-60 mi. base pay + \$3.50/hr. >60 mi. base pay + \$5.50/hr.

Zone Pay:

0-30 mi. free zone

Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.50/hr. >60 mi. base pay + \$5.50/hr.

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CONSTRUCTION EQUIPMENT OPERATORS GROUP 7

 Wage
 Benefit

 \$33.75
 \$13.65

This group includes but is not limited to:

Cranes, 150 tons up to and incl. 250 tons; Cranes, over 250 tons—add \$1.00 for every 100 tons over 250 tons; Crane, Tower (AII); Crane Stiff-Leg or Derrick; Helicopter Hoist.

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Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.50/hr. >60 mi. base pay + \$5.50/hr.

CONSTRUCTION LABORERS GROUP 1/FLAG PERSON FOR TRAFFIC CONTROL

Wage	Benefit	Zone Pay:
\$23.08	\$11.27	0-30 mi. free zone
		>30-60 mi. base pay + \$3.05/hr.
		>60 mi. base pay + \$4.85/hr.

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CONSTRUCTION LABORERS GROUP 2

Wage	Benefit
\$25.90	\$11.27

This group includes but is not limited to:

General Labor; Asbestos Removal; Burning Bar; Bucket Man; Carpenter Tender; Caisson Worker; Cement Mason Tender; Cement Handler (dry); Chuck Tender; Choker Setter; Concrete Worker; Curb Machine-lay Down; Crusher and Batch Worker; Heater Tender; Fence Erector; Landscape Laborer; Landscaper; Lawn Sprinkler Installer; Pipe Wrapper; Pot Tender; Powderman Tender; Rail and Truck Loaders and Unloaders; Riprapper; Sign Erection; Guardrail and Jersey Rail; Spike Driver; Stake Jumper; Signalman; Tail Hoseman; Tool Checker and Houseman and Traffic Control Worker.

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Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.05/hr. >60 mi. base pay + \$4.85/hr.

CONSTRUCTION LABORERS GROUP 3

Wage	Benefit
\$26.04	\$11.40

This group includes but is not limited to:

Concrete Vibrator; Dumpman (Grademan); Equipment Handler; Geotextile and Liners; High-Pressure Nozzleman; Jackhammer (Pavement Breaker) Non-Riding Rollers; Pipelayer; Posthole Digger (Power); Power Driven Wheelbarrow; Rigger; Sandblaster; Sod Cutter-Power and Tamper.

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CONSTRUCTION LABORERS GROUP 4

 Wage
 Benefit

 \$26.76
 \$11.27

This group includes but is not limited to:

Hod Carrier***; Water Well Laborer; Blaster; Wagon Driller; Asphalt Raker; Cutting Torch; Grade Setter; High-Scaler; Power Saws (Faller & Concrete); Powderman; Rock & Core Drill; Track or Truck Mounted Wagon Drill and Welder incl. Air Arc

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DIVERS

	Wage	Benefit
Stand-By	\$43.06	\$17.36
Diving	\$86.12	\$17.36

Depth Pay (Surface Diving)		
0-20 ft.	free zone	
>20-100 ft.	\$2.00 per ft.	
>100-150 ft.	\$3.00 per ft.	
>150-220 ft.	\$4.00 per ft.	
>220 ft.	\$5.00 per ft.	

 Diving In Enclosures

 0-25 ft.
 free zone

 >25-300 ft.
 \$1.00 per ft.

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Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.05/hr. >60 mi. base pay + \$4.85/hr.

Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$3.05/hr. >60 mi. base pay + \$4.85/hr.

***Hod Carriers will receive the same amount of travel and/or subsistence pay as bricklayers when requested to travel.

Zone Pay: 0-30 mi. free zone >30-60 mi. base pay + \$4.00/hr. >60 mi. base pay + \$6.00/hr.

DIVER TENDERS

Zone Pay: Wage Benefit \$17.36 0-30 mi. free zone \$42.06 >30-60 mi. base pay + \$4.00/hr. >60 mi. base pay + \$6.00/hr.

The tender shall receive 2 hours at the straight time pay rate per shift for dressing and/or undressing a Diver when work is done under hyperbaric conditions.

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ELECTRICIANS

Wage \$34.59	Benefit \$16.33	Travel: District 4 No mileage due when traveling in employer's vehicle. The following travel allowance is applicable when traveling in employee's vehicle:
		0-18 mi. free zone >18-60 mi. federal mileage rate/mi. >60 mi. \$75.00/day

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INSULATION WORKERS - MECHANICAL (HEAT AND FROST)

	Wage	Benefit	Travel:
	\$38.87	\$19.87	0-30 mi. free zone
			>30-40 mi. \$25.00/day
Duties Inclu	ıde:		>40-50 mi. \$35.00/day
Insulate pipes, ductwork or other mechanical systems.		ther mechanical systems.	>50-60 mi. \$50.00/day
		-	>60 mi. \$60.00/day plus
			 \$0.56/mi. if transportation is not provided.
			 \$0.20/mi. if in company vehicle.
			>60 mi \$95.00/day on jobs requiring an overnight stay

>60 mi. \$95.00/day on jobs requiring an overnight stay plus

- \$0.56/mi. if transportation is not provided.
- \$0.20/mi. if in company vehicle. •

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IRONWORKERS - STRUCTURAL STEEL AND REBAR PLACERS

Wage \$29.15 Duties Include: Structural steel erection; asser buildings; cut, bend, tie, and pl windmill type towers; metal ble fabrication and ornamental ste	ace rebar; energy producing acher seating; handrail	Travel:0-45 mi. free zone>45-60 mi. \$45.00/day>60-100 mi. \$70.00/day>100 mi. \$90.00/daySpecial Provision:When the employer provides transportation, travel will not be paid. However, when an employee is required to travel over 70 miles one way, the employee may elect to receive the travel pay in lieu of the transportation.
LINE CONSTRUCTION - EQ	JIPMENT OPERATORS	
Wage \$34.94 Duties Include: All work on substations † Back to Table of Contents	Benefit \$16.41	Travel: No Free Zone \$60.00/day
LINE CONSTRUCTION - GR	OUNDMAN	
Wage \$27.36 Duties Include: All work on substations † Back to Table of Contents	Benefit \$15.79	Travel: No Free Zone \$60.00/day
LINE CONSTRUCTION - LINEMAN		

Duties Include: All work on substations

Wage \$45.74

Benefit

\$17.32

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Travel: No Free Zone \$60.00/day

MILLWRIGHTS

Wage	Benefit	Zone Pay:
\$36.97	\$14.02	0-30 mi. free zone
		>30-60 mi. base pay + \$4.00/hr.
		>60 mi. base pay + \$6.00/hr.

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PAINTERS

Wage	Benefit	Travel:
\$25.00	\$0.00	No travel or per diem established.

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PILE BUCKS

WageBenefit\$32.00\$13.57

Duties Include:

All pile driving, bridge, wharf, building, and caisson work, on both land and water. General pile driving work includes all labor employed in the barking, shoeing, splicing, form building, heading, centering, placing, driving, staying, framing, fastening, demo, tooling of the cutter head, Lagging, automatic pile threading, pulling, and/or cutting off of all piling, to include all pile of any make and material as well as similar pre-cast structural shapes or units the setting of which is performed with a pile driver, derrick, crane, or similar power equipment. Fabrication, forming, handling, and setting of all such pre-cast, pre-stressed and post- stressed shapes that are an integral part of any heavy structure, rafting, boring, reeving, dogging, or booming of piles or other material. This includes the unloading of piling of all types together with the wailing and bracing included.

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Zone Pay:

0-30 mi. free zone >30-60 mi. base pay + \$4.00/hr. >60 mi. base pay + \$6.00/hr.

PLUMBERS, PIPEFITTERS, AND STEAMFITTERS

Wage	
\$37.78	

Duties Include:

Assemble, install, alter, and repair pipe-lines or pipe systems that carry water, steam, air, other liquids or gases. Testing of piping systems, commissioning and retrocommissioning. Workers in this occupation may also install heating and cooling equipment and mechanical control systems.

Benefit

\$19.86

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SPRINKLER FITTERS

Wage	Benefit
\$34.45	\$23.00

Duties Include:

Duties Include but not limited to any and all fire protection systems: Installation, dismantling, inspection, testing, maintenance, repairs, adjustments, and corrections of all fire protection and fire control systems, including both overhead and underground water mains, all piping, fire hydrants, standpipes, air lines, tanks, and pumps used in connection with sprinkler and alarm systems.

Travel:

0-70 free zone >70 mi.

- On jobs when employees do not work consecutive days: \$0.55/mi. if employer doesn't provide transportation. Not to exceed two trips.
- On jobs when employees work any number of consecutive days: \$105.00/day.

Travel All Districts

The following travel allowance is applicable when traveling in employee's vehicle.

0-60 mi. free zone >60-80 mi. \$19.00/day >80-100 mi. \$29.00/day >100 mi. \$105.00/day.

Special Provision

When traveling >100 miles, mileage at \$0.54/mi. + \$8.59 for every 15 miles traveled at beginning and end of job.

The following travel allowance is applicable when traveling in employer's vehicle.

0-100 mi. free zone >100 mi. \$105.00/day

Special Provision

When traveling >100 miles, \$8.59 for every 15 miles traveled, at beginning and end of job.

Per Diem: All Districts

No per diem is applicable when traveling in employee's vehicle

The following per diem is applicable when traveling in employer's vehicle.

0-100 mi. free zone >100 mi. \$105.00/day

TRUCK DRIVERS

Pilot Car Driver	No Rate Established	
	Wage	Benefit
Truck Driver	\$31.28	\$9.37

Truck drivers include but are not limited to:

Combination Truck and Concrete Mixer and Transit Mixer; Dry Batch Trucks; Distributor Driver; Dumpman; Dump Trucks and similar equipment; Dumpster; Flat Trucks; Lumber Carriers; Lowboys; Pickup; Powder Truck Driver; Power Boom; Serviceman; Service Truck/Fuel Truck/Tireperson; Truck Mechanic; Trucks with Power Equipment; Warehouseman, Partsman, Cardex and Warehouse Expeditor; Water Trucks.

Zone Pay:

All Districts 0-30 mi. free zone >30-60 mi. base pay + \$3.05/hr. >60 mi. base pay + .\$4.85/hr.

Special Provision:

Zone pay only applies to the Truck Driver classification. No zone pay was established for Pilot Car Driver.

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SPECIAL PROVISIONS

MONTANA STATE HOSPITAL WASTEWATER TREATMENT IMPROVEMENTS SECTION 00 95 10 SPECIAL PROVISIONS

SP1. CONTRACT DOCUMENTS

The Project Drawings are included as Appendix A to the Project Specifications. The CONTRACTOR will be given three (3) copies of the Contract documents (plans and specifications). One set of Contract documents shall be used by the CONTRACTOR for "As Constructed" drawings. One set of Contract documents shall be the CONTRACTOR's executed copy of the Contract documents.

Additional copies of the Contract documents shall be made available to the CONTRACTOR at a cost of \$75 per set. The CONTRACTOR will be required to have a minimum of one set of plans and specifications at the project site at all times during construction.

SP2. PREBID EXPLORATION/SITE INFORMATION

All Bidders are strongly encouraged to visit the site of the work and conduct all field investigations at their disposal to become acquainted with the nature of the work. Written authorization shall be obtained from the OWNER, utilities, and others who may be directly affected prior to: entering the property; conduction field tests; drilling, boring, excavating, or test pumping. A pre-bid conference will be held, commencing at <u>10:00 A.M.</u> at the Montana State Hospital new Wastewater Treatment Site in Warm Springs on <u>February 3rd, 2021</u>. All bidders are encouraged to attend the pre-bid meeting.

SP3. DRAWINGS

The ENGINEER has identified, to the best of his knowledge, all major objects that may influence construction and has indicated them on the Drawings for bidding purposes only. Because of scale, possible additions, subsurface uncertainties, etc., the CONTRACTOR shall be responsible for verifying in the field the exact locations of objects that may influence his construction operations. The ENGINEER and OWNER shall in no way be held responsible for objects not located exactly as shown on the Drawings or for objects installed subsequent to preparation of the Drawings. Locations of water and sewer lines, services and other utilities are approximate and are not intended to be used as exact locations. The CONTRACTOR must obtain assistance from the appropriate entities in locating their respective utilities during construction.

SP4. GEOTECHNICAL INVESTIGATION

Geotechnical investigation work has been done for this Project. **Appendix C** of the contract documents contains the September 2020 <u>Montana State Hospital Wastewater Treatment Plan</u> <u>Geotechnical Report, Rev. 2</u> by Pioneer Technical Services. The soil investigations represent only the site conditions at each borehole and the investigations were conducted and should not be considered as a warranty that the conditions exist throughout the site. This data is provided strictly for informational purposes in an effort to provide the contractor with all available information. There is no guarantee that the soil and groundwater conditions portrayed in the study are descriptive of conditions within the general construction area or for any particular time of the year.

SP5. UNSCHEDULED EMPLOYMENT OF THE ENGINEER – LIQUIDATED DAMAGES

Liquidated damages for the unscheduled employment of the ENGINEER and/or Inspector will be assessed against the CONTRACTOR necessitated by the following:

- a. The CONTRACTOR working beyond the specified contract time.
- b. The CONTRACTOR working more than 8 hours per day, (or 40 hours per week if four ten hour shifts are worked) or on Saturdays, Sundays and federal holidays.
- c. The CONTRACTOR utilizing material, supplies, or equipment that requires the redesign of the project.
- d. The CONTRACTOR destroying or disturbing baselines, benchmarks or reference stakes.
- e. The failure of the CONTRACTOR to maintain acceptable as-built records.
- f. Re-submittal review due to the CONTRACTOR not supplying adequate or correct shop drawings, operation and maintenance manuals, and information on the first submittal.

Liquidated damages for the unscheduled employment of the ENGINEER and/or Inspector shall be determined based on the following hourly rates:

Project Manager	\$125.00/Hour
Project ENGINEER	\$110.00/Hour
Inspector	\$85.00/Hour
Mileage	\$ 0.60/Mile

Out of pocket expenses for materials, equipment, supplies, transportation, and subsistence shall be billed at cost plus ten percent. Liquidated damages for unscheduled employment of the ENGINEER and/or Inspector shall be deducted from monthly progress payments and the final payment as the damages are incurred.

The CONTRACTOR shall reimburse the OWNER for all costs incurred as a result of the CONTRACTOR's failure to complete the work within the time period specified in the Contract unless modified by a Change in Contract Time. The OWNER shall have one or more representatives observing the work at all times work is taking place. The CONTRACTOR shall reimburse the OWNER for the cost of engineers, architects, attorneys, construction field representatives, and other professionals that are incurred due to the CONTRACTOR's failure to complete the work within the Contract time period.

SP6. SAFETY

The CONTRACTOR shall be responsible for identifying and meeting all safety standards that are applicable to this project. The ENGINEER, the OWNER or any of their representatives or employees do not work in the capacity of overseeing or enforcing safety on the project. The CONTRACTOR shall hold harmless the OWNER and ENGINEER from any claims made as a result of the CONTRACTOR's responsibilities in this regard. Given the institutional nature of the project area, the maintenance of a safe working area will be a priority. <u>Please refer to the Montana State Hospital Requirements for Construction</u> <u>Contractors provided in these Special Provisions for more information regarding safety on the Hospital Campus.</u>

The CONTRACTOR is responsible for providing safe working conditions for all employees, sub-contractors, inspectors, engineers, OWNERS while on site. This includes providing any personal protection equipment being recommended/required by the Centers for Disease Control or the World Health Organization for work completed during the Coronavirus outbreak.

SP7. OFFICE AND TELEPHONE

The CONTRACTOR shall provide the mailing and street address of a local or main office where information related to the project can be delivered or mailed. All communications, drawings, instructions, and other articles will be delivered to the CONTRACTOR's local or main office as appropriate. Communications delivered to either location shall be deemed to have been delivered to the CONTRACTOR. Telephone numbers of the main office and project superintendent shall also be provided.

The CONTRACTOR shall maintain copies of record drawings, specifications, shop drawings, submittals, and all communications pertinent to the performance of the work at the field office and available for use at all times.

The CONTRACTOR will provide a suitable office and restroom facilities as required to support the project and needs of the project superintendent and the contractor's employees.

SP8. PROJECT RELATED CONTACTS

OWNER:	Montana State Hospital Contact: Raul Luciani Telephone: 406-693-7110
ENGINEER:	Anderson-Montgomery Consulting Engineers, Inc. 1064 N. Warren Helena, MT 59601 Contact Person: Adam Eckhart, P.E. Telephone: 406-449-3303

 Utilities:
 One Call Locators

 Telephone:
 800-424-5555

 Note – Some utilities are privately owned on the MSH Campus

SP9. VERIFICATION OF SIZES AND UNIT QUANTITIES

Sizes, locations and quantities noted in the bid documents are based on survey data, visual observation and other available data. Some changes in quantities may be expected during construction. The contractor will be responsible for documenting the actual quantities used and for ordering the correctly sized materials.

SP10. BUILDING CODES PERMITS

As required, the CONTRACTOR will be responsible for obtaining Construction Permits from Anaconda-Deer Lodge County and Building, Electrical, Mechanical and Plumbing Permits from the Building Codes Bureau, Montana Department of Labor and Industry. The CONTRACTOR shall be responsible for application fees and any costs to implement the permit. The Building Codes contact phone number is (406) 841-2333.

SP11. ENVIRONMENTAL SAMPLING

Contractor must make arrangements with Anaconda Deer Lodge County during excavation but before backfill to collect a soil sample. Contact Carl Nyman, Anaconda Deer Lodge County Superfund Coordinator at 406 563-7019 for information.

SP12. CONSTRUCTION STAKING

The Contractor shall provide construction staking from the Contractor's layouts and the Engineer's control points and coordinates. Contractor's construction staking shall include:

- 1. Line and grade @ 50' O.C. for piping installation.
- 2. Establish actual (field verify) irrigation and distribution piping elevation prior to ordering flushing and frost-free hydrants.
- 3. Building Centerline and foundation offsets at 10' o.c.

Prior to commencing work, the Contractor shall carefully compare and check all drawings, each with the other that in any way affects the location or elevation of the work to be executed by him, and should any discrepancy be found, he shall immediately report the same to the Engineer for verification and adjustment. Any duplication of work made necessary by failure or neglect on his part to comply with this function shall be done at Contractor's sole expense.

SP13. ENGINEERING, INSPECTIONS, AND TESTING

The Contractor's work will be periodically tested and observed to ensure compliance with the Contract Documents. Complete payment will not be made until the Contractor has

demonstrated that the work is complete and has been performed as required. If the Engineer detects a discrepancy between the work and the requirements of the Contract Documents at any time, up to and including final inspection, such work will not be completely paid for until the Contractor has corrected the deficiency.

The Engineer will periodically monitor the construction of work to determine if the work is being performed in accordance with the contract requirements. The Engineer does not have the authority or means to control the Contractor's methods of construction. It is, therefore, the Contractor's responsibility to utilize all methods, equipment, manpower, and other means necessary to assure that the work is installed in compliance with the Drawings and Specifications, and laws and regulations applicable to the work. Any discrepancies noted shall be brought to the Contractor's attention, who shall immediately correct the discrepancy. Failure of the Engineer to detect a discrepancy will not relieve the Contractor of his ultimate responsibility to perform the work as required.

The Contractor shall inspect the work as it is being performed. Any deviation from the Contract requirements shall be immediately corrected. Prior to any scheduled observation by the Engineer, the Contractor shall again inspect the work and certify to the Engineer that he has inspected the work and it meets the requirements of the Contract Documents. All buried work items shall be inspected by the Engineer prior to backfilling, or may not be considered for payment.

The work will be subject to review by the Owner, whose findings shall be as valid as those of the Engineer. The results of all such observations shall be directed to the Contractor through the Engineer.

<u>Testing Services Provided by the Contractor</u>. The Contractor shall provide the following services at no additional cost to the Owner:

- a. Any field surveys to establish locations, elevations, and alignments as stipulated on the Plans.
- b. Preparation and certification of all required shop drawings and submittals as described in the Supplementary Conditions.
- c. Tests as required by the Contract Documents which include, but are not limited to proctors, pressure tests, compaction tests, concrete testing, and leakage testing. All tests requiring the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing laboratory acceptable to the Engineer. The laboratory shall be staffed with experienced technicians properly equipped, and fully qualified to perform the tests in accordance with the specified standards.
- d. The Contractor shall provide the Engineer with a written schedule indicating dates for specific testing and inspection services to be performed. The

schedule shall be updated as required to give the Engineer at least one week's advance notice. The Contractor shall notify the Engineer immediately of any change or shall be subject to pay engineering fees as herein defined.

- e. Maintenance of project record drawings. The project record drawings shall be available for review by the Engineer and Owner at the construction progress meetings.
- f. The Contractor shall arrange for and pay for all tests required not specifically identified below as being performed by the Engineer.

<u>Testing Services Provided by the Owner.</u> The Owner shall provide the following services at no cost to the Contractor except as required for retests as defined in the Contract Documents.

a. The Engineer may spot check compaction of backfill, subbase and base course using Proctor information supplied by the Contractor. These tests are only to determine if the material is complying with the Contract Documents. It is the responsibility of the Contractor to ensure that this level of compaction is constant in all locations and provide the services of an independent tester to check compaction and provide results to the Engineer.

SP14. UNDERGROUND AND OVERHEAD UTILITIES

As noted on the Drawings, underground or overhead utilities are present in certain areas of the project. The CONTRACTOR will be required to locate, expose the utilities and/or stake them out of the trench while installing pipelines in these areas or coordinate the lines relocation prior to construction. There is no guarantee as to the accuracy and completeness of such information shown in the Contract documents and all responsibility for the accuracy and completeness thereof is expressly disclaimed. The CONTRACTOR shall be solely responsible for any damage to underground or overhead utilities due to his operations. The CONTRACTOR shall work closely with the utilities to ensure their criteria are met and no problems result.

All costs associated with construction around, near, under, and/or over underground and overhead utility lines as shown on the contract drawings shall be the responsibility of the CONTRACTOR and included incidental to identified bid payment items. The CONTRACTOR will not be paid specifically for underground utility crossings and parallel underground utilities and the cost of dealing with such shall be included in the total bid amount. The CONTRACTOR will assume full responsibility for any utility conflict cost and repair and to construct within restrictions outlined by the utility company.

All above-ground utilities may not be shown on the plans. It will be the CONTRACTOR's responsibility to field review the magnitude of construction conflict created by the overhead lines and bid this work accordingly. There is no separate pay item for overhead utility

conflicts. The CONTRACTOR will need to consider the cost associated with the overhead utilities as a subsidiary cost to the total amount bid.

At least 2 but not more than 10 business days before beginning any excavation, the CONTRACTOR shall according to MCA 69-4-501 notify all owners of underground facilities and coordinate the Work with the owners of such underground facilities. The information shown or indicated in the Contract documents with respect to existing underground facilities is based on information and data obtained from the owners of the facilities without field exploration, and as such, OWNER and ENGINEER are not responsible for the accuracy or completeness of such information or data.

SP15. LOCATION OF EXISTING WATER AND SEWER LINES

The location of the existing water and sewer lines in proximity to the new buried utilities is based on old record drawings. The CONTRACTOR will be required to locate the existing water and sewer mains through exploratory excavation at no additional cost to the project other than that allowed for exploratory work.

SP16. ASBESTOS PIPE

The project may require disconnection and reconnection of existing asbestos cement (Transite) water main to new piping originating from the distribution system. The project also may require disconnection and reconnection of existing asbestos cement (Transite) sanitary sewer originating from the existing collection system. Specific requirements as imposed by the Montana Department of Environmental Quality for working with and the inspection of asbestos materials must be satisfied by the contractor, generally requiring special certification. No additional costs for compensation to the contractor will be allowed for compliance with these requirements. John Benoit at MDEQ can be contacted at 444-5286 for more information regarding compliance with these requirements.

SP17. DEWATERING AND PUMPING OPERATIONS

Installation of the work scheduled under this project may require dewatering operations. Dewatering operations shall be adequate to assure the integrity of the finished project. It is the intent of these specifications that such draining, pumping and dewatering, and cleaning operations shall be the obligation of the Contractor. The Contractor shall provide all necessary piping, as required to remove all surface water, groundwater, leakage, and water from excavations. **No separate pay item is designated for dewatering.** This work will be considered subsidiary to other bid items. Adequate dewatering is defined as the work required to lower the natural groundwater 12" or more below the bottom of excavation in order to get a structurally stable subgrade. If the existing subgrade material is coarse rock and is naturally stable, the 12" depth will not be required. Laying and installing pipe in water will not be allowed.

Any discharge of water during pumping and dewatering operations will be subject to approval of the Montana Department of Environmental Quality. As needed, the

CONTRACTOR shall obtain a Construction Dewatering Discharge Permit and/or 318 Authorization from DEQ for discharging effluent from dewatering operations and written approval from the OWNER if discharge is to the sanitary sewer system. If necessary, the Contractor shall make application and secure the Montana Pollutant Discharge Elimination System Application For Authorization To Discharge Under The General Permit For Storm Water Associated With Construction Activity and associated Erosion Control Plan. The Contractor shall be responsible for application fee and any cost to implement the permit. The DEQ contact phone number is (406) 444-3080.

The Contractor shall be responsible for any damages caused to surrounding structures, land and physical features in the area. Contractor will restore any ground that had been eroded to its natural state.

Stabilization – Prior to any embankment/backfill work, subgrades shall be firm, dense, and thoroughly compacted and consolidated and shall be sufficiently stable for equipment or manpower to work. Soil material that has been removed because it is too wet to permit compaction may be stockpiled and removed or spread and allowed to dry. Processing of saturated material will not be directly paid for. If the Contractor chooses to import material in lieu of processing wet materials, Contractor will assume responsibility and expense to do such. Authorization for payable import stabilization will only be per direction of Engineer

SP18. WEATHER SHUTDOWN

While it is desired to complete the work as soon as possible, it is recognized that inclement weather may result in a request for a weather shutdown. The OWNER reserves the right to approve or disapprove any shutdown or extension requests. Should a shutdown be granted for unanticipated conditions, the CONTRACTOR shall provide for maintenance of adequate water supply, close all open excavations, provide for maintaining traffic and provide for protection of public property at the work site. The CONTRACTOR will not be allowed to perform any work during the shutdown period unless prior approval is granted by the OWNER.

SP19. WAGE RATES

State of Montana Prevailing Wage Rates shall be utilized on all work. The appropriate wage rates are included and shall be applied to this project. Contractor shall comply with all applicable wage laws. The Contractor shall maintain weekly payroll reports and have them available for review by the OWNER or ENGINEER, upon request. All required postings and sample forms will be supplied to the Contractor upon request.

SP20. WARRANTY

The CONTRACTOR shall warranty the project for at least one (1) year against defective materials and defective workmanship according to the General Conditions. The project shall not be accepted as substantially complete until <u>ALL</u> project segments are substantially

complete. Only one (1) notice of substantial completion and start of warranty will be issued for this project. Warranty period begins upon <u>final acceptance</u> of project.

An eleven (11) month project inspection will be held for the project one (1) year warranty period. The CONTRACTOR, OWNER and ENGINEER will be invited to attend. At the inspections, warranty items will be defined for correction according to the General Conditions.

SP21. CONTRACTOR EXPERIENCE/PERFORMANCE REQUIREMENTS

The Bidder may be required to demonstrate his ability and capability to meet the requirements herein stipulated to complete the project. Unless specifically stated elsewhere in these specifications, all CONTRACTORs, subcontractors, suppliers and equipment manufacturers shall submit written evidence within five (5) days of OWNER's request, prior to contract award the following:

- a. Certification that his/her company(ies) has/have specifically been in the business for products or services which he is bidding.
- b. Number of years in business.
- c. List of three (3) similar projects completed in the last five (5) years and references for those projects. Similar projects shall include construction of pumphouses or similar structures.
- d. Certification of a permanent place of business.
- e. Certification and description of adequate plant, staffing and equipment to do the work properly and expeditiously.
- f. Certification of suitable financial status to meet obligations incident to the work.
- g. Certification of appropriate technical experience.
- h. Certification that no just or proper claims are pending against former work performed.

No Bidder will be acceptable if he is engaged on any other work which impairs his ability to finance this contract. These requirements will also apply to all equipment and materials furnished for the project. The OWNER will use these items in determining the lowest responsible bid.

SP22. NOTICES

Except as noted below, the CONTRACTOR shall notify affected users and the OWNER in writing of service outages a minimum of 24 hours in advance of planned outages, including property access. Provide details such as phone number of project superintendent, date, and times for outage.

Notify the ENGINEER and the OWNER a minimum of 48 hours by telephone in advance of any planned utility outage longer than two hours. Any planned outage must be approved in advance by the OWNER or ENGINEER. Notify the ENGINEER 24 hours in advance of intended excavation or other construction activity. Notify the OWNER and ENGINEER as soon as possible of any unplanned outage, even if the outage is corrected immediately.

SP23. REMOVING, REPLACING AND RELOCATING EXTRANEOUS ITEMS

The CONTRACTOR may encounter culverts, fences, signs, ditches, sidewalks, curbs, gutters, barricades, etc. during construction that may hinder his operations. Whether on private or public property, the CONTRACTOR shall, at his own expense, remove, replace, and/or relocate these objects as necessary to conduct his operations. CONTRACTOR shall notify OWNER of such item prior to construction and coordinate with OWNER as to methodology required. Objects removed shall be replaced in as good a condition as previously existed, and to the satisfaction of the ENGINEER.

SP24. RESTORATION OF PROPERTY

All property affected by project construction shall be restored to the preexisting condition found prior to project construction. Damaged turf must be fine graded, topsoiled, seeded and protected against erosion. The technical specification for seeding further describes restoration requirements.

SP25. MATERIAL STORAGE SITES

If necessary, the CONTRACTOR shall secure a storage site for material storage on the campus, location to be at the direction of the Raul Luciani, Facilities Superintendent for the Montana State Hospital. Generally all construction waste materials will be required to be hauled off site to an approved solid waste disposal site.

SP26. PROVISION OF UTILITIES

Water for construction purposes can be provided by the OWNER, generally from hydrants. The Contractor shall be responsible to ensure that water supplies are not contaminated through use or cross connections.

SP27. PROVISION OF WATER OR SEWER SERVICE

Installation of project components and connection to existing mains may require isolation of the existing main and temporary removal of portions of the main from service. **Prior notice and approval** of water or sewer service shutdown will be required. Generally, service should not be off more than 4 hours, unless absolutely necessary.

SP28. STANDARD SPECIFICATIONS AND DRAWING

Where referenced here and elsewhere in the Contract documents, relevant portions of the Montana Public Works Standard Specifications 6th Edition, April 2010 are adopted by reference and become part of the contract documents. The Montana Public Works Standard Specifications Drawings, 6th Edition, April 2010, are included in these project documents by reference.

SP29. PROJECT SCHEDULE

Contract time for the project will begin from the Notice to Proceed and end December 31st, 2021. Time is of the essence on this project and schedules must be followed to complete construction in a timely manner. Specific project activities must sequentially occur to allow for proper installation and startup of the specified project improvements. Of note, the abandonment of the sanitary sewer and existing wastewater treatment facility will need to be coordinated with the startup of the new wastewater plant. The CONTRACTOR must submit a project schedule prior to beginning construction activities on-site with periodic updates as described in Division 1 of the Technical Specifications.

SP30. BID SCHEDULES AND AWARD

The project will be bid in one (1) base bid schedule and two (2) alternates for completion of the work. No other work will be bid at this time. Award will be based upon available funding and will be decided upon by the Owner in entirety. Award will be based on the following three (3) scenarios:

<u>SCENARIO 1</u>: Total Estimated Base Bid Price.

SCENARIO 2: Total Estimated Base Bid Price plus Alternate #1. **SCENARIO 3**: Total Estimated Base Bid Price plus Alternate #1 and Alternate #2.

The following is a description of the Alternatives:

Alternate #1:

- Non-potable water piping extension, including 3 frost free hydrants located on the lagoon dikes.
- Non-potable water irrigation stub-out.

Alternate #2:

- Landscaping: including the grass seeding around both buildings, the trees along the secondary highway and a non-potable water irrigation system to water the grass and tree areas.
- Asphalt access road and parking area to replace the base bid gravel access road and parking area.
- Two stage are compressor located in the blower/UV building.

SP31. SUBSTITUTIONS FOR SPECIFIED EQUIPMENT

A. The names of equipment and/or materials that are specifically identified herein by manufacturer's names, model, or catalog number are open for substitution after bid opening, but CONTRACTOR must demonstrate "or equal" performance and quality or else requests will be rejected. Manufacturers desiring approval shall submit catalog cuts, which define quality of product and ability to perform as the unit specified.

- B. CONTRACTOR shall be responsible for proper selection of proposed substitution and that said substitution is in conformance with the plans and specifications insofar as proper capacities, dimensions, or electrical requirements.
- C. Additional cost associated with the evaluation or incorporation of a proposed substitution necessitating redesign of project components will be the responsibility of the CONTRACTOR.

SP32. TRAFFIC PLAN

An approved Traffic Control Plan must be developed outlining procedures to be followed for maintaining typical and emergency traffic throughout the campus and along the secondary highway. The plan must be developed and approved prior to initiating work on the project. Appropriate project planning and scheduling should be utilized by the Contractor to keep impacts to the flow of traffic to a minimum. Traffic disruption on the secondary highway should be kept to a minimum.

SP33. NATURAL GAS & POWER EXTENSION

Cost associated with extending Natural Gas to the new Blower/UV Building for the new wastewater treatment facility will be outside the contract for the project. The Contractor will be responsible for coordinating with North Western Energy to schedule the extension of the Natural Gas to the new building.

The Contractor will be responsible for coordinating with North Western Energy to install underground conduit for 3-phase power extension. The extension shall originate at the substation located on the Montana State Hospital campus downstream from the Montana State Hospital's main meter. The Contractor will install the conduit from the substation to the new buildings as shown on the Contract Drawings. Northwestern Energy will install the wire in the conduit.

SP34. REBATE PROGRAM – NATIONAL CENTER FOR APPROPRIATE TECHNOLOGY

This project qualifies for the rebate program affiliated with the National Center for Appropriate Technology (NCFA) for energy efficient equipment in the project. The Owner will be submitting documentation to the NCFA for rebates associated with eligible equipment. The Contractor shall be supportive in providing the documentation required for each piece of equipment that is eligible for a rebate. Documentation that will be required includes submittals (cut sheets), invoices for each particular piece of equipment, and a statement that the piece of equipment has been installed. The following is a list of equipment that will require documentation: Lift station pump VFDs, blower VFD's, non-potable pumps, gas unit heater, and all electrical components. The following is an example of the invoice breakdown that will be required. Example: The blowers will require a total cost for the piece of equipment and a cost for the VFDs. The invoices can have the original manufacturer's price blacked out to protect the Contractor's markup pricing.

SP35. MONTANA STATE HOSPITAL – REQUIREMENTS FOR CONSTRUCTION CONTRACTORS

The following conditions apply to construction contractors performing work on the Montana State Hospital Campus at Warm Springs, MT.

- A. Construction Operations: Limited to areas noted on drawings.
- B. Arrange use of site and premises to allow:
 - Montana State Hospital 24 hour occupancy.
- C. The surrounding grounds within the campus will be occupied during the course of this project. The contractor shall conduct operations accordingly and take all necessary precautions to protect patients and staff from exposure to the dangers associated with the work. Coordination and cooperation with the staff of MSH is of the utmost importance.
 - 1. The speed limit within the campus is 15 miles per hour. Pedestrians always have the right of way.
 - 2. Watch for and be careful of all clients (patients) everywhere on campus.
 - 3. Do <u>not</u> give money, tobacco, candy, gum or any other items to anyone.
 - 4. Keep all vehicles locked at any time the occupants are not in the vehicle.
 - 5. Remove the keys from the ignition of equipment and vehicles not in use even if standing beside the vehicle. Vehicles and equipment shall not be parked where they will interrupt the flow of traffic or service access.
 - 6. The use of tobacco products of any type is not allowed on the Montana State Hospital campus. The campus is entirely tobacco free.
 - 7. All trucks backing up should have the assistance of a guide.
 - 8. Montana State Hospital will not be responsible for theft or damage of any items.
 - 9. Do not leave ladders standing unattended.
 - 10. When power tools are not in use they will be unplugged and other tools should be kept where clients cannot get to them.
 - 11. Exterior areas of work shall be fenced and interior areas of work shall be barricaded to restrict access to these areas by clients and staff.
 - 12. Work areas shall not be left in a hazardous condition during non-working hours.
 - 13. All rubbish, chemicals, hazardous materials, etc. are to be secured in a manner to prevent client access at all time.
 - 14. Temporary or mobile storage facilities of the contractor are to be secured at all times in a manner to prevent access by clients.
 - 15. The contractor shall take any and all precautions necessary to protect the existing buildings, furnishings and surrounding areas from damage.
 - 16. Dust control barriers must be set up during construction work or demolition in any occupied building.
 - 17. The contractor and employees are not to eat or have coffee in the Montana State Hospital dining areas.

- 18. Lists of all contractors/subs are to be given to Raul Luciani, Maintenance Manager 693-7110.
- D. Provide secure access to and from designated work area as required by law and per the requirements of Montana State Hospital:
 - 1. Emergency Building Exits during Construction: Keep all exits required by code open during construction period; Provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks or other public ways without permission.
- E. Existing building spaces may not be used for storage.
- F. Time Restrictions:
 - 1. Limit conduct of interior work to the hours of 8 am to 5 pm.
 - 2. Limit use of any loud equipment to 8 am to 7 pm.
- G. Utility Outages and Shutdown:
 - 1. Interruption of any utility services must be coordinated through the facility Director. This coordination is to allow the user and the clients' reasonable use of the existing facilities at all times during normal working hours and interfere minimally with the user's and clients' activities.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days' notice to Montana State Hospital and authorities having jurisdiction.
 - 3. Do not disrupt or shut down utility services without 7 days' notice to Montana State Hospital and authorities having jurisdiction.
 - 4. Prevent accidental disruption of utility services to other facilities.
- H. Emergency: in case of emergency call <u>406-693-7440</u>. This phone is our emergency phone and usually is answered on the first ring.
 - In case of a <u>Medical emergency</u> Anaconda Community Hospital (406-563-8500) is 15 miles away. Call 911 for ambulance. The MSH does have physicians on campus that can help triage the situation until the ambulance arrives. Please call 406-683-7440.
 - 2. In case of **Fire** please call 406-693-7440, the campus is not in the Deer Lodge Fire District, we are under contract with the Opportunity Volunteer Fire Department for immediate response.

END OF SECTION

TECHNICAL SPECIFICATIONS

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01 11 00 SUMMARY OF WORK

PART 1 - GENERAL

1.01 PROJECT

- A. Project Name: Montana State Hospital Upgrade Wastewater System
- B. Owner's Name: Montana State Hospital, State of Montana
- C. Project Design Team:
 - Anderson-Montgomery Consulting Engineers, Inc. 1064 N. Warren St. Helena, MT 59601
 - DCI Engineers (Structural Engineering) 131 West Main Missoula, MT 59802 (406) 721-7315
 - Kingdom Builders Engineering, Inc. (Electrical Engineering) P.O. Box 8694 Kalispell, MT 59904 (406) 212-1624
- D. The Project consists of the following major project elements to be conducted at the new wastewater treatment plant site and outfall to the receiving stream in Warm Springs, Montana:
 - 1. Screen/Lift Station:
 - a. 695 ft² Screen Building with separate screen room and control room;
 - b. Spiral screen, washer/compactor with level-sensing and controls;
 - c. Manual bar screen in separate (bypass) influent channel;
 - d. Dual submersible pump lift station wetwell & valve pit, level sensing & controls;
 - e. Magnetic influent flow meter;
 - f. Refrigerated influent composite sampler;
 - g. HVAC, electrical, NPW & potable service;
 - 2. 3-Cell Aerated Treatment Lagoon System:
 - a. 146'x133' (10' deep with 3' freeboard) membrane lined, complete mix, aerated Cell #1;
 - b. 239'x133' (10' deep with 3' freeboard) membrane lined, partially mixed aerated Cell #2;

SUMMARY OF WORK

- c. 248'x133' (10' deep with 3' freeboard) membrane lined, partially mixed aerated Cell #3;
- d. Insulated floating modular covers for all three treatment cells;
- e. Steel aeration headers/PE laterals/throttling butterfly valves;
- f. Double High rate and low rate diffuser assemblies;
- g. Interpond structures, control plug valves, telescoping level control valves, discharge aprons
- 3. Nitrification Reactor:
 - a. 30'Lx15'Wx13.5'D concrete reactor basin with center wall;
 - b. Eight nitrification reactor modules;
 - c. Aeration piping and diffusers;
 - d. Influent/effluent piping
- 4. Disinfection/Aeration:
 - a. 1,250 ft² Blower/UV Building;
 - b. Two Hybrid blowers with VFD's;
 - c. UV disinfection channel with 1 bank; 2 modules; 4 lamps/module; automatic wiper with air compressor; UV intensity sensing; control panel;
 - d. Dual vertical centrifugal pump non-potable water system and piping;
 - e. Refrigerated effluent composite sampler;
 - f. HVAC, electrical, NPW & potable service;
 - g. Bathroom with lavatory and floor sink
- 5. Site Work
 - a. Sanitary sewer extension;
 - b. Potable water extension;
 - c. Site landscaping;
 - d. Gravel access road;
 - e. Plant security fencing;
 - f. New plant outfall line
- 6. Alternate #1
 - a. Non-potable water extension including 3 frost free hydrants located on the lagoon dikes
 - b. Non-potable water irrigation stub-out
- 7. Alternate #2

SUMMARY OF WORK

- a. Site landscaping including: grass seeding around both buildings, trees along the secondary highway, and a non-potable water irrigation system to water the grass and tree areas.
- b. Asphalt access road and parking area to replace the base bid gravel access road and parking area.
- c. Air compressor located in the blower/UV building.
- 1.02 TYPE OF CONTRACT
 - A. Contract Type: A single prime contract based on a Stipulated Price as described in this Document.
- 1.03 OWNER OCCUPANCY
 - A. Cooperate with the Owner to minimize interference with the operation of existing wastewater conveyance/treatment infrastructure due to demolition and construction activities. It is acknowledged that construction progress will generally take precedence. Coordinate with the Owner and their operations at all times.
- 1.04 CONTRACTOR USE OF SITE AND PREMISES
 - A. The Contractor shall conduct operations and take all necessary precautions to protect staff from exposure to dangers associated with the Work.
 - B. Provide secure access to and from designated work area as required by law and per the requirements of the Owner, noting that the Montana State Hospital has special restrictions for working on Campus that must be observed (See Special Provisions):
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
 - C. Existing building spaces may not be used for storage unless specifically authorized by the Owner.
 - D. Time Restrictions:
 - 1. Limit conduct of especially noisy and dusty exterior work to the hours of 8 am to 7 pm or as described in Special Provisions.
 - E. Utility Outages and Shutdown:
 - 1. Interruption of any utility services must be coordinated through the MSH Maintenance Director. This coordination is to allow the reasonable use of the existing facilities at all times during normal working hours and interfere minimally with the Owner's operational activities.
 - 2. Do not disrupt or shut down utility services without 7 days notice to the MSH and authorities having jurisdiction.

3. Prevent accidental disruption of utility services to other facilities.

1.05 WORK SEQUENCE

1. The Contractor will closely coordinate with the Owner and Engineer before conducting any work that impacts existing facilities. Work sequence and schedule shall be described by the Contractor and reviewed by the Engineer.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 11 00

SECTION 01 26 00 CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for administrative requirements.
 - 2. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.03 VARIATIONS IN WORK

A. Engineer will issue a Field Order authorizing variations in Work, not involving adjustment of the Contract Sum or the Contract Time.

1.04 PROPOSAL REQUESTS

- A. Owner-initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Engineer are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in the Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicated applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Engineer.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.05 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, the Engineer will issue a Change Order for signatures of Owner and Contractor.
- B. Change Order Form shall be in accordance with Section 00 63 63 of these Specifications

1.06 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive on EJCDC Document C-940 form see Section 00 63 49 of these specifications. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
- B. Work change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- C. Documentation: The Contractor shall maintain detailed records on a time and material basis for work required by the Work Change Directive.
- D. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 29 00 PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Format and Preparation of Applications.
 - 2. Schedule of Values
 - 3. Submittal Procedures.
 - 4. Substantiating Data.
- B. Related Sections include:
 - 1. General Conditions as provided in Contract Forms section of Contract Documents.
 - 2. Section 01 26 00 Contract Modification Procedures.
 - 3. Section 01 33 00 Submittal Procedures.
 - 4. Section 01 77 00 Closeout Procedures.
- 1.02 FORMAT AND PREPARATION OF APPLICATIONS
 - A. Utilize: Periodic Estimate for Partial Payment, Form 101 as provided in Contract Forms section of Contract Documents.
 - B. Preparation
 - 1. Present required information in typewritten form.
 - 2. Execute certification by signature of authorized officer.
 - 3. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored Products.
 - 4. List each authorized Change Order as an extension on Continuation Sheet, listing Change Order number and dollar amount as for an original item of Work.
 - 5. Prepare Application for Final Payment as specified in Section 01 77 00.

1.03 SCHEDULE OF VALUES

- A. Submit:
 - 1. Typed schedule of values in format similar to Periodic Estimate for Partial Payment, Form 101. The schedule of values shall be derived directly from the Bid Items included in the Bid Proposal included in the Project Documents.
 - 2. In duplicate within 15 days after date of Owner-Contractor Agreement.
 - 3. See Article 9.2 of the General Conditions.

- B. Format:
 - 1. Utilize a spreadsheet format referencing items in the Bid Proposal, suitable for insertion into the Partial Pay Estimate.
 - 2. Identify line items corresponding with number and title of Specification Section.
 - 3. Provide sufficient information regarding means of measurement of quantities or progress completed for verification by Engineer.
- C. Identify site mobilization including bonds and insurance separately. Payment for Mobilization, Bonds and Insurance is limited to 10% or less of the Total Bid Amount. Payment for mobilization will be based on the percentage of the original contract amount in place as described in the following schedule:

Percentage of Original	Percentage of Lump Sum
Contract Amount In-Place	Price for Mobilization Earned
5	20
10	50
25	60
65	75
90	90
100	100

- D. Payment: Payment for MOBILIZATON will be made on the percentage of the contract unit price bid per lump sum as indicated in the Bid Form.
 - 1. Include within each line item a direct proportional amount of Contractor's overhead and profit.
- E. Revise Schedule of Values to list approved Change Orders, and submit with each Application for Payment.

1.04 PROGRESS PAYMENTS

A. See Article 9 of the General conditions

1.05 SUBMITTAL PROCEDURES

- A. Submittals
 - 1. Five (5) copies of each Application for Payment or arrangements for electronic submittal of Payment Application documents can be made.
 - 2. Updated construction schedule with each Application for Payment.
 - 3. Payroll records as required.
 - 4. Payment Periods: As stipulated in the Agreement.
 - 5. Submit with transmittal letter as specified for Submittals in Section 01 33 00.
 - 6. Administrative actions which must precede or coincide with submittal of final application for payment include:

- a. Submit lien waivers, warranties and bonds, and project record documents with final application for payment.
- b. Completion of all work not included in substantial completion as defined in General and Supplementary Conditions.
- c. Completion of project closeout procedures as indicated in Section 01 77 00.
- d. Removal of temporary facilities and services.
- e. Removal of surplus materials, rubbish, or similar elements.
- f. Final cleaning.
- g. Transmittal of project construction record documents to Owner and Engineer.
- h. Consent of surety for final payment.

1.06 SUBSTANTIATING DATA

- A. When Engineer requires substantiating information, submit data justifying dollar amounts in question.
- B. Provide one (1) copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
- C. Provide copies of invoice(s) for payment of materials stored on-site. Payment will not be made for materials that are not stored on-site or within a bonded warehouse that has been approved by Engineer and Owner.
- D. Contractor shall supply substantiating information in compliance with federal and state requirements for monthly utilization reports and weekly prevailing wage and labor rates for laborers on-site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this section.
- 1.02 SUMMARY
 - A. This Section specifies administrative provisions for coordination construction operations on Project including, but not limited to, the following:
 - 1. Preconstruction Conference.
 - 2. General project coordination procedures.
 - 3. Conservation.
 - 4. Coordination Drawings.
 - 5. Administrative and supervisory personnel.
 - 6. Project meetings.
 - B. Related Sections include the following:
 - 1. Division 1 Section 01 70 00 Execution Requirements for procedure for coordinating general installation and field-engineering service, including establishment of benchmarks and control points.
 - 2. Division 1 Section 01 77 00 Closeout Procedures- for coordinating Contract Closeout.
 - 3. Division 1 Section 01 32 00 Construction Progress Documentation for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.03 COORDINATION

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different specification divisions and sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.

- B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner, Engineer and separate contractors if coordination of their work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Installation and removal of temporary facilities and controls.
 - 3. Delivery and processing of submittals.
 - 4. Progress meetings.
 - 5. Preconstruction conferences.
 - 6. Project closeout activities.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and minerals.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.
 - a. All materials salvaged in the project shall become the property of the Owner unless otherwise specified. Material identified as salvage shall be delivered by the Contractor to a suitable storage location as directed by the Engineer.
- 1.04 SUBMITTALS
 - A. Staff Names: At the preconstruction conference submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office and mobile telephone numbers by which Contractor's representatives can be reached immediately. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
 - 1. Post copies of the contact list in temporary field office and by each temporary telephone.
- 1.05 ADMINISTRATIVE AND SUPERVISORY PERSONNEL
 - A. In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.
- 1.06 PROJECT MEETINGS
 - A. General: Schedule and conduct meetings and conferences at Project site, unless

otherwise indicated.

- 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times.
- 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
- 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.
- B. Preconstruction Conference: Engineer and Owner will schedule a preconstruction conference at the Project site or other convenient location. The meeting shall be conducted by the Engineer who shall review work responsibilities and personnel assignments.
 - 1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and his superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
 - 2. Contractor shall bring a written, detailed construction schedule to the preconstruction conference.
 - 3. Agenda: The Owner, Engineer and Contractor shall discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing.
 - d. Designation of responsible personnel.
 - e. Subcontractor list.
 - f. Testing Responsibilities.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises.
 - m. Responsibility for temporary facilities and controls.
 - n. Office, work, and storage areas.

- o. Delivery and storage of materials and equipment.
- p. Security.
- q. Progress and restoration.
- r. Working hours.
- s. Specific County regulations.
- t. Montana DEQ requirements.
- u. Specific MSH requirements.
- C. Progress Meetings: Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests.
 - 1. Attendees: In addition to representatives of the Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Review and correct or approve minutes of previous progress meetings. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Review present and future needs of each entity present, including the following:
 - i. Interface requirements.
 - ii. Sequence of operations.
 - iii. Status of submittals.
 - iv. Deliveries.
 - v. Off-site fabrications.
 - vi. Access.
 - vii. Site utilization.
 - viii. Temporary facilities and controls.
 - ix. Work hours.
 - x. Hazards and risks.

- xi. Progress, restoration and cleanup.
- xii. Quality and work standards.
- xiii. Change Orders.
- xiv. Documentation of information for payment requests.
- 3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - a. Schedule Updating: As needed revise Contractor's construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including, but not limited to, the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Daily construction reports.
 - B. Related Sections include the following:
 - 1. Division 1 Section 01 29 00 Payment Procedures for submitting the Schedule of Values.
 - 2. Division 1 Section 01 31 00 Project Management & Coordination for submitting and distributing meeting and conference minutes.
 - 3. Division 1 Section 01 33 00 Submittals for submitting schedules and reports.
 - 4. Division 1 Section 01 40 00 Quality Requirements for submitting a schedule of tests and inspections.
 - 5. Division 1 Section 01 77 00 Closeout Procedures for submitting digital photographic documentation as part of the Project Record Documents at Project closeout.
- 1.03 DEFINITIONS
 - A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path. They must start and finish on the planned start and finish times.
 - 2. Predecessor activity is an activity that must be completed before a given activity can be started.
 - B. Event: The starting or ending point of an activity.

- C. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- D. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- E. Milestone: A key or critical point in time for reference or measurement.
- F. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.04 SUBMITTALS

- A. Qualification Data: For firms and persons specified in Section 01 40 00 Quality Requirements to demonstrate their capabilities and experience. Include lists of completed project names and addressed, names and address of Engineers and Owners, and other information specified.
- B. Preliminary Construction Schedule: Submit two printed copies: one a single sheet of reproducible media, and one print.
- C. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.
- D. Daily Construction Reports: Submit two copies at monthly intervals.

1.05 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an earlier or later completion date. Contract time can only be authorized through the formal Change Order process. See Section 01 26 00 and Standard General Conditions Article 9.07.
 - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrications, and delivery.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittals" in schedule. Coordinate submittal review times in contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include time for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
- B. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final completion.

2.02 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule at the preconstruction conference.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for construction.
- 2.03 REPORTS

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE UPDATING

- A. At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

- 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, order, actual starts and finishes, and activity durations.
- 3. As the Work progresses, indicate actual completion percentage for each activity.

3.02 CONTRACTOR'S CONSTRUCTION SCHEDULE DISTRIBUTION

- A. Distribute copies of approved schedule to Engineer, Owner, separate testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This Section includes administrative and procedural requirements for submitting shop drawings, Product Data, and other miscellaneous submittals.
- 1.03 DEFINITIONS
 - A. Action Submittals: Written and graphic information that requires Engineer's responsive action.
 - B. Informational Submittals: Written information that does not require Engineer's approval. Submittals may be rejected for not complying with requirements.
- 1.04 SUBMITTAL PROCEDURES
 - A. General: If needed, electronic copies of CAD Drawings of the Contract Drawings will be provided by Engineer for Seller's use in preparing submittals. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, deliver, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
 - B. Submittals shall clearly indicate what product is being submitted and what specification and section the submittal is applicable to. Each submittal shall contain a single piece of equipment being submitted unless grouping of similar items has been approved by the reviewing engineer.
 - C. Submittals Schedule: Comply with requirements in Section 01 32 00 Construction Progress Documentation for list of submittals and time requirements for scheduled performance of related construction activities.
 - D. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal.

- 1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with Engineer's review of subsequent submittals. Engineer will advise Seller when a submittal being processed must be delayed to permit coordination with subsequent submittals. Engineer will advise Seller when a submittal being processed must be delayed for coordination.
- 2. Allow 15 days for processing each resubmittal.
- 3. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit review and processing.
- E. Identification: Place a permanent label or title block on each submittal for identification.
 - 1. Indicate name of firm or entity that prepared each submittal on label or title block.
 - 2. Provide a blank second page to record Prime Contractor's review and approval markings and action taken by Engineer.
 - 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Engineer.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Unique identifier, including revision number.
 - i. Number and title of appropriate Specification Section.
- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.
- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Engineer will discard submittals received from sources other than Contractor.
 - 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer on previous submittal, and *deviations from requirement* of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.

- 2. Include certification stating that information submitted complies with requirements of the Contract Documents.
- 3. Transmittal Form: Provide locations on form for the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Submittal and transmittal distribution record.
 - i. Remarks.
 - j. Signature of transmitter.
- I. Distribution: Furnish copies of submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals with mark indicating action taken by Engineer in connection with construction.

PART 2 - PRODUCTS

2.01 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Number of Copies: Submit four (4) hard copies and one electronic copy (bearing the Contractor's legal signature) of each action submittal, unless otherwise indicated. Engineer will return two hard copies. Contractor will mark up and retain one returned copy as a Project Record Document.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.

- b. Manufacturer's product specifications.
- c. Manufacturer's installation instructions.
- d. Standard color charts.
- e. Manufacturer's catalog cuts.
- f. Wiring diagrams showing factory-installed wiring.
- g. Printed performance curves.
- h. Operational range diagrams.
- i. Mill reports.
- j. Standard product operation and maintenance manuals.
- k. Compliance with recognized trade association standards.
- 1. Compliance with recognized testing agency standards.
- m. Application of testing agency labels and seals.
- n. Notation of coordination requirements.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Compliance with specified standards.
 - k. Notation of coordination requirements.
 - 1. Notation of dimensions established by field measurement.
 - 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

- 3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 inches by 11 inches but no larger than 30 by 40 inches.
- D. Coordination Drawings: Comply with requirements in Section 01 31 00 Project Management and Coordination.
- E. Contractor's Construction Schedule: Comply with requirements in Section 01 32 00 Construction Progress Documentation for Construction Manager's action.
- F. Submittals Schedule: Comply with requirements in Section 01 32 00 Construction Progress Documentation."
- G. Application for Payment: Comply with requirements in Section 01 29 00 Payment Procedures.
- H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specifications Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

2.02 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specifications Sections.
 - 1. Number of Copies: submit two (2) hard copies and one electronic copy of each informational submittal, unless otherwise indicated. Engineer will not return copies.
 - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - 3. Test and Inspection Reports: Comply with requirements in 01 40 00 Quality Requirements.
- B. Contractor's Construction Schedule: Comply with requirements in Section 01 32 00 Construction Progress Documentation.
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addressed, names and addresses of Engineers and Owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

- E. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
- F. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- G. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- H. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- I. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
- J. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product.
- K. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- L. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- M. Maintenance Data: Prepare written and graphic instructions and procedure for operation and normal maintenance of products and equipment. Comply with requirements in Section 01 77 00 - Closeout Procedures.
- N. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculation. Include page numbers.
- O. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guideline, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
 - 1. Preparation of substrates.
 - 2. Required substrate tolerance.

- 3. Sequence of installation or erection.
- 4. Required installation tolerance.
- 5. Required adjustments.
- 6. Recommendations for cleaning and protection.
- P. Manufacturer's Field Reports: Prepare written information documenting factoryauthorized service representative's tests and inspections. Include the following, as applicable:
 - 1. Name, address, and telephone number of factory-authorized service representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products and installation will affect warranty.
 - 7. Other required items indicated in individual Specification Sections.
- Q. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance and bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amount of deductibles, if any, and term of the coverage.
- R. Material Safety Data Sheets: Submit information directly to Owner. If submitted to Engineer, Engineer will not review this information but will return it with not action taken.

PART 3 - EXECUTION

3.01 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Seller's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
- 3.02 ENGINEER'S ACTION
 - A. General: Engineer will not review submittals that do not bear Seller's approval stamp and will return them without action.

- B. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicated action taken, as follows:
 - 1. No Exceptions Noted.
 - 2. Exceptions Noted
 - 3. Returned for Correction.
- C. Informational Submittals: Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01 33 00

SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor and/or Equipment Supplier of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's qualitycontrol procedures that facilitate compliance with the Contract Documents requirements.
 - 3. Requirements for Contractor/Supplier to provide quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Section 01 32 00 Construction Progress Documentation for developing a schedule of required tests and inspections.
 - 2. Divisions 2 through 16 Technical Sections for specific test and inspection requirements.

1.03 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.
- C. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.04 SUBMITTALS

- A. Qualification Data: For testing agencies specified in Section 01 40 00 Quality Requirements to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Ambient conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and re-inspecting.
- C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
- 1.05 QUALITY ASSURANCE
 - A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
 - B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
 - C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project,

whose work has resulted in construction with a record of successful in-service performance.

- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in those types of tests and inspections to be performed.
- F. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.06 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency or Engineer to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to the Contractor.
- B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

- 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
- 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
- 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- 6. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- 7. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- C. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 - 5. Do not perform any duties of Contractor.
- D. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field-curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

- 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- E. Coordination: Coordinate sequence of activities to accommodate required qualityassurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Owner-Provided Temporary Utilities.
 - B. Contractor-Provided Temporary Utilities.
 - C. Security requirements.
 - D. Vehicular access and parking.
 - E. Waste removal facilities and services.
 - F. Field offices.

1.02 OWNER PROVIDED TEMPORARY UTILITIES

- A. Owner will provide the following:
 - 1. Water supply (from hydrant), consisting of connection to Owner's existing water infrastructure. Any damage due to making or maintaining this connection shall be completely repair with no cost to the Owner.
 - 2. The contractor will be expected to use Owner provided utilities in a conservative manner.
- B. Contractor shall use trigger-operated nozzles for water hoses, to avoid waste of water.

1.03 CONTRACTOR-PROVIDED TEMPORARY UTILITIES

- A. Temporary Electrical Services, as required.
- B. Telecommunications Services
 - 1. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization, as needed.
- C. Temporary Sanitary Facilities
 - 1. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
 - 2. Maintain daily in clean and sanitary condition.
- D. Barriers
 - 1. Provide barriers to prevent unauthorized entry to demolition areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from demolition operations.
 - 2. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

- E. Fencing to be provided as directed by the Engineer to maintain security of the construction site.
- 1.04 SECURITY
 - A. Coordinate with Owner's security program.
- 1.05 VEHICULAR ACCESS AND PARKING
 - A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
 - B. Coordinate access and haul routes with governing authorities and Owner.
 - C. Provide and maintain access to fire hydrants, free of obstructions.
 - D. Provide means of removing mud from vehicle wheels before entering streets.
 - E. Designated existing on-site roads may be used for construction traffic. Coordinate with Construction Manager and MSH on-site representative.
 - F. Provide temporary parking areas to accommodate Contractor personnel.
- 1.06 WASTE REMOVAL
 - A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
 - B. Provide containers with lids. Remove trash from site at regular intervals..
 - C. If materials to be recycled or must be stored on-site, provide suitable non-combustible storage areas unless otherwise approved by the authorities having jurisdiction.
- 1.07 FIELD OFFICES (as needed)
 - A. Office: Weathertight, with lighting, electrical outlets, heating, ventilating equipment, and equipped with sturdy furniture.
 - B. Locate offices a minimum distance of 30 feet from existing structures.
- 1.08 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
 - A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.
 - B. Clean and repair damage caused by installation or use of temporary work.
 - C. Restore existing facilities used during construction to original condition.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION 01 50 00

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project: product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include, but are not limited to, the following:
 - 1. Section 01 77 00 Closeout Procedures for submitting warranties for contract closeout.
 - 2. Divisions 2 through 16 for specific requirements for warranties on products and installation specified to be warranted.

1.03 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of dated of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are no considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specifications: Where a specific manufacturer's product is named including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorse by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- F. Reference herein to the name "Contractor" will be considered the same as the name "seller".
- 1.04 SUBMITTALS
 - A. Substitution Request: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addressed and names and addresses of Engineers and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - i. Cost information, including a proposal of change, if any, in the Contract Sum.
 - j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

- k. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
- 2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Engineer cannot make a decision on use of a proposed substitution within time allocated.
- B. Basis-of-Design Product Specifications Submittal: Comply with requirements in Division 1 Section "Submittal Procedures" Show compliance with requirements.
- C. Contractor will be responsible for any project redesign and/or construction costs that may become necessary as a result of the product substitution.
- 1.05 QUALITY ASSURANCE
 - A. Compatibility of Options: If Contractor is given option of selecting between two more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
- 1.06 PRODUCT DELIVERY, STORAGE AND HANDLING
 - A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss including theft. Comply with manufacturer's written instructions.
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products to allow for inspection and measurement of quantity or counting of units.
 - 6. Store materials in a manner that will not endanger Project structure.
 - 7. Store products that are subject to damage by the elements, under cover in a watertight enclosure above ground, with ventilation adequate to prevent condensation.

- 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- 9. Protect stored products from damage.

1.07 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 33 00 Submittal Procedure and Section 01 77 00 Closeout Procedures.

PART 2 - PRODUCTS

2.01 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or "or approved," comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures: Procedures for product selection include the following:
 - 1. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered unless otherwise indicated.
 - 2. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.

2.02 PRODUCT SUBSTITUTIONS

- A. Timing: Engineer will consider requests for substitution if received within 30 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Engineer.
- B. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
 - 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducing additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2. Requested substitution does not require extensive revisions to the Contract Documents.
 - 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4. Substitution request is fully documented and properly submitted.
 - 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 - 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - 7. Requested substitution is compatible with other portions of the Work.
 - 8. Requested substitution has been coordinated with other portions of the Work.
 - 9. Requested substitution provides specified warranty.

2.03 COMPARABLE PRODUCTS

- A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
 - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents;
 - 2. That it is consistent with the Contract Documents and will produce the indicted results, and that it is compatible with other portions of the Work.
 - 3. Detailed comparison of significant qualities of proposed product with those named n the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - 4. Evidence that proposed product provides specified warranty.

- 5. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
- 6. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 60 00

SECTION 01 70 00 EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections include, but are not limited to, the following:
 - 1. Section 01 31 00 Project Management and Coordination for procedures for coordinating field engineering with other construction activities.
 - 2. Section 01 33 00 Submittal Procedures for submitting surveys.
 - 3. Section 01 77 00 Closeout Procedures for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
- 1.03 SUBMITTALS
 - A. Qualification Data: As required, land surveyors must demonstrate their capabilities and experience. Include lists of completed projects with project names and addressed, names and addresses of Engineers and Owners, and other information specified.
- 1.04 QUALITY ASSURANCE
 - A. Land Surveyor Qualifications; A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services is necessary for all required legal surveys.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- 3.02 PREPARATION
 - A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocated existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
 - B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of propose utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
 - C. Field Measurements: Take field measurements as required to locate and execute the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - D. Space Requirements: Verify space requirements and dimensions of items shown on Drawings.
 - E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.
- 3.03 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.
- B. General: As required, engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Check the location, level and plumb, of every major element as the Work progresses.
 - 5. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
 - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities in the surveying discipline.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.04 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocated existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

- 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
- 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.05 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do no use tools or equipment that produces harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
- G. Hazardous Materials: Use products, cleaners and installation materials that are not considered hazardous.

3.06 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of material lawfully.
 - 1. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- F. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortars, oils, putty, and similar materials.
 - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original Condition.
- G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.07 STARTING AND ADJUSTING
 - A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
 - B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
 - C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualifications requirements in Division 1 Section "Quality Requirements."

3.08 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

3.09 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction.
 - 1. Repair includes replacing defective parts, refinishing damaged surfaces, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION 01 70 00

SECTION 01 77 00 CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Closeout Procedures
 - 2. Substantial Completion
 - 3. Final Completion
 - 4. Certificate of Occupancy
 - 5. Final Cleaning
 - 6. Project Record Documents
 - 7. Spare parts and Maintenance Products
 - 8. Warranties and Bonds
 - 9. Maintenance Service
- B. Related Sections include:
 - 1. Section 01 31 00 Project Management & Coordination.
 - 2. Section 01 50 00 Temporary Facilities and Controls.
 - 3. Section 01 78 23 Operation and Maintenance Data.
- 1.02 CLOSEOUT PROCEDURES
 - A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
 - B. Provide submittals to Engineer that are required by governing or other authorities.
 - C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
 - D. Owner will occupy all portions of the Project.

1.03 SUBSTANTIAL COMPLETION

- A. Prior to substantial completion Contractor shall review Contract Documents for items which are not complete or need to yet be completed including submittal of all manuals, and testing reports. Contractor shall make a list of incomplete work, a value of the incomplete work, and reasons why work is incomplete. Contractor shall complete all items required to be completed as part of substantial completion.
- B. Contractor shall provide a written notice to Engineer that the work, or specific portions of the work, is substantially complete and ready for review. If there are any items remaining to

be corrected or completed Contractor shall submit a list of these items along with the notice of substantial completion. Along with the list of items the Contractor should provide a written explanation of why these items are not considered necessary for substantial completion.

- C. Upon receipt of Contractor's notice of substantial completion, Engineer will proceed with inspection for substantial completion.
- D. Following the substantial completion inspection by the Engineer and Engineer's subconsultants, Engineer will either prepare certificate of substantial completion, or notify the Contractor in writing that substantial completion has not been meant listing the various reasons.
- E. Contractor shall promptly complete the items required to meet substantial completion and submit a second notice of substantial completion to the Engineer.
- F. Engineer will review the work a second time do determine the status of substantial completion.
- G. When Engineer considers the project to be substantially complete, Engineer will prepare the preliminary certificate of substantial completion along with a substantial completion punch list of items to be completed prior to final payment. Engineer will deliver preliminary certificate and punch list to Owner and consider any objections by the Owner as provided in the Conditions of the Contract.
- H. Upon agreement by Owner and Engineer of substantial completion and punch list items, Engineer will execute and deliver to the Contractor and Owner a final certificate of substantial completion along with substantial completion punch list of items to be completed prior to final payment.
- I. A maximum of two (2) reviews of substantially complete work will be completed by Engineer and Engineer's subconsultants for any one portion of work under the Contract. Should a third or subsequent reviews be necessary the following requirements will be met:
 - 1. Owner will compensate Engineer for additional reviews.
 - 2. Owner will deduct the amount of compensation paid to the Engineer for additional reviews from the payment to the Contractor.
 - 3. Compensation shall be at Engineer's standard hourly rates plus actual cost of reimbursables.

1.04 FINAL COMPLETION

- A. Following substantial completion Contractor shall complete remaining work and items to be corrected as part of substantial completion punch list as well as final cleaning and transferring site to Owner.
- B. When Contractor considers that all work is complete, Contractor shall provide written notice of final completion to Engineer.
- C. Following receipt of final completion certification, Engineer and Engineer's subconsultants shall review the work to verity that the requirements for final completion have been met.

- D. Upon review of work for final completion Engineer will either request the Contractor to make closeout submittals or will notify Contractor that the work is not complete with a list of incomplete or defective work.
- E. Contractor shall promptly take steps to correct all listed deficiencies and incomplete work before sending a second written notice of final completion certification to Engineer.
- F. If final completion was not met following first review, Engineer will review work a second time to determine if the requirements for final completion have been met.
- G. A maximum of two (2) reviews of final complete work will be completed by Engineer and Engineer's subconsultants for any one portion of work under the Contract. Should a third or subsequent reviews be necessary the following requirements will be met:
 - 1. Owner will compensate Engineer for additional reviews.
 - 2. Owner will deduct the amount of compensation paid to the Engineer for additional reviews from the payment to the Contractor.
 - 3. Compensation shall be at Engineer's standard hourly rates plus actual cost of reimbursables.
- H. When Engineer considers all work to be complete in accordance with the Contract Documents, Engineer shall request the Contractor to make closeout submittals.
- 1.05 CERTIFICATE OF OCCUPANCY
 - A. In accordance with State Building Codes, when WORK is complete and ready for occupancy, CONTRACTOR shall contact local building official and request a final building code review for the purposes of obtaining a Certificate of Occupancy for the new Water Treatment Plant.
 - B. CONTRACTOR shall, in accordance with Supplementary Conditions submit copy of Certificate of Occupancy with final Application for Payment.
- 1.06 FINAL CLEANING
 - A. Execute final cleaning prior to final project assessment.
 - B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains, and foreign substances, polish transparent and glossy surfaces, mop all floors.
 - C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
 - D. Replace filters of operating equipment.
 - E. Clean debris from roofs, gutters, downspouts, and drainage systems.
 - F. Clean site; sweep paved areas, rake clean landscaped surfaces.
 - G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.07 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling current and future reference by Owner and Engineer.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Provide GPS survey during construction for horizontal and vertical locations of all underground piping and utilities at fittings, valves, building connections, pull boxes, junction boxes, manholes, and other appurtenances.
 - 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 5. Field changes of dimension and detail.
 - 6. Details not on original Contract drawings.
- G. Submit documents to Engineer with claim for final Application for Payment.
- 1.08 SPARE PARTS AND MAINTENANCE PRODUCTS
 - A. Provide spare parts, maintenance, and extra Products in quantities specified in individual specification sections.
 - B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.09 WARRANTIES AND BONDS

- A. Provide duplicate notarized copies.
- B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in D size three ring binders with durable plastic cover.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance.
- 1.10 MAINTENANCE SERVICE
 - A. Furnish service and maintenance of components during the warranty period.
 - B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
 - C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
 - D. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

1.11 FINAL ADJUSTMENT OF ACCOUNTS

- A. Contractor shall submit a final statement of accounting to Engineer. Statement shall reflect all adjustments to the contract sum and include the following:
 - 1. Original contract sum.
 - 2. Additions and deductions resulting from:
 - a. All previous change orders
 - b. Allowances
 - c. Unit prices
 - d. Deductions for uncorrected work
 - e. Penalties and bonuses
 - f. Deductions for liquidated damages
 - g. Deductions for multiple reviews
 - h. Other adjustments
 - 3. Total contract sum as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.

B. Engineer will prepare a final change order, reflecting approved adjustments to the contract sum which were not previously made by change orders.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 77 00

SECTION 01 78 23 OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Quality Assurance.
 - 2. Format.
 - 3. Contents of Each Volume.
 - 4. Manual for Equipment and Systems.
 - 5. Instruction of Owner's personnel.
 - 6. Submittals.
 - 7. Asset Management Submittals.
 - 8. Schedule of Submittals.
- B. Related Sections include:
 - 1. Section 01 33 00 Submittal Procedures.
 - 2. Section 01 40 00 Quality Requirements.
 - 3. Section 01 77 00 Closeout Procedures.
- 1.02 QUALITY ASSURANCE
 - A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- 1.03 FORMAT
 - A. Prepare data in the form of an instructional manual. Arrange data in numerical format in accordance with the Specification Divisions.
 - 1. Binders:
 - a. Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers.
 - b. 2 inch maximum ring size.
 - c. When multiple binders are used, correlate data into related consistent groupings.
 - 2. Cover; Identify:
 - a. Each binder with typed title OPERATION AND MAINTENANCE INSTRUCTIONS.
 - b. Title of Project.

- c. Subject matter of contents.
- d. Volume number.
- e. Year of construction.
- 3. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- B. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- C. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages. Folded paper should be unfoldable without removal from binder.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Materials testing reports (compaction, concrete, pipe leakage, etc.).
 - c. Certificates.
 - d. Photocopies of warranties.
 - e. Bonds.

1.04 CONTENTS OF EACH VOLUME

- A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- F. Warranties: Prepare and submit per Section 01 77 00.
- G. Bonds: Prepare and submit per Section 01 77 00.

1.05 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed. Refer to applicable Division 16 specification Sections.
- C. Include color coded wiring diagrams as installed. Refer to applicable Division 26 specification Sections.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage, and local sources of supply.
- N. Additional Requirements: As specified in individual Product specification sections.
- O. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

- P. Electronic Copies: Compact discs (CD) OR USB drives shall be provided with all manuals in electronic format in a portable document format (*.pdf). The documents shall be placed as required under the appropriate tabs and labels as previously required for the compact disk. Each file shall be adequately labeled to identify the contents without requiring the document to be opened. Additionally all files shall be named consistently and in a uniform system for cataloguing files.
- 1.06 INSTRUCTION OF OWNER PERSONNEL
 - A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
 - B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
 - C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
 - D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.
- 1.07 SUBMITTALS
 - A. Submit electronic copy of preliminary draft or proposed formats and outlines of contents before Substantial Completion. Engineer will review draft and return one copy with comments.
 - B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
 - C. Submit electronic copies of completed volumes fifteen (15) working days prior to final inspection. One (1) copy will be returned after final inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.
 - D. Submit four (4) sets of revised final volumes in final form within ten (10) days after final inspection.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

DIVISION 2

EXISTING CONDITIONS, SITEWORK

SECTION 02 41 00 SITE DEMOLITION, DISPOSAL & SALVAGE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section. <u>Site demolition will include existing sewerage piping and manholes. No</u> <u>buildings are scheduled to be demolished</u>.

1.02 SUMMARY

- A. This Section includes the following (where applicable):
 - 1. Removal and disposal of all construction indicated on the plans or specified in these documents.
 - 2. Removal and disposal of paving, curbing, sidewalks, driveways, crosswalks, utility structures, piping, below grade foundations, improvements to avoid conflict with new construction, disconnection, capping and removal of utilities no longer in use, pollution control during demolition including noise control and removal and legal disposal of materials.
- B. Related Sections include the following:
 - 1. Division 1 Section "Payment Procedures" for a schedule of unit prices.
 - 2. Division 32 Section "Landscaping" for finish grading, including placing and preparing topsoil for lawns and plantings.
 - 3. Division 31 Section "Earthwork" for excavation and embankment, site stripping, grubbing, removing topsoil, and protecting trees to remain.

1.03 SUBMITTALS

- A. Schedule: Submit schedule indicating proposed methods and sequence of operations for selective demolition work to Engineer for review prior to commencement of work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.
- B. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
- C. Coordinate with Owner's continuing occupation of portions of existing building, and with Owner's reduced usage of any portion thereof.
- D. Submit project record documents under provisions of Section 01 77 00.

1.04 REGULATORY REQUIREMENTS

A. Conform to all applicable codes for worker safety, confined space entry, dust

control, and water and sludge discharges and disposal.

- B. Obtain required permits from authorities.
- C. Notify affected utility companies before starting Work and comply with applicable requirements.
- D. Do not close or obstruct roadways except as permitted by Owner. Do not close or obstruct egress width to exits without prior written permission of Owner.
- E. Do not disrupt or compromise effectiveness of WWTF operations without written permission of Owner.
- F. Conform to procedures applicable if hazardous materials or situations discovered.
- 1.05 PROJECT CONDITIONS
 - A. Dust Control: The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the site or building and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding, and pollution.
 - B. Protection of Existing Work: Before beginning any cutting or demolition work, the Contractor shall carefully survey the existing facilities and examine the plans and specifications to determine the extent of the work. The Contractor shall take all necessary precautions to ensure against damage to existing facilities to remain in place, to be reused, or to remain the property of the Owner, and any damage to such work shall be repaired or replaced as approved by the Engineer at no additional cost to the Owner. The Contractor shall carefully coordinate the work of this section with all other work and construct and maintain shoring, bracing and supports, as required.
 - C. Protection of Buildings from the Weather: The interior of buildings and all materials and equipment shall be protected from the weather at all times.
 - D. Protection of Trees: Trees which might be damaged during demolition and which are indicated to be left in place shall be protected. Any tree designated to remain that is damaged during the Work under this contract shall be replaced.
 - E. Burning: The use of burning at the project site for the disposal of refuse and debris will not be permitted.
 - F. Occupancy: Owner will be continuously occupying areas of the building immediately adjacent to areas of selective demolition. Conduct selective demolition work in manner that will minimize need for disruption of Owner's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities which will severely impact Owner's normal operations.
 - G. Condition of Structures: Owner assumes no responsibility for actual condition of items to be demolished.

- 1. Conditions existing at time of commencement of contract will be maintained by Owner insofar as practicable. However, variations may occur by Owner's removal and salvage operations prior to start of selective demolition work.
- H. Partial Demolition and Removal: Materials of marketable value that are removed in accordance with the provisions of the Project, but that are not to be possessed by the Owner, shall become the property of the Contractor and shall be removed from the right-of-way. Transport salvaged items from site as they are removed.
 - 1. Storage or sale of removed items on site will not be permitted.
- I. Protections: Provide temporary barricades and other forms of protection as required to protect Owner's personnel and general public from injury due to selective demolition work.
 - 1. Confine Work and stockpiling to within Owner's property or easement as approved by Engineer. Leave undisturbed all street and utility appurtenances not indicated for removal or renovation.
 - 2. Provide protective measures as required to provide free and safe passage of Owner's personnel and general public to and from occupied portions of buildings.
 - 3. Provide interior and exterior shoring, bracing, or support to prevent movement, settlement, or collapse of element to be demolished, and adjacent facilities or work to remain.
 - 4. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
 - 5. Protect floors with suitable covering when necessary.
 - 6. Construct temporary insulated solid dustproof partitions where required to separate areas where noisy or extensive dirt or dust operations are performed. Equip partitions with dustproof doors and security locks if required.
 - 7. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces, and installation of new construction to insure that no water leakage or damage occurs.
 - 8. Maintain, during operation and at completion, pavement removal areas in such condition that they will be well drained at all times.
 - 9. Protect and maintain survey monuments or any construction staking from disturbance during pavement removal.
- J. Damages: Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.
- K. Explosives: Use of explosives will not be permitted.
- L. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

M. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities as acceptable to governing authorities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

- 3.01 INSPECTION
 - A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from selective demolition work; file with Owner's Representative prior to starting work.

3.02 PREPARATION

- A. Become familiar with required lines of removal and saw cutting.
- B. Identify underground utilities.
- C. Provide, erect, and maintain adequate barriers and warning lights.
- D. Keep streets, sidewalks, and driveways in usable condition; avoid property owner inconvenience insofar as practicable; do not trespass on private property.
- E. Verify traffic control in place prior to commencement of pavement removal.
- F. Inspect and record existing conditions onsite and at adjacent areas prior to starting construction. Commencement of this Section's Work means acceptance of existing conditions.

3.03 PAVING REMOVAL

- A. Saw cutting may be required on concrete and asphalt pavements. Pavement removal beyond the limits established in the notes on the Drawings shall be replaced at the Contractor's expense.
- B. Saw cut vertically; remove on straight lines approximately parallel or perpendicular to centerline of pavement.
- C. Saw cut vertically full depth to obtain a clean break. After saw cutting, use pneumatic jackhammer or similar device prior to breaking out pavement.
- D. Break out remainder of pavement.
- E. Disturbances, breakage, or damage to areas not designated for removal shall be restored at Contractor's expense prior to making final payment.
- F. Leave underlying sub-base material in a condition suitable for traffic if construction sequence involves delays and if local situation requires access by the public.

- G. Pavement removed beyond the limits established shall be replaced to the same specifications as the adjacent removal at Contractor's expense.
- 3.04 TOLERANCES
 - A. Saw cut full depth to achieve a clean break.
 - B. If line of removal falls within 2 feet of an existing joint, adjust line of removal to be the existing joint.
 - C. Remove entire width of sidewalk if removal width is less than sidewalk width.
- 3.05 DEMOLITION
 - A. General: Remove and legally dispose of paving, curbing, sidewalks, driveways, crosswalks, utility structures, piping, below grade foundations, improvements to avoid conflict with new construction, disconnection, and capping and removal of utilities no longer in use.
 - 1. Demolition of existing structures and piping shall only commence after provisions are made to ensure continuing existing utility services.
 - B. Structures: Existing structures indicated shall be completely removed to two feet below grade. The excavations shall be backfilled and final graded in accordance with other sections of these specifications.
 - C. Pavement: Cut, remove and dispose of existing pavement to the lines indicated on the plans or as directed by Engineer. Make straight and an approximately vertical cut of edges along which new pavement is to be placed.
 - D. Driveways and Sidewalks: Remove and dispose of existing concrete
 - E. Piping: Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the plans, the Engineer shall be notified. Buried piping may be left in place provided that exposed pipe ends are plugged.
 - 1. Pipes shall be plugged with a low slump concrete the entire diameter of the pipe to a minimum depth of 18 inches.
 - F. Driveways and Sidewalks: Remove and dispose of existing concrete driveways and/or sidewalks which interfere with construction of improvements or which do not match new grade as shown on the contract documents or as directed by Engineer.
 - 1. Remove to a distance of 8 inches behind curbs, or to greater distance if required to properly match the new curb and gutter grade.
 - 2. Saw cut along a neat line to a depth of at least 25 percent of the concrete thickness and take care in removing the concrete assuring the slab breaks on the sawed neat line.
 - G. Filling: Excavations and other hazardous openings shall be filled in accordance with appropriate sections of these specifications.

- 3.06 DISPOSAL
 - A. General: Upon completion of demolition, all debris shall be disposed of in a legal manner, and the site shall be fine graded to the prevailing adjacent grades and contours.
- 3.07 SALVAGE
 - A. Title to Materials: Title to all materials and equipment to be demolished, excepting Owner salvage and historical items, is vested in the Contractor upon receipt of Notice to Proceed. The Owner will not be responsible for the condition, loss or damage to such property after Notice to Proceed.
 - B. Material for Contractor Salvage: Material for salvage shall be stored as approved by the Engineer. Salvage materials shall be removed from Owner's property before completion of the contract. Material for salvage shall not be sold on the site. Salvage material may not be reused in the project without written approval of the Engineer.
 - C. Unsalvageable Materials: Materials, other than those permitted to remain in place, shall be disposed of in a legal manner. On-site disposal will not be allowed.

END OF SECTION 02 41 00

DIVISION 3

CONCRETE & GROUT

SECTION 03 10 00 CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.
 - B. Related Requirements:
 - 1. Section 32 13 13 "Concrete Paving" for formwork related to concrete pavement and walks.
- 1.03 DEFINITIONS
 - A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
 - B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.
- 1.04 PREINSTALLATION MEETINGS
 - A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.05 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Void forms.

- 4. Form ties.
- 5. Waterstops.
- 6. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301 and ACI 350.5 when not indicated in Drawings.
 - a. Location of construction joints is subject to approval of the Engineer.
 - 3. Indicate location of waterstops.
 - 4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Waterstops, Joint Fillers, Joint Sealers, Backing Rods, and Bond Breaker:
 - 1. Certified mill certificates showing that the material meets all of the requirements specified here-in. The Engineer, at their option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by the Owner. If any materials should fail to meet these Specifications, all costs for further testing of the replacement materials shall be borne by the Contractor.
- C. Minutes of preinstallation conference.
- 1.07 QUALITY ASSURANCE
 - A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- 1.08 DELIVERY, STORAGE, AND HANDLING
 - A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- 1.09 OBSTRUCTIONS
 - A. Contractor shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor, wall and roof sections can be expected under temperature or other conditions.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 and ACI 350.5, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-tocenter spacing of supports.
 - 3. Forms for circular structures shall conform to the circular shape of the structure.
 - 4. Do not use earth cuts as forms for vertical or sloping surfaces unless required or permitted in drawings.
 - 5. Formwork shall be essentially watertight and shall prevent loss of mortar from concrete. Seal all joints or gaps with an acceptable material.

2.02 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.
 - 3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA HDO (high-density overlay).
 - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
 - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
 - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
 - c. Do not use form-facing materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of concrete surfaces.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 - 1. Provide lumber dressed on at least two edges and one side for tight fit.

- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.
 - 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.03 WATERSTOPS

- A. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. JP Specialties, Inc.
 - b. Sika Corporation.
 - 2. Profile: Ribbed without center bulb.
 - 3. Dimensions: 6 inches by 3/8 inch thick; nontapered.
- B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Sika Corporation.
 - b. Or approved equal.
 - 2. Profile: As indicated.
 - 3. Dimensions: As indicated; nontapered.
- C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Sika Corporation.
 - b. Or approved equal.

2.04 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

- B. Chamfer Strips: Smooth wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Rustication Strips: Smooth wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1-1/2 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes at least 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls.

PART 3 - EXECUTION

- 3.01 INSTALLATION OF FORMWORK
 - A. Comply with ACI 301 and ACI 350.5.
 - B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
 - C. Limit concrete surface irregularities as follows:
 - 1. Environmental Surface Finish-1.0 (ESF-1.0): 1 inch
 - a. No formwork facing material is specified
 - b. Patch voids greater than 1-1/2 in. wide or 1/4 in. deep
 - c. Remove projections greater than 1/2 in.
 - d. Tie holes needed to be patched
 - e. Surface tolerance Class C (ACI 117)
 - f. Leave surfaces with the texture imparted by the forms
 - g. Mockup not required
 - 2. Environmental Surface Finish-2.0 (EFS-2.0): 1/4 inch
 - a. Patch voids greater than 3/4 in. wide or 1/4 in.

- b. Remove projections greater than 1/4 in.
- c. Patch tie holes
- d. Surface tolerance Class B (ACI 117)
- e. Mockup not required
- 3. Environmental Surface Finish-3.0 (ESF-3.0): 1/8 inch
 - a. Patch voids greater than 3/4 in. wide or 1/4" deep
 - b. Remove projections greater than 1/8 in.
 - c. Patch tie holes
 - d. Surface tolerance Class A (ACI 117)
 - e. Provide mockup of concrete surface appearance and texture
- D. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.
 - a. For ESF 3.0 surfaces, set the facing materials in an orderly and symmetrical arrangement, and keep the number of seams to a practical minimum. Facing materials shall be supported with studs or other backing capable of maintaining deflection with the tolerances specified in Part 1. Fit adjacent panels with tight joints.
 - 3. Taper form ties shall be placed with the larger end on the side of the structure that will be in contact with liquid.
 - a. Seal tie holes in formwork to prevent leakage where ties penetrate the formwork.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.

- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Engineer prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams and slabs in the middle third of spans, unless indicated otherwise in plans.
 - 5. Locate horizontal joints in walls at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls as indicated on Drawings.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Clean embedded items immediately prior to concrete placement.
 - 5. Fill voids in inserts to prevent entry of concrete.
 - 6. Coat surfaces of aluminum embedments to prevent reaction with the concrete.

3.03 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 03 30 00 "Cast-In-Place Concrete."
 - 4. Secure waterstops in correct position at 12 inches on center in such a manner that bending over one way or another is prevented.
 - a. Vertical waterstops shall be anchored back to the reinforcement with wire ties or by other acceptable means.
 - b. For flexible waterstops placed horizontally, the waterstop shall be folded upward along its entire length while concrete is placed and consolidated up to the level of the waterstop, and then the waterstop shall be pressed into the top of of the fresh concrete. Then complete concrete placement and consolidation so as to provide full encasement of the water stop in concrete.
 - 5. Waterstops at vertical joints shall terminate 3 in. below the tops of exposed walls.
 - 6. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.

- c. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop, and shall be watertight.
- 7. Clean waterstops immediately prior to placement of concrete.
- 8. Waterstops with a center bulb shall have the ends of the center bulb plugged with a flexible material, such as foam rubber, to prevent concrete intrusion at ends where the bulb will be exposed to concrete extrusions.
- 9. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed waterstops during progress of the Work.
- 3.04 REMOVING AND REUSING FORMS
 - A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70% of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 - B. Clean and repair surfaces of forms to be reused in the Work.
 - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 - 2. Apply new form-release agent.
 - C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 - 1. Align and secure joints to avoid offsets.
 - 2. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.
- 3.05 SHORING AND RESHORING INSTALLATION
 - A. Comply with ACI 350 and ACI 301 for design, installation, and removal of shoring and reshoring.

- 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- 3.06 FIELD QUALITY CONTROL
 - A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Inspections:
 - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed, and for compliance within tolerances specified in ACI 117.
 - 2. Waterstops:
 - a. It is required that all waterstop field joints shall be subject to rigid inspection, and no such work shall be scheduled or started without having made prior arrangements with the ENGINEER to provide for the required inspections. Not less than 24 hours' notice shall be provided to the ENGINEER for scheduling such inspections. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the CONTRACTOR at its own expense.
 - b. The following waterstop defects represent a partial list of defects which shall be grounds for rejection.
 - 1) Offsets at joints greater than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
 - 2) Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
 - 3) Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.
 - 4) Misalignment of joint which result in misalignment of the waterstop in excess of ½-inch in 10 feet.
 - 5) Porosity in the welded joint as evidenced by visual inspection.
 - 6) Bubbles or inadequate bonding which can be detected with a pen knife test. (If, while prodding the entire joint with the point of a pen

knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

- 3. Waterstop Samples:
 - a. Field samples of fabricated fittings (crosses, tees, etc.) may be selected at random by the ENGINEER at their discretion, for testing by a laboratory at the OWNER'S expense. When tested, they shall have a tensile strength across the joints equal to at least 75 percent of the manufacturer's reported tensile strength of the product. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this contract.

END OF SECTION 03 10 00

SECTION 03 11 15 CORROSION-RESISTANT MANHOLE LINER

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The objective of this specification is to cover the supply and installation of a vacuum formed semi-rigid liner for use in wastewater and light industrial concrete structures to effectively shield the interior of the structure from corrosion.
- B. The design of the liner system shall insure that it will conform to the contour of the structure and form a permanent mechanical bond to the concrete through use of preformed horizontal ribs and dovetails. The liner shall be incorporated into the manhole during casting.
- C. The liner will be formed in such a manner that the joints between the structure sections will be afforded protection through the use of a continuous PVC return into the joint for a minimum of .50 of an inch.
- D. Provisions will be made to allow the pipe penetrations to be sealed by applying a cementitious corrosion resistant material to the unlined exposed areas within the openings. The cementitious material shall be manufactured and installed per the liner manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MATERIAL

- A. Liner shall be Dura Plate 100 as manufactured by A-LOK[®] Products, Incorporated, Tullytown, Pennsylvania.
- B. Liner Composition The liner, channel joints, H-joints and corner joints shall be manufactured from an Acrylic PVC Alloy.
 - 1. All sheet compound will result in a semi-rigid material suitable for thermoforming to the contour of the structure and shall maintain a minimum wall thick- ness of .065 inches.
- C. Rubber Joint Composition The fabricated liner panels shall be joined together by a slotted strip of EPDM rubber according to the manufacturer's specification.
- D. Butyl Joint Composition Sections of lined concrete structures shall be joined together by an approved butyl strip (A-LOK[®] Products, Inc. Tullytown, PA. MT-329) designed to produce sufficient squeeze-out between PVC returns.
- E. All EPDM and Butyl joint compound shall be formulated to meet the chemical resistant properties.

2.02 PHYSICAL PROPERTIES

- A. General All materials shall meet the physical and chemical resistant properties specified in the following appropriate section.
 - 1. Physical Properties All semi- rigid liner sheets, joint assembly components, corner and weld strips shall have the following properties when tested at 77 degrees +/- 5 degrees Fahrenheit.
 - 2. Antifungal and Antibacterial Properties Dura Plate 100 Liner shall be made from Acrylic PVC Alloy sheets that resist bacteriological and fungal development. Sheet shall not readily provide a source of nutrients for bacteria and fungi. Plasticizers that allow a source of nutrients which support microbial growth for bacterial or fungal growth shall not be permitted.
 - 3. Sheet shall be subjected to fungus resistance testing in accordance with ASTM G-21 and bacteria resistance testing in accordance with ASTM G-22, Procedure B.
- B. Fungus Resistance Testing, ASTM G-21: Eighteen day cultures of the following pure culture fungi were harvested, washed and their spore counts adjusted to 1,000.000 (±200,000 per ml).

Organism	ATCC Number
Aspergillus niger	9642
Penicillium pinophilum	11797
Gliocladium virans	9645
Aureobasidum pullulans	15233
Chaetomium globosum	6205

- 1. The spore suspensions were combined and sprayed on the samples and controls which were placed on mineral salts agar and placed in the test chamber.
- 2. The samples, along with controls were incubated for 28 days and examined weekly.

Sample Designation			Obser (Ratir	vations 1g*)
Thermoplastic	7	14	21	28
Sheet:	Days	Days	Days	Days
#1 #2 #3 #4 Controls:	0 0 0 0	0 0 0 0	$\begin{array}{c} 0\\ 0\\ 0\\ 0\\ 0 \end{array}$	0 0 0 0
Filter Paper Glass Slides	4 0	4 0	4 0	4 0

*Rating: 0=no growth. 1=traces, 2=light, 3=moderate, 4=heavy growth

C. Bacteria Resistance Testing, ASTM G-22: Conclusion of Fungus Resistance Testing: The sheet samples did not allow any fungus growth (rating of 0).

A twenty-four hour culture of Pseudomonas aeruginosa (ATCC 13388) was harvested and washed three times by centrifugation using sterile distilled water. The bacterial suspension was added to sterile, melted minerals salts agar, mixed and plates poured. A sample of the inoculated agar was taken and a plate count to determine the number of viable pseudomonas present.

Sample Designation			Observations (Rating*)
Thermoplastic	7	14	21
Sheet:	Days	Days	Days
#1	0	0	0
#2	0	0	0
#3	0	0	0
#4	0	0	0
Controls:			
Inoculated Aga	r 0	0	0
Glass Slides	0	0	0
Plate Count Ag	gar 1	1	1

*Rating: 0=no growth, 1=growth

Conclusion of Bacteria Resistance Testing: The sheet samples did not allow any bacterial growth (rating of 0).

2.03 DETAILS AND DIMENSIONS OF STANDARD LINER

- A. Liner panels shall have a minimum thickness of .065 inches. A combination of standing ribs and mechanical dovetails shall be used to secure the liner panels to the wall of the structure and shall be spaced a maximum of 6.0 inches apart.
- B. Liner panels with a combination of standing ribs and dovetails in diameters of 48" through 60" shall be at least .50 inches high. Panels of 72" diameter and above shall be at least .75 inches high.
- C. Liner with locking extensions shall be able to withstand a test pull of 100 pounds per linear inch applied perpendicular to the concrete surface for a period of 60 seconds. No rupture of the locking extensions or withdrawal from embedment shall be acceptable. This test shall be made at a temperature between 70 and 80 degrees Fahrenheit inclusive.
- D. Liner panels shall be formed to the correct radius to assure a true diameter match between joined precast sections when assembled.
- E. Liner panels shall be formed with a continuous return into the joint for a minimum of .50 of an inch which shall afford protection between the lined pre- cast sections.
- F. All radius panels shall be vacuum tested for pinholes during the molding process and shall withstand a mini- mum of 25 inches of mercury for a period of 60 seconds.
- G. Panel sections shall be custom formed to a specified height not to exceed 6' in overall length. Lengths specified shall include a tolerance ratio of +/- .0625 per foot.

2.04 PLANT INSTALLATION OF LINER

- A. General Installation of all lining shall be done in accordance with the manufacturer's recommendations.
- B. Lining coverage shall not be less than the minimum shown on the approved shop drawings or construction plans.
- C. The liner panels when assembled shall form a circular cylinder that fits snugly against the inner steel core of the form. A removable extruded rubber pro- file or suitable one-sided tape can be used to seal the liner against the core to prevent concrete fines from washing down between the liner and steel core.
- D. Concrete poured around the liner shall be distributed evenly to prevent shifting of the liner.
- E. Concrete poured against the liner shall be vibrated, or compacted in a manner to protect the liner and produce a dense homogenous concrete to securely anchor the assembly to the exposed surfaces on the interior of the structure.
- F. When extracting the steel core, care should be taken to protect the liner from damage. Instruments with sharp or jagged edges should not be used to release the forms from the liner.
- G. Visual inspection of the liner shall be made after demolding and any cuts or tears shall be repaired by following the manufacturer's repair recommendations.
- H. The concrete producer shall take all necessary measures to prevent damage due to casting, demolding, and delivery of the lined concrete structure.
- 2.05 FIELD INSTALLATION OF LINING
 - A. General Field installation of all lined precast sections shall be done in accordance with the recommendations of the manufacturer.
 - B. The horizontal joints between sections of lined concrete structures can be made by either butyl or a combination of butyl and rubber joint per the recommendation of the concrete manufacturer.
 - C. Joint surfaces must be clean to ensure proper adhesion of the butyl. An application of a butyl based primer will produce the highest degree of adhesion to the joint surfaces.
 - D. Butt ends of material together. Material should never be overlapped. Butyl material shall be an approved strip.
 - E. Lined sections should be carefully centered and lowered to complete coupling process. Apply sufficient pressure to properly seat joint and achieve squeeze out.
 - F. After structure is in place, care should be taken to properly plug all lift pin inserts or holes with a suitable non-shrink grout.
 - G. The installing contractor shall take all necessary measures to prevent damage to the liner due to material handling, installation, or equipment or material used in installing, or used

in or taken through the structure.

- 2.06 TESTING AND INSPECTION
 - A. General This section covers the in-plant and field inspection and testing method of lined concrete sections.
 - B. The liner manufacturer shall test each panel to withstand a constant vacuum of 25 inches of mercury for a period of 60 seconds. Any sections failing to meet this requirement shall be rejected.
 - C. In-plant inspections of panels cast into concrete sections shall be visually inspected for cuts or tears and shall be repaired following the manufacturers recommendations.

2.07 LINER APPURTENANCES

- A. Steps or Ladders
 - 1. Steps shall be attached by either casting a preformed polypropylene insert to accept a polypropylene drive, or by casting or drilling a precise hole to accept a polypropylene press fit step, as per the recommendations of the step manufacturer.
 - 2. After installation of either the steps or ladders, the junction point of the device and the liner shall be sealed by applying an approved butyl caulking material (A-LOK[®] Products, Inc., Tullytown, Pennsylvania, Lap Sealant).
- B. Hole Liners
 - 1. Pipe penetrations through the lined wall shall be afforded protection by applying .125 inch trowelable, chemical and corrosion resistant epoxy mortar to the unlined exposed areas within the openings and shall overlap the liner wall a minimum of 1.50 inches.
- C. Grade Work Protection
 - Corrosion protection between the lined concrete structure and the cast iron frame and cover shall be obtained through the use of a telescoping Liner System (A-LOK[®]Products,Inc., Tullytown, Pennsylvania, Water-LOK Connector)
 - 2. Corrosion protection shall be afforded for aluminum entry frames and doors by fabricating a semi- rigid riser to match the inside dimensions of the access frame.

2.08 WARRANTY

- A. A-LOK[®] Products, Incorporated warrants that the product described in this bulletin meets that material, quality, and workmanship conformable to the recommended use.
- B. A-LOK[®] Products, Incorporated liability is limited to replacement or repair of defective parts, excluding cost of removal, installation or unauthorized repairs. A-LOK[®] Products will not be responsible for incidental or consequential damages or for products which have been altered or modified. No representative of the company, or any other person, has the authority to waive, alter or add to this guarantee or to assume for the

company any obligation or liability in connection with the sale or installation of A- $LOK^{\mathbb{R}}$ Products, Inc. products. This warranty is in lieu of all other warranties, express or implied.

- C. A-LOK[®] Products, Inc. Standard Terms and Conditions of Sale apply to purchase of this product.
- D. All information is subjected to change without notice.

2.09 SPECIFICATIONS OF MANHOLE COATINGS AND LININGS

- A. Interior Lining
 - 1. The concrete structure shall have a liner that is integrally cast with the precast section, at the time of manufacture.
 - 2. The liner shall be manufactured from an acrylic modified PVC alloy.
 - 3. The liner shall be thermo-vacuum formed to create a semi-rigid liner.
 - 4. The liner shall conform to the interior diameter of the structure.
 - 5. The liner shall be formed with dove-tail ribs so that it is securely anchored to the concrete structure.
 - 6. The liner shall be formed with returns into the bell and spigot joints to allow for butyl sealant to be placed and to eliminate the need for any field welding of the joint.
 - 7. The liner shall be light in color to reflect light.
 - 8. The liner shall have both antifungal and antibacterial properties that will not readily provide a source of nutrients for bacteria or fungi.
 - 9. The liner shall be a minimum of .065" thick.
 - 10. The liner panels shall be joined together by an EPDM slotted rubber strip.
 - 11. All materials shall meet the physical and chemical properties specified in the appropriate ASTM specification.
 - 12. The liner shall be Dura Plate 100 as manufactured by A-LOK[®] Products, Incorporated. Tullytown, PA, or approved equal.

END OF SECTION 03 11 15

SECTION 03 20 00 CONCRETE REINFORCING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. Section Includes:
 - 1. Steel reinforcement bars.
 - 2. Welded-wire reinforcement.
 - B. Related Requirements:
 - 1. Section 03 30 00 "Cast-In-Place concrete for reinforcing used in cast-in-place concrete.
 - 2. Section 03 41 00 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
 - 3. Section 32 13 13 "Concrete Paving" for reinforcing related to concrete pavement and walks.
- 1.03 PREINSTALLATION MEETINGS
 - A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction contraction and isolation joints.
 - c. Steel-reinforcement installation.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Each type of steel reinforcement.
 - 2. Bar supports.
 - a. Include a written description of where each bar support will be used.
 - 3. Mechanical splice couplers.
- B. Shop Drawings: Comply with ACI SP-066:
 - 1. Include placing drawings that detail fabrication, bending, and placement.

- 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure where not indicated in Drawings.
 - 1. Location of construction joints is subject to approval of the Engineer.
- 1.05 INFORMATIONAL SUBMITTALS
 - A. Welding certificates.
 - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
 - B. Material Certificates:
 - 1. Mill test certificates shall be submitted to the Engineer to certify that the reinforcing steel meets the specified requirements. Mill test certificates shall be furnished and paid for by the Contractor.
 - 2. In addition, the Engineer may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the Owner's expense.
 - C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
 - 2. Mechanical splice couplers.
 - D. Minutes of preinstallation conference.
- 1.06 QUALITY ASSURANCE
 - A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth, oil, or other materials that may decrease bond to concrete.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed. Grade 40 steel shall be allowed for #3 and smaller bars.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.
- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- 2.02 REINFORCEMENT ACCESSORIES
 - A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
 - B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
 - 1. Manufacture bar supports from stainless steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice" and ACI 315, and as follows:
 - a. Where legs of wire bar supports contact forms, use CRSI Class 1 plasticprotected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
 - For plastic protected wire, plastic shall have a thickness of 3/32 inches or greater at points of contract with formwork and the plastic shall extend along the wire at least 1/2 inches from the point of contact iw the formwork.
 - 2) For stainless steel protected wire-reinforcement supports, the nonstainless steel portion of the supports shall not extend closer than 3/4 inches from the form surface.
 - b. Precast concrete (adobes) shall, as a minimum, be no less in compressive strength or cement content than the concrete in which it will be cast, and a surface area of not less than 4 square inches. Water absorption and porosity of precast concrete supports shall be equal to or less than water absorption and porosity of concrete being placed. Adobes manufactured from plastic or with low cement contents will not be accepted. Brick, broken concrete masonry units, spalls, rocks or similar materials shall not be used for support of reinforcing steel.
 - c. All-plastic reinforcement supports shall incorporate perforations in plane areas to compensate for the difference in the coefficient of thermal expansion between the plastic and concrete.

- C. Mechanical Splice Couplers: ACI 318 Type 2, same material of reinforcing bar being spliced; tension-compression type.
 - 1. Products: Subject to compliance with requirements, available products by one of the following:
 - a. Dayton Superior.
 - b. Or approved equal.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 - 1. Finish: Plain.
- 2.03 FABRICATING REINFORCEMENT
 - A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice," and in accordance with fabricating tolerances of ACI 117.
 - B. Bend reinforcement cold unless heating is approved by the Engineer prior to fabrication.
 - C. Minimum inside bend diameters shall conform to the requirements of ACI 350.5 unless otherwise permitted. The beginning of the bend shall not be closer to the concrete surface than the minimum diameter of the bend.
 - D. Kinked bars shall not be used.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. Do not cut or puncture vapor retarder.
 - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- 3.02 INSTALLATION OF STEEL REINFORCEMENT
 - A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
 - B. Accurately position, support, and secure reinforcement against displacement.
 - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - 2. The supports shall be of sufficient quantity, strength and stability to maintain the reinforcement in place throughout the concreting operations. Bar supports shall be placed no further than 4 feet apart in each direction.
 - 3. Do not tack weld crossing reinforcing bars.

- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 350.
 - 1. Placing tolerances shall not reduce cover requirements except as specified in ACI 117.
 - 2. No "bury" or "carrier" bars will be allowed unless specifically approved by the Engineer.
- E. Reinforcing Tying:
 - 1. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
 - 2. There shall be at least three ties in each bar length (this shall not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity).
 - 3. Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections shall be tied at not less than every second intersection, but at not greater than the following maximum spacings:
 - a. Slab Bars: Bars No. 5 and smaller = 30 inches; Bars No. 6 through No. 9 = 48 inches; Bars Bars No. 10 through No. 11 = 60 inches
 - b. Wall Bars: Bars No. 5 and smaller = 24 inches; Bars No. 6 through No. 9 = 30 inches; Bars No. 10 through No.11 = 48 inches.
- F. Reinforcing partially embedded in concrete shall not be field bent unless indicated on the Drawings.
- G. Splices: Lap splices as indicated on Drawings.
 - 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 - 2. Stagger splices in accordance with ACI 350.
 - 3. Lapped spliced bars shall be fastened together with steel tie wire.
 - 4. Unless specified or shown otherwise on the Drawings, the bars at a lap splice shall be in contact with each other.
 - 5. Unless shown otherwise on the Drawings, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.
 - 6. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

- a. Mechanical splices for reinforcement not shown on the Project Drawings shall not be used unless accepted by the Engineer.
- 7. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- H. When there is a delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.
- I. Reinforcement relocation When necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, submit the resulting arrangement of reinforcement for acceptance by the Engineer.
- J. Install welded-wire reinforcement in longest practicable lengths.
 - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
 - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
 - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
 - 4. Lace overlaps with wire.
 - 5. The welded wire fabric shall be bent as shown or required on the Drawings to fit the work. Welded wire fabric shall be rolled or otherwise straightened to make a perfectly flat sheet before placing in the Work.
- 3.03 JOINTS
 - A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement.
 - 2. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.
- 3.04 INSTALLATION TOLERANCES
 - A. Comply with ACI 117.
- 3.05 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Steel-reinforcement placement.
 - 2. Reinforcing support type, spacing, and quantity of reinforcing supports.
 - 3. Steel-reinforcement mechanical splice couplers.
 - 4. Steel-reinforcement welding.

END OF SECTION 03 20 00

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 03 20 00 Concrete Reinforcing
- C. Section 03 10 00 Concrete Forming and Accessories

1.02 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
- 1.03 DEFINITIONS
 - A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
 - B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.

CAST-IN-PLACE CONCRETE

- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- 1. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

1.05 ACTION SUBMITTALS

- A. Product Data: For each of the following.
 - 1. Portland cement. <u>Note all precast and cast-in-place concrete in direct contact with</u> <u>native soils must utilize Type V Portland cement.</u>
 - 2. Fly ash.
 - 3. Slag cement;
 - 4. Silica fume;
 - 5. Aggregates.
 - a. Include types, pit or quarry locations, producers' names, gradations, specific gravities, and evidence of not more than 90 days old demonstrating compliance with product specifications.
 - 6. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
 - 7. Bonding agents;
 - 8. Color pigments.
 - 9. Fiber reinforcement.
 - 10. Vapor retarders.
 - 11. Floor and slab treatments.
 - 12. Liquid floor treatments.

- 13. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are reco
 - b. ended by color pigment manufacturer.
- 14. Joint fillers.
- 15. Repair materials.
- B. Design Mixtures: For each concrete mixture, include the following:
 - 1. Mixture identification.
 - 2. Minimum 28-day compressive strength.
 - 3. Durability exposure class.
 - 4. Maximum w/cm.
 - 5. Calculated equilibrium unit weight, for lightweight concrete.
 - 6. Slump limit.
 - 7. Air content.
 - 8. Nominal maximum aggregate size.
 - 9. Steel-fiber reinforcement content.
 - 10. Synthetic micro-fiber content.
 - 11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 - 12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
 - 13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
 - 14. Intended placement method.
 - 15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
 - 1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Engineer.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 - 1. Concrete Class designation.
 - 2. Location within Project.

- 3. Exposure Class designation.
- 4. Formed Surface Finish designation and final finish.
- 5. Final finish for floors.
- 6. Curing process.
- 7. Floor treatment if any.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Ready-mixed concrete manufacturer.
 - 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Fiber reinforcement.
 - 4. Curing compounds.
 - 5. Floor and slab treatments.
 - 6. Bonding agents.
 - 7. Adhesives.
 - 8. Vapor retarders.
 - 9. Semirigid joint filler.
 - 10. Joint-filler strips.
 - 11. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Portland cement.
 - 2. Fly ash.
 - 3. Slag cement;
 - 4. Silica fume;
 - 5. Aggregates;
 - 6. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Research Reports:

- 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- E. Preconstruction Test Reports: For each mix design.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.
- 1.07 QUALITY ASSURANCE
 - A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
 - B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
 - C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
 - D. Field Quality Control Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.08 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

- f. Permeability.
- 1.09 DELIVERY, STORAGE, AND HANDLING
 - A. Comply with ASTM C94/C94M and ACI 350.5
- 1.10 FIELD CONDITIONS
 - A. Cold-Weather Placement: Comply with ACI 350.5 and ACI 306.1, including but not limited to the following:
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40° F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 350.5;
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35° F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
 - B. Hot-Weather Placement: Comply with ACI 350.5 and ACI 306.1, including but not limited to the following:
 - 1. Keep concrete subgrade uniformly moist without standing water, soft spots or dry areas;
 - 2. Maintain concrete temperature at time of discharge to not exceed 95° F;
 - 3. Use a concrete consistency that permits rapid placement with least delay;
 - 4. Protect the concrete against moisture loss at all times during placing and curing;
 - 5. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete.
 - C. There will not be any additional reimbursement made to the Contractor for costs incurred for placing concrete in cold or hot weather.

PART 2 - PRODUCTS

- 2.01 CONCRETE, GENERAL
 - A. ACI Publications: Comply with ACI 350.5 unless modified by requirements in the Contract Documents.
- 2.02 CONCRETE MATERIALS
 - A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

- 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
- 3. Obtain aggregate from single source.
- 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
 - Portland Cement: ASTM C150/C150M, Type V, for cast-in-place exposed to high sulfate native soils and wastewater. The September 2019 Montana State Hospital Wastewater Treatment Plant Geotechnical Report recommends the use of Type V cement for "all cast-in-place structural concrete exposed to the native soils". Use Type V cement for the following cast-in-place elements:
 - a. Footings;
 - b. Foundation walls;
 - c. Interior slabs on grade exposed to H2S (Screening Room)

Type I/II Portland Cement is otherwise acceptable.

- 2. Fly Ash: ASTM C618, Class C or F.
- 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120
- 4. Silica Fume: ASTM C1240 amorphous silica
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source.
 - 1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb/yd3 for moderately reactive aggregate or 3 lb/yd3 for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
 - 2. Maximum Coarse-Aggregate Size: ³/₄ inch nominal.
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

- 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
- 2. Retarding Admixture: ASTM C494/C494M, Type B.
- 3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
- 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
- 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
- 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- 7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
- 8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
- 9. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi or 14 days.
- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable
- 2.03 LIQUID FLOOR TREATMENTS
 - A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens and densifies concrete surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation;
 - b. Dayton Superior;
 - c. Euclid Chemical Company;
 - d. W.R. Meadows, Inc.;
 - e. SealantPro
 - B. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning

materials with 100 percent passing No. 4 sieve.

2.04 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Corporation;
 - b. Dayton Superior;
 - c. Euclid Chemical Company;
 - d. W.R. Meadows, Inc.;
 - e. Sika Corporation
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./yd2 when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
 - 1. Color:
 - a. Ambient Temperature Below 50° F: Black.
 - b. Ambient Temperature between 50° F and 85° F: Any color.
 - c. Ambient Temperature Above 85° F: White.
- D. Curing Paper: 8' wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, solvent-borne, membrane-forming, curing and sealing compound: ASTM C1315, Type 1, Class A
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not necessarily limited to, the following:
 - a. BASF Corporation; MasterKure CC 250 XS
 - b. Dayton Superior; Cure & Seal 25% J22UV
 - c. Euclid Chemical Company (The); an RPM company; Luster Seal 300
 - d. Laticrete International, Inc.; L&M Lumiseal Plus
 - e. W.R. Meadows, Inc; CS-309-30.
 - f. Lambert Corporation; UV Super Seal
- 2.05 VAPOR RETARDERS
 - A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick.

Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.06 RELATED MATERIALS

- A. Joint Sealers: two-part, self-leveling, uniform, stiff consistency, non-staining, polyurethane elastomeric sealant which cures at ambient temperature, conforming to ASTM C-920 and does not contain solvents.
 - 1. The material shall be of a type that will effectively and permanently seal joints subject to movements in concrete.
 - 2. The mastic shall tenaciously adhere to primed concrete surfaces, shall remain permanently mastic and shall be NSF approved for use with potable water.
 - 3. For sloping joints, vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C 920 Class 12-1/2
 - 4. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C 920 Class 25. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 25 to 35, shall be used.
 - 5. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
 - 6. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. PERMAPOL RC-270SL RESERVOIR SEALANT, as manufactured by PRODUCTS RESEARCH & CHEMICAL CORP., Gloucester City, New Jersey (800-257-8454)
 - SIKAFLEX/2C POLYURETHANE ELASTOMERIC SEALANT, as manufactured by SIKA CHEMICAL CORP., Santa Fe Springs, CA (213-941-0231)
 - c. SELECT SEAL U-227 RESERVOIR GRADE, as manufactured by SPC, Upland, CA (714-985- 5771)
 - d. Or approved equal.
- B. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- C. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- D. Backing Rod: Backing rod shall be an extruded closed cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

- E. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.
- F. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete
- G. Bond Breaker: Bond breaker shall be SUPER BOND BREAKER WATER BASE as manufactured by Burke Company, San Mateo, California; SELECT EMULSION CURE 309, as distributed by Select Products Co., Upland, CA (clear or white pigmented) or equivalent. Fugitive dye may be used in bond breakers if recommended by the manufacturer.
- H. Floor Slab Protective Covering: 8' wide cellulose fabric.

2.07 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from ¹/₈" and that can be feathered at edges to match adjacent surface elevations/profiles.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel: ¹/₈" to ¹/₄", or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4,500 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from ¹/₄" and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, ¹/₈" to ¹/₄", or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.
- 2.08 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 350.5.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use water reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in and concrete with a w/cm below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 - 5. Use permeability-reducing admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment (if called for in project documents) to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.09 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings.
 - 1. Exposure Class: ACI 318 F1, S2, W0, C0.
 - 2. Minimum Compressive Strength: 3500 psi at 28 days.
 - 3. Maximum w/cm: 0.55.
 - 4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site .
 - 5. Air Content:

- a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size .
- 6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- B. Class B: Normal-weight concrete used for grade beams and non-fluid retaining foundation walls.
 - 1. Exposure Class: ACI 318 F2, S2, W0, C0
 - 2. Minimum Compressive Strength: 4500 psi at 28 days.
 - 3. Maximum w/cm: 0.50.
 - 4. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 5. Air Content:
 - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
 - 6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- C. Class C: Normal-weight concrete used for Screen Room interior slab-on-grade, fluid-retaining slabs and walls and roof slabs over fluid-containing tanks.
 - 1. Exposure Class: ACI 318 F2, S2, W1, C2.
 - 2. Minimum Compressive Strength: 4500 psi at 28 days.
 - 3. Maximum w/cm: 0.42
 - 4. Minimum Cementitious Materials Content: 560 lb/cu. yd.
 - a. Provide Portland Cement Type V combined with a minimum of 20 percent, by weight, of cementitious material with either of the following:
 - b. Fly Ash supplemented with Silica Fume, or
 - c. Ground-Granulated Blast-Furnace Slag supplemented with Silica Fume.
 - 5. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 6. Air Content:
 - a. Exposure Classes F2 and F3: 6 percent, plus or minus, 1.5 percent measured at the point of delivery for concrete containing 3/4-inch nominal maximum size aggregate;
 - b. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

- 7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.
- D. Class D: Normal-weight concrete used for interior slabs-on-grade (excluding the Screen Room slab), topping for metal decks, and equipment bases.
 - 1. Exposure Class: ACI 318 F0, S0, W0, C0.
 - 2. Minimum Compressive Strength: 4000 psi at 28 days.
 - 3. Maximum w/cm: 0.45.
 - 4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
 - 5. Slump Limit: 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
 - 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 - 7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- E. Class F: Controlled Low Strength Material (CLSM) for flowable backfill.
 - 1. Design and produce non-excavatable CLSM in accordance with the following requirements:
 - a. Unconfined compressive strength greater than 150 psi determined by ASTM D4832.
 - b. Air Content between 5% and 30% determined by ASTM D6023.
 - c. Unit weight of 100-130 lbs/cu. ft. determined by ASTM D6023.
 - d. Consistent flow producing a self-leveling product free of segregation determined by ASTM D6103.
 - e. Do not use materials in CLSM with a plasticity index over 4.
 - f. Furnish aggregates in accordance with the following gradation:
 - i. 3/4-inch sieve: 100 percent passing
 - ii. No. 4 sieve: 65- 100 percent passing
 - iii. No. 30 sieve: 40 80 percent passing
 - iv. No. 200 sieve: 10 30 percent passing.
- F. Class H: Normal-weight concrete used for building walls not exposed to H2S or immersion.
 - 1. Exposure Class: ACI 318 F2.

- 2. Minimum Compressive Strength: 5000 psi at 28 days.
- 3. Maximum w/cm: 0.45.
- 4. Slump Limit: 8 inches plus or minus 1 inch for concrete with verified slump of 3 inches plus or minus 1 inch before adding high-range water-reducing admixture or plasticizing admixture at Project site.
- 5. Air Content:
 - a. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.
- 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- G. Class I: Grout used for Grout Shaping of flumes, wet wells, etc.
 - 1. Exposure Class: ACI 318 F0, S2, W1
 - 2. Minimum Compressive Strength: 4000 psi at 28 days.
 - 3. Maximum w/cm: 0.50.
 - 4. Slump Limit: 4 inches, plus or minus 1 inch.
 - 5. Air Content:
 - a. Exposure Class F0: None required.
 - 6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- 2.10 CONCRETE MIXING
 - A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections,

acceptable to testing agency, including the following:

- 1. Daily access to the Work.
- 2. Incidental labor and facilities necessary to facilitate tests and inspections.
- 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
- 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.03 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.04 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than 6 inches sealing vapor retarder to concrete.
 - 4. Lap joints 6 inches and seal with manufacturer's recommended tape.
 - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.
- 3.05 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls as indicated on Drawings . Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 350 but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 350.5.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.

- c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
- d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Do not place concrete floors and slabs in a checkerboard sequence.
 - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 3. Maintain reinforcement in position on chairs during concrete placement.
 - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 5. Level concrete, cut high areas, and fill low areas.
 - 6. Slope surfaces uniformly to drains where required.
 - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 - 8. Do not further disturb slab surfaces before starting finishing operations.

3.07 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 - 1. ACI 350 Environmental Surface Finish ESF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Apply to concrete surfaces not exposed to view for non-fluid-retaining elements.
 - 2. ACI 350 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view.
- B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:
 - 1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive

until producing a uniform color and texture.

- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the inplace concrete.
- d. Maintain required patterns or variances as shown on Drawings or to match mockups.
- C. Related Unformed Surfaces:
 - 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
 - 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
 - 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 - 2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
 - 3. Apply scratch finish to surfaces to receive grout shaping.
- C. Float Finish:
 - 1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 - 2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
 - 3. Apply float finish to surfaces to receive trowel finish and fluid-retaining slabs.
- D. Trowel Finish:
 - 1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 - 2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
 - 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

- 4. Do not add water to concrete surface.
- 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
- 6. Apply a trowel finish to surfaces exposed to view .
- 7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - i. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
 - b. Suspended Slabs:
 - i. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings . While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 - 1. Coordinate required final finish with Engineer before application.
 - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Engineer before application.
- 3.09 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS
 - A. Filling In:
 - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
 - B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
 - C. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.

- 2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
- 3. Minimum Compressive Strength: 4000 psi at 28 days.
- 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
- 5. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- 6. Aluminum Inserts and Embeds. All aluminum materials inserted in concrete shall have the contact surface coated with bitumastic.

3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 350.5 and ACI 306.1 for cold weather protection during curing.
 - 2. Comply with ACI 350.5 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 - 2. Curing period shall not be less than seven days.
 - 3. If forms remain during curing period, moist cure after loosening forms.
 - 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.

- d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - i. Method by itself is not permitted for fluid-retaining structures.
- e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions. This method is not permitted for fluid-retaining structures.
 - i. Recoat areas subject to heavy rainfall within three hours after initial application.
 - ii. Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors for non- fluid retaining slabs:
 - a. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - i. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - Lap edges and ends of absorptive cover not less than 12 inches.
 - Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - ii. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moistureretaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - Cure for not less than seven days.
 - iii. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - Water.
 - Continuous water-fog spray.
 - b. Floors to Receive Curing Compound:
 - i. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - ii. Recoat areas subjected to heavy rainfall within three hours after initial

application.

- iii. Maintain continuity of coating, and repair damage during curing period.
- iv. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- c. Floors to Receive Curing and Sealing Compound:
 - i. Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - ii. Recoat areas subjected to heavy rainfall within three hours after initial application.
 - iii. Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.
- 3. Slabs for fluid-retaining structures:
 - a. Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire are of floor.
 - i. Lap edges and ends of absorptive cover not less than 12 inches.
 - ii. Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - b. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moistureretaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
 - i. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - ii. Cure for not less than seven days.
 - c. Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - i. Water.
 - ii. Continuous water-fog spray.

3.11 TOLERANCES

- A. Conform to ACI 117
- 3.12 APPLICATION OF LIQUID FLOOR TREATMENTS
 - A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor

treatment in accordance with manufacturer's written instructions.

- 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
- 2. Do not apply to concrete that is less than 14 days' old.
- 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
- 4. Rinse with water; remove excess material until surface is dry.
- 5. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Install cork type joint filler in joints in fluid-retaining elements.
 - 2. Defer joint filling until concrete has aged at least six month(s).
 - 3. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 JOINT SEALING

- A. Joints, not requiring waterstops or when so indicated on the Drawings, shall be sealed.
- B. Joint sealed areas shall be sandblasted or roughened and blown clean of dust and sand with compressed air before the material may be applied.
- C. Joints shall be primed (if required) and the sealant shall be applied in accordance with the manufacturer's recommendations.

3.15 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Engineer.
 - 2. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Repair cracks in liquid containing concrete structures with widths greater than 0.010 inches, unless otherwise specified or directed by the Engineer.

- C. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing. Mix the repair mortar and turn the mortar frequently with a trowel without adding water.
- D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Engineer.
- E. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 3. After concrete has cured at least 14 days, correct high areas by grinding.
 - 4. Correct localized low areas during, or immediately after, completing surfacefinishing operations by cutting out low areas and replacing with patching mortar.

- a. Finish repaired areas to blend into adjacent concrete.
- 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
- 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
- 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- G. Repair materials and installation not specified above may be used, subject to Engineer's approval.
- 3.16 WATER HOLDING STRUCTURES LEAKAGE TESTING

- A. Complete in accordance with ACI 350.1.
- B. All concrete structures that are designed to hold or pass water shall be hydraulically tested after curing has completed. All structures shall be prepared for testing by plugging the outlets or providing proper standpipes. The structure shall be filled to the proper operating depth and maintained at that level for (7) days. No leakage will be allowed
- C. All cracks, leaks, and irregularities shall be properly and aesthetically repaired by the contractor at no additional expense to the Owner. All repairs shall be completed to the satisfaction of the Owner.
- D. Water Holding Structures include but are not limited to the Screening channels, UV Channel, and the Polishing Reactor.
- E. Testing procedures and results shall be submitted to the Engineer for DEQ approval.
- 3.17 FIELD QUALITY CONTROL
 - A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
 - B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 - 2. Testing agency shall immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - i. Project name.
 - ii. Name of testing agency.
 - iii. Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - iv. Name of concrete manufacturer.
 - v. Date and time of inspection, sampling, and field testing.
 - vi. Date and time of concrete placement.
 - vii. Location in Work of concrete represented by samples.
 - viii. Date and time sample was obtained.

- ix. Truck and batch ticket numbers.
- x. Design compressive strength at 28 days.
- xi. Concrete mixture designation, proportions, and materials.
- xii. Field test results.
- xiii. Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.

xiv. Type of fracture and compressive break strengths at seven days and 28 days.

- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 - 6. Batch Plant Inspections: On a random basis, as determined by Engineer.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. but less than 25 cu. yd. plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
 - a. One test for each composite sample, but not less than one test for each day's

pour of each concrete mixture.

- 4. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 ° F and below or 80 ° F and above, and one test for each composite sample.
- 5. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
- 6. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- 7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- 8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi
- 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
- 10. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.
 - i. Acceptance criteria for concrete strength shall be in accordance with ACI 350.5 section 1.6.7.3.
- 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.18 PROTECTION

- A. Protect concrete surfaces as follows:
 - 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.
 - 3. Prohibit vehicles from interior concrete slabs.
 - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 - 5. Prohibit placement of steel items on concrete surfaces.
 - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

SECTION 03 41 00 PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. Section Includes:
 - 1. Precast structural concrete.
 - 2. Thin-brick-faced, precast structural concrete.
 - 3. Stone-faced, precast structural concrete.
 - 4. Precast structural concrete with commercial architectural finish.
 - B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for placing connection anchors in concrete.
 - 2. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
 - 3. Section 05 50 00 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
 - 4. Division 07 for water-repellent finish treatments roof and walls.
- 1.03 DEFINITIONS
 - A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Engineer.
- 1.04 PREINSTALLATION MEETINGS
 - A. Preinstallation Conference: Conduct conference at Project site.
- 1.05 ACTION SUBMITTALS
 - A. Product Data: For each type of product.
 - B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.
 - C. Shop Drawings:
 - 1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.

- 2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
- 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
- 4. Indicate separate face and backup mixture locations and thicknesses.
- 5. Indicate type, size, and length of welded connections by AWS standard symbols.
- 6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
- 7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
- 8. Include and locate openings larger than 4 inches for walls and roof, and 8 inches for slabs. Where additional structural support is required, include header design.
- 9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
- 10. Indicate relationship of precast structural concrete units to adjacent materials.
- 11. Indicate locations, dimensions, and details of thin-brick units (if applicable), including corner units and special shapes, and joint treatment.
- 12. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
- 13. Indicate estimated camber for precast floor slabs with concrete toppings.
- 14. Indicate shim sizes and grouting sequence.
- 15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Samples:
 - 1. For each type of finish indicated on exposed (interior and exterior) surfaces of precast structural concrete units with architectural finish, provide samples representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.
 - a. Where other faces of precast concrete unit are exposed, include samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
- E. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Show precast structural concrete unit types, connections, types of reinforcement,

including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer and fabricator.
- B. Welding certificates.
- C. Material Certificates: For the following:
 - 1. Cementitious materials.
 - 2. Reinforcing materials and prestressing tendons.
 - 3. Admixtures.
 - 4. Bearing pads.
 - 5. Insulation.
 - 6. Structural-steel shapes and hollow structural sections.
 - 7. Anchors and accessories.
- D. Material Test Reports: For aggregates, by a qualified testing agency.
- E. Preconstruction test reports.
- F. Source quality-control reports.
- G. Field quality-control and special inspection reports.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Designated as a PCI-certified plant as follows:
 - a. Group C, Category C3 Prestressed Straight Strand Structural Members.
- B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S1 Simple Structural Systems
- C. Installer Qualifications: An experienced precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project installed by erector in Category S1 - Simple Structural Systems and who can produce an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products."
- D. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- E. Quality-Control Standard: For manufacturing procedures, testing requirements, and

quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

- F. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.4/D1.4M, "Structural Welding Code Reinforcing Steel."
- G. Sample Panels: After sample approval and before fabricating precast structural concrete units with architectural finish, produce a minimum of two sample panels approximately 16 ft2 in area for review by Engineer. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.
 - 1. Locate panels where indicated or, if not indicated, as directed by Engineer.
 - 2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
 - 3. After approval of repair technique, maintain one sample panel at fabricator's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
 - 4. Demolish and remove sample panels when directed.
- H. Mockups: After sample panel approval but before production of precast structural concrete units with architectural finish or thin-brick facing, construct full-sized mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup as indicated on Drawings including sealants and precast structural concrete units with an architectural finish complete with anchors, connections, flashings, and joint fillers.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.
- 1.09 DELIVERY, STORAGE, AND HANDLING
 - A. Support units during shipment on non-staining shock-absorbing material in same position as during storage.
 - B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent

staining, and to prevent cracking, distortion, warping or other physical damage.

- 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
- 2. Place adequate dunnage of even thickness between each unit.
- 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

- 2.01 PERFORMANCE REQUIREMENTS
 - A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design precast structural concrete units.
 - B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
 - C. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
 - D. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Dead Loads: As calculated.
 - 2. Live Loads: Per general structural notes in construction documents.
 - 3. Roof Loads: 20-PSF.
 - 4. Snow Loads: 30-PSF.
 - 5. Seismic Loads: Per general structural notes in construction documents.
 - 6. Wind Loads: Per general structural notes in construction documents.
 - 7. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.
 - a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of -40°F to +105°F.

2.02 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that

provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

- 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

2.03 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from asdrawn steel wire into flat sheets.
- D. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
- 2.04 PRESTRESSING TENDONS
 - A. Pretensioning Strand: ASTM A 416/A 416M, Grade 250 or Grade 270 uncoated, sevenwire, low-relaxation strand.
- 2.05 CONCRETE MATERIALS
 - A. Portland Cement: ASTM C 150/C 150M, Type V for all concrete exposed to native soils containing sulfate per the Geotechnical Report and all concrete exposed to H2S. Types I, II or III, gray, for all other applications.
 - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
 - B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 - 2. Metakaolin: ASTM C 618, Class N.
 - 3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
 - 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - 5. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IS, Portland blast-furnace slag cement.
 - C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33/C 33M,

with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

- D. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
 - 5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
 - 8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 - 9. Corrosion-Inhibiting Admixture: ASTM C 1582/C 1582M.
- 2.06 STEEL CONNECTION MATERIALS
 - A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
 - B. Carbon-Steel-Headed Studs: ASTM A 108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
 - C. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
 - D. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or Grade C.
 - E. Deformed-Steel Wire or Bar Anchors: ASTM A 496/A 496M or ASTM A 706/A 706M.
 - F. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.
 - G. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.
 - 1. Do not zinc coat ASTM A 490 bolts.

PRECAST STRUCTURAL CONCRETE

- H. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.
- I. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.
- J. Welding Electrodes: Comply with AWS standards.
- K. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.
- 2.07 STAINLESS-STEEL CONNECTION MATERIALS
 - A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201.
 - B. Stainless-Steel Bolts and Studs: ASTM F 593, Alloy Group 1 or 2, hex-head bolts and studs; ASTM F 594, Alloy Group 1 or 2 stainless-steel nuts; and flat, stainless-steel washers.
 - 1. Lubricate threaded parts of stainless-steel bolts with an anti-seize thread lubricant during assembly.
 - C. Stainless-Steel-Headed Studs: ASTM A 276, Alloy 304 or 316, with minimum mechanical properties of PCI MNL 116.
- 2.08 BEARING PADS
 - A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 - 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi per ASTM D 412.
 - 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 - 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered

cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.

- 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for inservice stress.
- 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.09 ACCESSORIES

- A. Reglets: Specified in Section 076200 "Sheet Metal Flashing and Trim."
- B. Reglets: PVC extrusions, felt or fiber filled, or with face opening of slots covered.
- C. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.10 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.
- 2.11 INSULATED FLAT-WALL PANEL ACCESSORIES
 - A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type VII, 2.20 lb/ft3 square edges; with thickness of 3".
 - B. Wythe Connectors: Glass-fiber-reinforced vinylester connectors manufactured to connect wythes of precast concrete panels.

2.12 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

- 2. Limit use of fly ash to 35 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 20 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.
- F. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Unit Weight: Calculated equilibrium unit weight of 115 lb/ft3., plus or minus 3 lb/ft3, according to ASTM C 567.
- G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- I. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.13 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly chamfered.
- C. Install Rustication Joint molds (if applicable) per Architectural Drawings. Use metal, PVC or rubber strips, kerfed for ease of form removal. Use form "Low Profile 877" by Victory Bear or approved equal
- 2.14 FABRICATION
 - A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
 - B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
 - C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
 - D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.
 - E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 - 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 - 3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

- 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Prestress tendons for precast structural concrete units by either pretensioning or posttensioning methods. Comply with PCI MNL 116.
 - 1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
 - 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 - 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 - 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 - 5. Protect strand ends and anchorages with a minimum of 1-inch- thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
 - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.
- L. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

PRECAST STRUCTURAL CONCRETE

- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.15 CASTING INSULATED WALL PANELS

- A. Cast, screed, and consolidate wythe supported by mold.
- B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.
- C. Ensure bottom wythe and insulation layer are not disturbed after bottom wythe reaches initial set.
- D. Cast, screed, and consolidate top wythe to meet required finish.
- E. Maintain temperature below 150°F in bottom concrete wythe.
- 2.16 FABRICATION TOLERANCES
 - A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.
 - B. Thin-Brick-Faced Precast Structural Concrete Units: Restrict the following misalignments to 2 percent of number of thin bricks in a unit:
 - 1. Alignment of Mortar Joints:
 - a. Jog in Alignment: 1/8 inch
 - b. Alignment with Panel Centerline: Plus or minus 1/8 inch
 - 2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 inch
 - 3. Tipping of Individual Thin Bricks from the Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch; minus 1/4 inch less than or equal to depth of form-liner joint.
 - 4. Exposed Thin-Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 inch minus 1/8 inch
 - 5. Individual Thin-Brick Step in Face from Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch; minus 1/4 inch less than or equal to depth of form-liner joint.

- C. Stone Veneer-Faced Precast Structural Concrete Units:
 - 1. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated: Plus or minus 1/4 inch
 - 2. Variation in Joint Width: 1/8 inch in 36 inches or a quarter of nominal joint width, whichever is less.
 - 3. Variation in Plane between Adjacent Stone Units (Lipping): 1/16-inch difference between planes of adjacent units.

2.17 COMMERCIAL FINISHES

- A. Commercial Grade: Remove fins and protrusions larger than 1/8 inch and fill holes larger than 1/2 inch. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch.
- B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in.. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- C. Grade B Finish: Fill air pockets and holes larger than 1/4 inch in diameter with sandcement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch in width that occur more than once per 2 sq. in.. Grind smooth form offsets or fins larger than 1/8 inch. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.
- D. Grade A Finish: Repair surface blemishes and fill air holes with the exception of air holes 1/16 inch in width or smaller, and form marks where the surface deviation is less than 1/16 inch. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.
- E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
- G. Apply roughened surface finish according to ACI 318 to precast concrete units that receive concrete topping after installation.
- 2.18 COMMERCIAL ARCHITECTURAL FINISHES
 - A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform and straight. Finish exposed-face surfaces of

precast concrete units to match approved sample panels and as follows:

- 1. PCI's "Architectural Precast Concrete Color and Texture Selection Guide," of plate numbers indicated.
- 2. As-Cast-Surface Finish: Provide surfaces to match approved sample or mockup for acceptable surface, air voids, sand streaks, and honeycomb.
- 3. Textured-Surface Finish: Impart by form liners or inserts.
- 4. Bushhammer Finish: Use power or hand tools to remove matrix and fracture coarse aggregates.
- 5. Exposed-Aggregate Finish: Use chemical-retarding agents applied to concrete molds and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
- 6. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
- 7. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.
- 8. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
- 9. Polished Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.
- 10. Sand-Embedment Finish: Use selected stones placed in a sand bed in bottom of mold, with sand removed after curing.
- 11. Thin-Brick Facing: See "Thin-Brick Facings" Article.
- 12. Stone Facing: See "Stone Facings" Article.

2.19 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 - 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712/C 1712M.
 - 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

- D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
 - 1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Engineer.
 - 2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.
 - 3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
 - 4. Report test results in writing on same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.02 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
 - 4. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of Engineer.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
 - 3. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.

- 4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
 - 2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
 - a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - c. Twist-off Tension Control Bolt: ASTM F 1852.
 - d. Direct-Tension Control Bolt: ASTM F 1852.
 - 3. For slip-critical connections, use method and inspection procedure approved by Engineer and coordinated with inspection agency.
- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
 - 1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
 - 2. Fill joints completely without seepage to other surfaces.
 - 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 - 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 - 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 - 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.03 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.
- 3.04 FIELD QUALITY CONTROL
 - A. Special Inspections: Owner will engage a qualified special inspector to perform the

PRECAST STRUCTURAL CONCRETE

following special inspections:

- 1. Erection of precast structural concrete members.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- D. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- G. Prepare test and inspection reports.

3.05 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.
- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.06 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of

exposed concrete finishes or damage adjacent materials.

3.07 WARRANTY

A. The pre-cast concrete structural buildings shall be free from evidence of leaking on the interior of the buildings and the wall and roof panels shall be free of uncontrolled cracking for a period of 5 years from the date of substantial completion.

END OF SECTION 03 41 00

SECTION 03 60 00 GROUT AND REPAIR MORTAR

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

- A. This section includes, but not limited to, the following:
 - 1. Grouting of structural base plates, equipment baseplates and other miscellaneous uses of non-shrinking grout.
 - 2. Epoxy grouting of anchor bolts and reinforcing bars to be installed in hardened concrete.
 - 3. Repair of deteriorated concrete surfaces
- B. Related Sections include, but are not limited to, the following:
 - 1. Division 5 Section "Metal Fabrications; Stairs; Gratings; Decking; Framing"
 - 2. Division 3 Section "Reinforcing Steel"
 - 3. Division 3 Section "Precast Structural Concrete; Cast-In-Place Concrete"
- 1.03 SUBMITTALS
 - A. The Contractor shall submit manufacturers' information indicating the application, formulation, and installation procedures for each brand and type of grout to be used.
- 1.04 PRODUCT HANDLING
 - A. Delivery of Materials: Materials shall be delivered to the project site in original, new and unopened containers bearing the manufacturer's name and label showing at least the following information:
 - 1. Name of material.
 - 2. Federal specification number, if applicable.
 - 3. Manufacturer's name.
 - 4. Contents by volume for major constituents.
 - 5. Handling instructions.
 - 6. Application instructions.
 - B. Storage of Materials: Materials shall be stored to prevent moisture contamination,

damage, and deterioration of grout materials.

C. Protection: Materials and Work shall be protected before, during and after installation of the grout.

PART 2 - PRODUCTS

- 2.01 NONSHRINKING GROUT
 - A. Nonshrinking Grout shall be: Sika Grout 212; Master Builders "Masterflow 713 Grout"; Savereisen Cement "F-100 Level Fill Grout"; U.S. Grout "Five Star Grout"; or USM "Upcon" or equal.
- 2.02 EPOXY GROUT
 - A. Adhesive: Two-component liquid equal to: Thermal-Chem "Mortar Resin Products M3"; Minwax "Por-Rok Anchoring Cement", or equal.
 - B. Aggregate: As recommended by the epoxy grout manufacturer.
- 2.03 REPAIR MORTAR
 - A. The material to be used for repair of the Bar Screen structure shall be twocomponent, polymer-modified, cementitious, non-sag mortar equal to SikaTop-123 Plus" with FerroGard 901 penetrating corrosion inhibitor.
- 2.04 QUICK SETTING HYDRAULIC CEMENT
 - A. Quick setting hydraulic cement shall be SikaSet Plug, or equal
- 2.05 SETTING ANCHOR BOLTS/DOWELS
 - A. High strength adhesive shall be Simpson Strong-Tie AT-XP, or equal.
- 2.06 WATER
 - A. Clean and free of deleterious substances.

PART 3 - EXECUTION

- 3.01 NONSHRINKING GROUT
 - A. General: Nonshrinking grout shall be furnished factory-premixed so only water is added at the project site. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout as recommended by the manufacturer.
 - B. Preparation: Concrete to receive nonshrinking grout shall be saturated with water for 24 hours prior to grouting.
 - C. Placement: Grout shall be placed in strict accordance with the directions of the manufacturer so all spaces and cavities below the top baseplates or against concrete slabs or walls are completely filled without voids. Forms shall be provided where structural components of baseplates or launders will not confine the grout.

- D. Finishing: The grout shall be finished smooth in all locations where the top surface or edge of the grout will be exposed to view after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate, bedplate, member, or piece of equipment.
- E. Curing: Nonshrink grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. After edge finishing is complete, the grout shall be wet cured for at least 7 days.
- 3.02 EPOXY GROUT
 - A. General: Components shall be packed separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.
 - B. Preparation: Where indicated on the Drawings, anchor bolts and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be ¹/₄ inch larger than the maximum dimension of the bolt head, and ¹/₂ inch larger than the bar diameter. The embedment depth for epoxy-grouted anchor bolts and reinforcing bars shall not be less than ten bolt or bar diameters unless indicated otherwise on the Drawings.
 - 1. Holes shall be prepared for grouting as recommended by the grout manufacturer.
 - C. Installation: Anchor bolts and reinforcing bars shall be clean, dry, and free of grease and other foreign matter at the time of installation. The bolts and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to insure that all spaces and cavities are filled with epoxy grout, without voids.

3.03 REPAIR MORTAR

- A. General: Components shall be packed separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.
- B. Preparation: Where indicated on the Drawings, the surfaces to receive repair mortar shall be cleaned and completely free of deleterious substances, standing or adhered water and shall be prepared in strict accordance with the manufacturer's requirements before the repair mortar is mixed and applied.
- C. Installation: All surfaces shall be clean, dry, and free of grease and other foreign matter at the time of installation. The mortar shall be placed and finished in accordance with the recommendations of the manufacturer. Particular care shall be taken to insure that all spaces and cavities are filled with repair mortar, without voids.

3.04 QUICK SETTING HYDRAULIC CEMENT

- A. General. Contents shall be packaged at the factory and mixed with water in the field to obtain the desired consistency. Proportioning and mixing shall be in accordance with the manufacturer's recommendations.
- B. Preparation. The concrete area to receive quick setting hydraulic cement should be thoroughly cleaned and lightly dampened just prior to application.
- C. Installation. The quick setting hydraulic cement shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to insure that all spaces and cavities are filled without voids.

3.05 USES OF GROUT

- A. Non-shrink grout shall be used beneath all equipment bases and other locations shown on the Drawings or specified herein. Grouting thicknesses and application shall meet the equipment manufacturer's requirements.
- B. Epoxy grout shall be used at locations shown on the Drawings or specified herein. Repair of rock pockets or surface defects in concrete work approved for repair by the Engineer shall generally be repaired with epoxy grout unless otherwise directed by the Engineer.
- C. Anchor bolts approved by the Engineer for installation in concrete shall be set in high-strength anchoring adhesive unless otherwise directed by the Engineer. This adhesive shall not be used in contact with potable water.
- D. Quick setting hydraulic cement shall be used at locations shown on the Drawings or specified herein. All penetrations/joints in concrete manholes, vaults, or structures where a watertight seal is required shall use this type of grout.

END OF SECTION 03 60 00

DIVISION 5

METALS

SECTION 05 12 00 STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. Section Includes:
 - 1. Structural steel.
 - 2. Prefabricated building columns.
 - 3. Shear stud connectors.
 - 4. Shrinkage-resistant grout.
- 1.03 DEFINITIONS
 - A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
 - B. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches;
 - 2. Welded built-up members with plates thicker than 2 inches.
 - 3. Column base plates thicker than 2 inches.
 - C. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
 - D. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.
- 1.04 COORDINATION
 - A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
 - B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.
- 1.05 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the Work Site, at a stage that allows for the timely identification and correction of potential issues.
- 1.06 ACTION SUBMITTALS
 - A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Shear stud connectors.
 - 4. Anchor rods.
 - 5. Threaded rods.
 - 6. Forged-steel hardware.
 - 7. Slide bearings.
 - 8. Prefabricated building columns.
 - 9. Shop primer.
 - 10. Galvanized-steel primer.
 - 11. Etching cleaner.
 - 12. Galvanized repair paint.
 - 13. Shrinkage-resistant grout.
 - B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the seismic-load-resisting system.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand-critical welds.
 - 8. Identify members not to be shop primed.
 - C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).

2. Electrode manufacturer and trade name, for demand-critical welds.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, shop-painting applicators, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Field quality-control reports.
- 1.08 QUALITY ASSURANCE
 - A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
 - B. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.
 - C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

- 2.01 PERFORMANCE REQUIREMENTS
 - A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 341.
 - 3. ANSI/AISC 360.
 - 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2.02 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles: ASTM A36/A36M.

Materials complying with first option in "Plate and Bar" Paragraph below are widely available; those complying with second option are less so. Third option is a specialty-steel material; verify availability if required.

- C. Plate and Bar: ASTM A36/A36M.
- D. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars (if applicable to this project): ASTM A588/A588M, 50 ksi ;
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- F. Welding Electrodes: Comply with AWS requirements.
- 2.03 BOLTS AND CONNECTORS
 - A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators (if applicable for this project): ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
 - B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavyhex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating;
 - 2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.
 - C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- 2.04 RODS

STRUCTURAL STEEL FRAMING

- A. Headed Anchor Rods: ASTM F1554, Grade 36, straight
 - 1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.05 PRIMER

- A. Steel Primer:
 - 1. Comply with Division 09 Standard and High-Performance Painting and Coatings.
- 2.06 SHRINKAGE-RESISTANT GROUT
 - A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
 - B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 1.
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wallopening framing to be attached to structural-steel frame. Straighten as required to provide

uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

- H. Welded-Steel Door Frames: Build up welded-steel door frames attached to structuralsteel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches O.C. unless otherwise indicated on Drawings.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.08 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- 2.09 GALVANIZING
 - A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches;
 - 2. Surfaces to be field welded;
 - 3. Surfaces of high-strength bolted, slip-critical connections;
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing);
 - 5. Surfaces enclosed in interior construction;
 - 6. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill

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scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

- 1. SSPC-SP 3.
- 2. SSPC-SP 7 (WAB)/NACE WAB-4.
- 3. SSPC-SP 14 (WAB)/NACE WAB-8.
- 4. SSPC-SP 11.
- 5. SSPC-SP 6 (WAB)/NACE WAB-3.
- 6. SSPC-SP 10 (WAB)/NACE WAB-2.
- 7. SSPC-SP 5 (WAB)/NACE WAB-1.
- 8. SSPC-SP 8.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.

- 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
- 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. If unresolved discrepancies exist, prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.03 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge

of plate before packing with grout.

- 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.04 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened unless indicated otherwise in Drawings.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.05 INSTALLATION OF PREFABRICATED BUILDING COLUMNS

- A. Install prefabricated building columns to comply with ANSI/AISC 360, manufacturer's written recommendations, and requirements of testing and inspecting agency that apply to the fire-resistance rating indicated.
- 3.06 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
 - 1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Cleaning and touchup painting are specified in Section 09 90 02 "High-Performance Coatings."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 09 90 02 "High-Performance Coatings."
- 3.07 FIELD QUALITY CONTROL
 - A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
 - B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - i. Liquid Penetrant Inspection: ASTM E165/E165M.
 - ii. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - iii. Ultrasonic Inspection: ASTM E164.

iv. Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 12 00

STRUCTURAL STEEL FRAMING

ECTION 05 50 00 METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel framing and supports.
 - 2. Metal floor plate.
 - 3. Metal Canopies.
 - 4. Miscellaneous steel trim.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
 - 2. Steel weld plates and angles for casting into concrete.

1.02 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Fasteners.
 - a. Furnish ICBO Evaluation reports, product data, and installation instructions for post-installed anchors.
 - 2. Shop primers.
 - 3. Shrinkage-resisting grout.
 - 4. Slotted channel framing.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- 1.03 INFORMATIONAL SUBMITTALS
 - A. Adhesive Anchors. Furnish the following:
 - 1. Manufacturer's past project experience data on at least three similar projects supplied with proposed system within the last three years, to include client name, address, contact person, phone number, project location, and description of work.
 - 2. Test reports for each batch of adhesive delivered to site. Provide manufacturer's written certification that each batch delivered meets these Specifications, the intended uses on project, and capability to bond to damp or wet concrete surfaces.

- 3. Manufacturer's written letter of certification identifying contractor employees qualified for installing adhesive anchors, trained through jobsite instruction conducted by manufacturer.
- 4. Furnish specific written statement from EPA and health agencies that the adhesive product is acceptable for use in potable water structures or conveyances prior to use on this project.
- B. All Concrete Anchors. Provide specific instructions or all phases of installation including hole size, preparation, placement, and procedures. Provide also specific instructions for safe handling and installation of all anchors to Contractor staff handling and installing these anchors.

1.04 QUALITY ASSURANCE

- A. Qualifications. Qualify welding operators in accordance with requirements of current AWS Standard Qualification Procedure D1.1, Chapter 5.
 - 1. Qualification Tests. Performed by a recognized testing laboratory.
- B. Certification. Certify welders of structural and reinforcing steel for all positions of welding in accordance with such procedure.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Shipment.
 - 1. Insofar as practical, factory assemble items specified herein.
 - 2. Package and clearly tag parts and assemblies that are of necessity shipped unassembled, in a manner that will protect materials from damage, and facilitate identification and field assembly.
- B. Storage of Adhesive Products.
 - 1. Store components on pallets or shelving in a covered storage area with locking door.
 - 2. Control temperature within 41 degrees F to 77 degrees F and dispose of product if shelf life has expired.
 - 3. If stored at temperatures above manufacturer's recommended maximum, test components prior to use to determine if they still meet specified requirements.

PART 2 - PRODUCTS

- 2.01 PERFORMANCE REQUIREMENTS
 - A. Like Items of Materials. End products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.
 - B. Lifting Lugs. Provide on equipment and equipment components weighing over 100 pounds.
- 2.02 GENERAL

METAL FABRICATIONS

- A. Furnish miscellaneous items.
 - 1. Miscellaneous metal work and castings as shown, or as required to secure various parts together and provide a complete installation.
 - 2. Items specified herein are not intended to be all-inclusive. Provide metal work and castings shown, specified, or which can reasonably be inferred as necessary to complete the project.
- 2.03 METALS
 - A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
 - B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
 - C. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A588, Grade 50.
 - D. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 316L.
 - E. Rolled-Stainless Steel Floor Plate: ASTM A793, Type 316L.
 - F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
 - G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
 - 2. Material: Galvanized steel, ASTM A653/A653M, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.
 - H. Aluminum Structural Shapes & Plates: Alloy 6061-T6, meeting referenced specifications & ASTM sections found in Aluminum Association current Construction Manual Series
 - I. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.
 - J. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
 - K. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- 2.04 FASTENERS
 - A. General: Unless otherwise indicated, provide ASTM A193, Type 316stainless steel fasteners if not permanently embedded in concrete, but located outdoors in areas subject to the weather; chemical handling areas; equipment rooms subject to drainage, leakage, and washdown; and in galleries and trenches.
 - 1. Provide stainless steel fasteners for fastening aluminumand stainless steel .
 - 2. ASTM A307 or A36 with ASTM A153 galvanized if not permanently embedded in concrete, and not used for structural steel or piping, but located indoors where wash down, leakage, and drainage are not likely to occur (e.g., in personnel

buildings excluding laboratories, on motor floors, in electrical equipment rooms, and in control rooms).

- 3. For Flanges of Piping, Valves, and Other Similar Connections. As specified in other sections, or as shown.
- 4. Tie Rod assemblies:
 - a. ASTM A307A or A36 with ASTM A153 galvanized for threaded rods.
 - b. ASTM A668 Class A with ASTM A153 galvanized for clevises and turnbuckles.
 - c. ASTM A307A or A36 with ASTM A123/A153 galvanized for clevis pins.
- B. Anchor Bolts:
 - 1. Nonsubmerged Use:
 - a. Galvanized Steel. For equipment and machinery, where permanently anchored into concrete, unless otherwise shown.
 - b. Diameter, Length, and Bend Dimensions. As required by equipment or machinery manufacturer. Unless otherwise required by calculations for seismic or other loadings, provide 5/8-inch minimum diameter and other geometry as shown.
 - c. Furnish minimum two nuts and a washer of same material for each bolt.
 - d. Provide sleeves as required or as shown for location adjustment.
 - 2. Submerged Use:
 - a. Submerged use is defined as any connection below a point 1 foot 6 inches above maximum water surface elevation in a water holding basin.
 - b. As specified for nonsubmerged use, for anchoring equipment, machinery or other connection except as follows:
 - 1) 316 stainless steel.
 - 3. For anchoring fabricated metal work or structural building columns, or other components where connections will be protected or dry.
 - a. Galvanized steel.
 - b. Minimum Size. 5/8-inch diameter by 12-inch long, unless otherwise shown or required by calculations.
 - c. Furnish two nuts and one washer per bolt of same material as bolt, unless otherwise shown.
 - 4. For anchoring fabricated metal work or structural building, or structural frame components in areas of wet use, wash down areas, or areas outside heated buildings.
 - a. Galvanized steel.

- b. Minimum Size. 5/8-inch diameter by 12-inch long, unless otherwise shown or required by calculations.
- c. Furnish two nuts and one washer per bolt of same material as bolt, unless otherwise shown.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchorsas indicated in Drawings.
 - 1. Manufacturer:
 - a. Dewalt Anchors
 - b. Hilti, Inc.
 - c. Simpson Strong-Tie
 - d. Or approved equal.

2.05 ANCHOR BOLT SLEEVE

- A. Fabricated Steel Sleeve.
 - 1. Material. A36 steel.
 - 2. Dimensions, welding, and sizes as shown.
- 2.06 MISCELLANEOUS MATERIALS
 - A. Weld Electrodes: Provide weld electrodes that are compatible with the connected base metal(s).
 - 1. Use E70xx electrode to weld carbon steel base metals.
 - 2. Use low-alloy E80xx-W to weld weathering steel base metals.
 - 3. Use 308L electrode to weld austenitic stainless steel (types 301, 302, 304, 305 stainless steel) base metals.
 - 4. Use 316L electrode to weld type 316 and 316L stainless steel base metals.
 - B. Shop Primers: Provide primers that comply with Section 09 90 00 "Painting and Coating" and Section 09 90 02 "High Performance Painting and Coating".
 - C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
 - D. Stainless Steel Fastener Lubricant (Antiseizing)
 - 1. Provide for stainless steel nuts and machined bolts, anchor bolts, concrete anchors, and all other threaded fasteners.
 - 2. Lubricant shall contain substantial amounts of molybdenum disulfide, graphite, mica, talc, or copper as manufactured by:
 - a. Loc Tite Co., Permatex.
 - b. Or equal.

E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.07 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, not less than 8 inches from ends and corners of units and 24 inches o.c.

2.08 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- 2.09 METAL FLOOR PLATE
 - A. Fabricate from rolled-stainless steel floor plate of thickness indicated below:
 - 1. Thickness: As indicated.

- B. Provide stainless steel angle supports as indicated.
- C. Provide flush stainless steel bar drop handles for lifting removable sections, one at each end of each section.
- 2.10 MISCELLANEOUS STEEL TRIM
 - A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
 - B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
 - C. Prime miscellaneous steel trim with primer specified in Section 09 90 02 "High-Performance Painting & Coating."
- 2.11 STEEL WELD PLATES AND ANGLES
 - A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.
- 2.12 GENERAL FINISH REQUIREMENTS
 - A. Finish metal fabrications after assembly.
- 2.13 STEEL AND IRON FINISHES
 - A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
 - B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 09 90 00 "Painting and Coating" primers specified in Section 09 90 02 "High Performance Painting and Coating" unless indicated.
 - C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
 - D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
 - 1. Do not begin installation until concrete or masonry receiving anchors have attained design strength.
 - 2. Do not install an anchor closer than six times its diameter to either an edge of concrete or masonry, or to another anchor, unless specifically shown otherwise.
- E. Apply specified antiseizing lubricant to threads prior to making up connections.
- F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- 3.02 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS
 - A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
 - B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.
 - C. Anchor shelf angles securely to existing construction with expansion anchors .

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

3.03 ELECTOLYTIC PROTECTION

- A. Aluminum.
 - 1. Where in contact with dissimilar metals, or embedded in masonry or concrete, protect surfaces as specified in Section 09 90 00 "Painting and Coating".
 - 2. Allow paint to dry before installation of the material.
 - 3. Protect painted surfaces during installation.
 - 4. Should coating become marred, prepare and touch up per paint manufacturer's written instructions.
- B. Where titanium equipment is in contact with concrete or dissimilar metals, provide fullface neoprene insulation gasket, 3/32-inch minimum thickness and 70 durometer hardness.

3.04 INSTALLATION OF BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.05 REPAIRS

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 50 00

SECTION 05 53 13 BAR GRATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes metal bar gratings and metal frames and supports for gratings.
- B. Related Requirements:
 - 1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.
 - 2. Section 09 90 02 "High Performance Painting & Coating" for any gratings other than stainless or galvanized steel, or aluminum.

1.03 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Where applicable, coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- 1.04 ACTION SUBMITTALS
 - A. Product Data: For the following:
 - 1. Metal bar gratings.
 - 2. Clips and anchorage devices for gratings.
 - 3. Paint products.
 - B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1.05 INFORMATIONAL SUBMITTALS

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."
 - 3. AWS D1.3/D1.3M, "Structural Welding Code Sheet Steel."
 - 4. AWS D1.6/D1.6M, "Structural Welding Code Stainless Steel."

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. McNichols Company GHB Series Heavy Duty Welded Bar Grating.
 - 2. Or approved equal.

2.02 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."
- B. Design characteristics for Metal Bar Gratings shall be:
 - 1. Live Load = minimum 125 lb/ft^2 ;
 - 2. 1,000 lb. concentrated load in middle of span;
 - 3. ¹/₄" maximum deflection under live load conditions
- C. Welded Steel Grating:
 - 1. Bearing Bar Spacing: 1-3/16 inches o.c.
 - 2. Bearing Bar Depth: 2 inches *(including serration depth)*
 - 3. Bearing Bar Thickness: 1/4 inch.
 - 4. Crossbar Spacing: 2 inches o.c.
 - 5. Grating Mark: GHB-200-2 by McNichols Company (or approved equal).
 - 6. Traffic Surface: Serrated.
 - 7. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.03 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- C. Wire Rod for Bar Grating Crossbars: ASTM A 510.
- 2.04 FASTENERS
 - A. All support members and fasteners for the bar grating shall be type 316 stainless steel;

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563 and, where indicated, flat washers.
- C. Post-Installed Anchors: chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.05 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.06 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
 - 1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.

- H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.
- I. Do not notch bearing bars at supports to maintain elevation.
- 2.07 GRATING FRAMES AND SUPPORTS
 - A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 - 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.
 - B. Galvanize steel frames (UNO) and supports in the following locations:
 - 1. Exterior.
 - 2. Interior.

2.08 STEEL FINISHES

- A. Finish gratings, frames, and supports after assembly.
- B. Galvanizing: Hot-dip galvanize items where indicated on the drawings to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

- 3.01 INSTALLATION, GENERAL
 - A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
 - B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete.
 - D. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the

surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- E. Field Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

3.02 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.03 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 53 13

SECTION 05 53 16 PLANK GRATINGS (OHIO GRATINGS)

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes:
 - 1. Prefabricated custom-designed aluminum plank gratings;
 - 2. Metal frames and supports for gratings;
 - 3. Miscellaneous installation hardware and accessories

1.02 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01, 03 and 05 Specifications.
- 1.03 REFERENCES
 - A. ASTM B 221 Aluminum Extruded Bars and Shapes
 - B. ANSI/NAAMM- MBG-531-09 Metal Bar Grating Manual
 - C. CANSI-NFSI B101.3-2012 Test Method for Measuring Wet Dynamic Coefficient of Friction (Wet DCOF) of Common Hard-Surface Floor Materials

1.04 COORDINATION

- A. Where applicable, coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.05 ACTION SUBMITTALS

- A. Product Data: The contractor shall submit the manufacturer's catalog pages including load tables, anchor details and standard installation details.
- B. Shop drawings: The contractor shall submit for approval shop drawings for the fabrication and erection of all gratings, based on construction drawings of current issue. Include plans, elevations, and details of sections and connections as required. Show type and location of all fasteners.
- C. Samples of Grating and Anchorage system shall be submitted for approval.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualification: A company specializing in the manufacture of metal bar gratings with not less than 10 years of documented experience.
- B. Fabrication tolerances shall be in accordance with applicable provisions and recommendations of ANSI/NAAMM 531-09 Metal Bar Grating Manual.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum."

1.07 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 SOURCE REQUIREMENTS

A. Design is based upon use of gratings as manufactured by Ohio Gratings and terminology used herein may include reference to the specific performance or product of this manufacturer. Such reference shall be construed only as establishing the quality of materials, operational features and workmanship to be used under this Section and shall not, in any way, be construed as limiting competition.

2.02 MANUFACTURERS

A. Acceptable Manufacturers include Ohio Gratings, 5299 Southway St. SW, Canton, Ohio 44706, 800-321-9800 <u>www.ohiogratings.com</u>, or approved equal.

2.03 MANUFACTURED UNITS

- A. Description: Aluminum Heavy Duty Plank Grating type UNPUNCHED: Six inch wide (minimum width see contract drawings for dimensions) extruded aluminum plank with support bars spaced 1.2" on center, fabricated with banding into panels of standard width to fill areas shown on the drawings.
 - 1. Plank Depth: based on loading requirements and clear span.
 - 2. Top Surface: Striated or with OnGrip[™] Spray Traction Surface
- B. Fabrication: Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings. Band ends and cuts in grating with 3/16" thick bars of same depth as the plank.
- C. Design Criteria:
 - 1. Loading: Grating Products shall be designed and manufactured to meet the

live load conditions of 125 lb/ft² with maximum deflection of 1/4" for the clear spans shown on the drawings. Plank depth shall be as shown on the contract drawings or as recommended by the manufacturer to meet the loading requirements, clear span conditions and maximum deflections specified.

- D. Materials: Plank and banding are Aluminum type 6063-T6.
- E. Fabrication Tolerances shall be in accordance with ANSI/NAAMM MBG 531-09 Metal Bar Grating Manual.
- F. Finish: Gratings shall be Mill finish or A-41 Clear Anodized or Powder Coat Painted (choose color)
- G. FASTENERS
 - 1. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - a. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.
 - 3. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.04 FABRICATION

- A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Fit exposed connections accurately together to form hairline joints.
- C. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- D. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.
 - 1. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
- E. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch thick to

the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.05 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 - 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

PART 3 - EXECUTION

3.01 FIELD VERIFICATION

A. Take field measurements prior to preparation of final shop drawings and fabrication where required to ensure proper fitting of the work.

3.02 INSTALLATION

- A. Prior to grating installation, contractor shall inspect supports for correct alignment and conditions for proper attachment and support of the gratings. Any inconsistencies between contract drawings and supporting structure deemed detrimental to grating placement shall be reported in writing to the Engineer or owner's agent prior to placement.
- B. Install grating in accordance with shop drawings and standard installation clearances as recommended by ANSI/NAAMM MBG-531-09 Metal Bar Grating Manual.
- C. Protection of Aluminum from Dissimilar Materials:
 - 1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint or use of other approved insulating material.
 - 2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry or lime mortar, exposed aluminum surfaces shall be painted with one coat of bituminous paint or use of other approved insulating material.

3.03 GRATING ATTACHMENT

A. Use approved attachment system and fasteners to secure grating to supporting members as shown on plans.

END OF SECTION 05 53 00

PLANK GRATINGS

DIVISION 6

WOODS, PLASTICS, COMPOSITES

SECTION 06 10 00 ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Rooftop equipment bases and support curbs.
 - 3. Wood blocking and nailers.
- 1.02 ACTION SUBMITTALS
 - A. Product Data: For each type of process and factory-fabricated product.
- 1.03 INFORMATIONAL SUBMITTALS
- 1.04 QUALITY ASSURANCE

PART 2 - PRODUCTS

- 2.01 WOOD PRODUCTS, GENERAL
 - A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
 - 3. Dress lumber, S4S, unless otherwise indicated.
 - B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
 - C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

- 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 - 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 - 4. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction, Stud, or No. 3 grade.
 - 1. Application: All interior partitions.
 - 2. Species:
 - a. Western woods; WCLIB or WWPA.
- B. Framing Other Than Non-Load-Bearing Partitions: No. 2 grade.
 - 1. Application: Framing other than interior partitions.
 - 2. Species:
 - a. Spruce-pine-fir; NLGA.
- 2.04 MISCELLANEOUS LUMBER
 - A. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- 2.05 FASTENERS
 - A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressurepreservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
 - B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.06 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Simpson Strong-Tie Co., Inc.
 - 2. USP Structural Connectors.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
 - 1. Use for wood-preservative-treated lumber and where indicated.
- 2.07 MISCELLANEOUS MATERIALS
 - A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

- G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.

3.02 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

DIVISION 7

THERMAL & MOISTURE PROTECTION

SECTION 07 11 00 DAMPPROOFING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to furnish and install, complete, all belowgrade dampproofing.
- 1.02 RELATED SECTIONS
 - A. Division 3 Concrete & Grout
- 1.03 GENERAL
 - A. See the GENERAL CONDITIONS and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.
- 1.04 SUBMITTALS
 - A. Submittals shall be made in accordance with Section 01 30 00, SUBMITTALS in Division 1, GENERAL REQUIREMENTS.
 - B. Submit the following:
 - 1. Manufacturer's Literature: Submit manufacturer's literature, specifications, and application instructions for dampproofing materials.
 - 2. Certificate: Submit manufacturer's certificate of conformance with these Specifications.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. The use of a manufacturer's name and catalog number is for the purpose of establishing the standard of quality desired only. Products of other manufacturers will be considered in accordance with the General Conditions.

2.02 DAMPPROOFING

A. Asphalt compound of brush or spray consistency conforming to Federal Specification SS-A-701 or ASTM D449, Type A; A.C. Horn Dehydratine 4; J & P Petroleum Products Tex-Mastic No. 720; W.R. Meadows, Inc. Spray-Mastic; Sonneborn Hydrocide 700B; or equal.

PART 3 - EXECUTION

- 3.01 ENVIRONMENTAL REQUIREMENTS
 - A. Do not start work until the following environmental requirements are met.

- B. Do not proceed with application of materials when ambient temperature is less than 50°
 F.
- C. Do not apply dampproofing in rainy conditions or within 3 days after surfaces become wet from rainfall or other moisture.
- D. Do not apply materials when low temperature of 40 degrees F or less is predicted within a period of 24 hours after application.
- 3.02 INSPECTION
 - A. Examine surfaces to receive dampproofing to assure conditions are satisfactory for application of materials.
- 3.03 SURFACE PREPARATION
 - A. Clean surfaces to remove dust, dirt, oil, wax, efflorescence, and other foreign materials, in accordance with dampproofing manufacturer's instructions.
 - B. Remove efflorescence by scrubbing surface with muriatic acid and thoroughly rinsing with water.
 - C. Allow 3 days drying time following washing down of substrate surfaces.
 - D. Fill all cracks, voids, and honeycombs with mortar to provide sound surface for dampproofing.

3.04 APPLICATION

- A. Apply dampproofing with a brush, or with manufacturer-approved low pressure airless spray equipment with a coarse nozzle.
- B. Apply materials at rate and as recommended by the manufacturer and in two coats.
- C. Start application at top of wall and work down surface, keeping a wet edge at all times, forming a continuous, unbroken film, free from pinholes and other surface breaks.
- 3.05 ADJUST AND CLEAN
 - A. Clean spillage and overspray from adjacent surfaces as recommended by manufacturer.
- 3.06 FIELD QUALITY CONTROL
 - A. After dampproofing has dried, spray coat surfaces with water.
 - B. Recoat surfaces that show water absorption, as recommended by manufacturer. To prevent blistering, protect surfaces from heat and direct sunlight until dried, then backfill.
- 3.07 PRODUCT DELIVERY, STORAGE, AND HANDLING
 - A. Deliver materials in original sealed containers, clearly marked with manufacturer's name, brand name, and type of material.
 - B. Store materials in area where temperatures are not less than 50 degrees F or over 85 degrees F, unless otherwise authorized by manufacturer.
- 3.08 APPLICATION SCHEDULE

DAMPPROOFING

A. <u>Apply dampproofing to all exterior surfaces of all cast-in-place and pre-cast concrete</u> <u>structures below finish ground level to at least 4" above finished ground surface.</u> Do not apply to interior of water holding basins.

END OF SECTION 07 11 00

SECTION 07 13 00 SHEET WATERPROOFING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Rubberized Asphalt Sheet Membrane Waterproofing System
- 1.02 RELATED SECTIONS
 - A. Section 03 30 00 Cast in Place Concrete

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM) International Annual Book of ASTM Standards
 - 1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - 2. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials.
 - 3. ASTM C836 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for use with Separate Wearing Course.
 - 4. ASTM E154 Standard Test Methods for Water Vapor Retarders used in contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 - 5. ASTM D5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
- B. Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) Architectural Sheet Metal Manual.
- C. American Society of Civil Engineers (ASCE).
- 1.04 SUBMITTALS
 - A. Product Data: Provide copies of manufacturer's product data information and samples for each type of membrane product.
 - B. Manufacturers Application Instructions: Provide manufacturer's application instructions that indicate preparation required, installation procedures, and detail drawings.

1.05 MANUFACTURER & CONTRACTOR QUALIFICATIONS

- A. Manufacturer Qualifications: Provide all primary membrane products, including sheet waterproofing membrane, primers and mastics offered by a single manufacturer.
- B. Installer Qualifications: Installer must be licensed or otherwise authorized by all federal, state and local authorities for installation of all membrane products to be installed under this section.
- 1.06 REGULATORY REQUIREMENTS
 - A. Install all membrane products in accordance with all applicable federal, state and local

building codes.

B. All work shall be performed in a manner consistent with current OSHA guidelines.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product and other materials to site in manufacturer's unopened labeled packaging. Promptly verify quantities and conditions. Immediately remove damaged products from site.
- B. Store all products in manufacturer's unopened, labeled packaging until they are ready for installation.
- C. Store rolls on a flat surface. Maximum stacking height shall not exceed TAMKO's recommendations. Store all rolls on end and do not double stack pallets.
- D. Store and dispose of solvent-based materials in accordance with all applicable federal, state and local regulations.
- E. Store products in weather protected environment out of direct sunlight, below 90°F, above 32°F clear of ground and moisture. All waterproof tarps shall be opaque.

1.08 WEATHER CONDITIONS

- A. Proceed with work only when existing and forecasted weather conditions will permit work to be performed in accordance with TAMKO's application instructions.
- B. Membrane must not be left exposed to sunlight for more than 30 days after installation.

1.09 LIMITED WARRANTY AND ARBITRATION AGREEMENT

- A. Manufacturer's Limited Warranty: Provide to the owner a TAMKO® Waterproofing, Fenestration Flashings, Underlayment's and Accessories Limited Warranty and Arbitration Agreement for the product listed below which includes a binding arbitration provision.
 - 1. TAMKO® TW-60 Self-Adhering Sheet Waterproofing Membrane: TAMKO Waterproofing, Fenestration Flashings, Underlayment's and Accessories Limited Warranty and Arbitration Agreement. Available at www.tamko.com
 - 2. Term: The period of time this Limited Warranty lasts is five (5) years for TW-60 Self-Adhering Sheet Waterproofing Membrane.
 - 3. The limited warranty does not cover any cost or expenses associated with removal, excavation, or replacement of concrete or other materials in connection with the testing, repair, removal, or replacement of the product.
 - 4. Exclusions: See TAMKO® Waterproofing, Fenestration Flashing, Underlayment's and Accessories Limited Warranty and Arbitration Agreement for exclusions and other important details. Contact TAMKO for a copy of the Limited Material Warranty.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS Basis of Design: TAMKO® TW-60 Self-Adhering Sheet Waterproofing Membrane: 12" wide roll, centered over joint.
 - A. Acceptable Manufacturer: TAMKO Building Products, Inc., 220 West 4th Street, Joplin, MO 64801. Toll Free: 1-800-641-4691.
 - B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

PART 3 - EXECUTION

3.01 LOCATION

A. Apply the outside face of wall/slab joint where interior slab-on-grade is below the exterior finish. See structural drawings for exact locations.

3.02 EXAMINATION

- A. Examine substrates, areas and conditions, with installer present for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. The surface must be dry and have a smooth (not broomed) finish and be free of form release agents, voids and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If preparation is the responsibility of another installer, notify the architect or building owner of unsatisfactory preparation before proceeding.

3.03 PREPARATION

- A. Any holes or voids must be repaired with non-shrink grout. Cracks greater than 1/16" in width shall be cut out to a minimum of ¹/₄" with a minimum depth of ¹/₄" and sealed using a sealant suitable for use with rubberized asphalt per sealant manufacturer, prior to the installation of the sheet membrane.
- B. Concrete must be properly cured and dry. Curing time is a minimum of 7 days for normal structural concrete and a minimum of 14 days for lightweight structural concrete. Curing agents containing wax, oil, or pigment should not be used.
- C. Masonry (CMU) surfaces must have a thorough parge coat and mortar joints must be flush to the face of the concrete block or brick, and have a thorough parge coat.
- D. Forms should be removed as quickly as possible. On a horizontal deck, do not apply membrane when forms are in place unless the forms are vented.
- E. Expanded/Extruded Polystyrene (EPS/XPS) or Insulated Concrete Forms (ICF). Ultraviolent radiation in sunlight causes a rapid deterioration of the surface of these materials which can create a chalky or dusty layer which could interfere with membrane adhesion. If this occurs, or if the surface is dirty, brush off all dirt and dust to provide a clean dry surface for the application of the membrane. Joints and voids in the surface over ¼" wide should be filled with non-shrink grout, expandable foam or compatible crack filler.

3.04 PRIMING

- A. Priming is required on concrete, masonry, metal, EPS/XPS and ICF surfaces. Thoroughly mix the primer. Apply at recommended coverage rates with a sprayer or long nap roller and allow drying as specified in the primer's application instructions.
 - 1. TAMKO® TWP-1 Primer: Apply primer to a properly prepared, clean surface. All surfaces that are to receive a waterproofing membrane shall be primed at the rate of 250 to 300 sq. ft. per gallon. Apply an even coat, and allow drying. Refer to manufacturer's written application instructions for specific application rates and drying time.
 - 2. TAMKO® TWP-2 Primer: Apply primer to a properly prepared, clean surface. All surfaces that are to receive a waterproofing membrane shall be primed at the rate of 350 to 400 sq. ft. per gallon. Apply an even coat, and allow drying. Refer to manufacturer's written applications instructions for specific application rates and drying time.

3.05 APPLICATION

- A. Horizontal: Starting at the low point of the surface and working to the high point, install the sheet waterproofing membrane by simultaneously rolling the sheet into place while removing the release film. Side laps should be a minimum of 2 1/2", and end laps should be a minimum of 5". Stagger all end laps. All edges terminating on a surface other than the waterproofing membrane should be sealed with TWM-1 Mastic or another compatible termination sealant. Roll the entire membrane as soon as possible with a minimum 75 lb. hard-surface or rubber-faced roller.
- B. Vertical: Install waterproofing membrane in lengths of 8' or less. Overlap edge seams a minimum of 2 ½". On walls greater than 8' apply in 8' sections, starting at the lowest point with the higher section overlapping the lower section a minimum of 5". Use heavy hand pressure or a suitable roller to press membrane firmly against wall and to seal all overlaps.

3.06 TERMINATIONS

A. Concrete or Masonry Surfaces: TW-60 sheet should be installed over the top of a wall or over the edge of a slab. If the membrane must terminate on a vertical surface, use a reglet, termination bar, or counter flashing. Press terminating edge firmly with a hammer handle, roller, or similar tool. Apply TWM-1 Mastic or another compatible termination sealant to all edges terminating on a surface other than TW-60. TW-60 Sheet Membrane shall be installed on the base of the foundation wall, over the edge of the footing and the terminating edge pressed firmly against the vertical surface of the footing. Apply TWM-1 Mastic or another compatible terminating edges including both vertical and horizontal.

Note: Failure to use adequate pressure at terminating edges will result in poor seal, potential leaks and may affect coverage under the limited warranty. The use of a terminating sealant is not a substitute for a good membrane seal.

3.07 MEMBRANE PROTECTION

A. Protection of the waterproofing membrane on vertical and horizontal surface is required immediately after installation with an appropriate protection course. For balcony and breezeway installations, use of protection course is not required.

3.08 CLEAN UP

A. In areas where adjacent finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions. Remove all debris, tools and equipment.

END OF SECTION 07 13 00

SECTION 07 21 00 BUILDING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Thermal Batt Insulation
 - 2. Extruded polystyrene rigid board insulation
 - 3. Spray insulation

1.02 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00.
- B. Product Data: Submit product data and manufacturer's instructions for each product.
- 1.03 QUALITY ASSURANCE
 - A. Single Source Responsibility: Furnish each insulation type from one manufacturer for entire Project, unless otherwise acceptable to Architect.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Comply with requirements of Section 01 60 00.
 - B. Identify products with appropriate markings of applicable testing and inspecting organization.
 - C. Storage and Protection:
 - 1. Store materials raised off floor or ground and under cover to keep dry.
 - 2. Protected from weather, direct sun light, contamination, sources of ignition, and damage from construction operations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Extruded polystyrene rigid board insulation
 - 1. Manufacturer:
 - a. Owens Corning Foamular 250;
 - b. Dow Styrofoam;
 - c. Approved equal
 - 2. General Requirements:
 - a. Thickness/R value per drawings.

- 3. Location:
 - a. Where indicated on the design drawings above process yard piping with inadequate burial.
- B. Closed Cell Spray Foam Insulation
 - 1. Manufacturer:
 - a. Johns Manville Corbond III or approved equal.
 - 2. Location:
 - a. Door and window gaps
 - b. May be used as substitution for batt insulation where approved by Engineer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions and proceed with work in accordance with Section 01700.
- B. Verify that work of other trades which will be covered by insulation is complete, approved, and tested.
- 3.02 INSTALLATION
 - A. General:
 - 1. Install in strict accordance with manufacturer's recommendations including specific requirements per product type below.
 - B. Protect finished work in accordance with Section 01 70 00.

END OF SECTION 07 21 00

SECTION 07 25 00 WEATHER BARRIERS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings
- 1.02 SUMMARY
 - A. Section Includes:
 - 1. Underslab Vapor Barrier
 - 2. Commercial weather barrier assemblies.
 - 3. Flexible flashing.
 - 4. Weather barrier flashing.
 - 5. Fluid-applied flashing.
 - 6. Weather barrier accessories.
 - 7. Drainage material.
 - B. Related Requirements:
 - 1. Section 07 90 00 Joint Sealers
 - 2. Section 07 21 00 Building Insulation
- 1.03 DEFINITIONS
 - A. Vapor Barrier: A combination of materials and accessories that prevent the movement of vapors from a building's exterior to its interior.
 - B. Weather Barrier: A combination of materials and accessories that do the following:
 - 1. Prevents the accumulation of water as a water-resistive barrier.
 - 2. Minimizes the air leakage into or out of the building envelope as a continuous air barrier.
 - 3. Provides sufficient water vapor transmission to enable drying as a vapor-permeable membrane.
 - C. Water-Resistive Barrier: A combination of materials and accessories that prevent the accumulation of water within the wall assembly per International Building Code Section 1403.2.
 - D. Continuous Air Barrier: The combination of interconnected materials, assemblies, and sealed joints and components of the building envelope that minimize air leakage into or out of the building envelope per ASHRAE 90.1 section 5.4.3.1.
 - E. Vapor Diffusion: A slow movement of individual water vapor molecules from regions of

higher to lower water vapor concentration (higher to lower vapor pressure).

F. Vapor Permeable Membrane: The property of having a water-vapor permeance rating of 10 perms or greater, when tested in accordance with the desiccant method using Procedure A of ASTM E 96 per definition in International Building Code. Vapor permeable material permits the passage of moisture vapor through vapor diffusion.

1.04 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For weather barrier, include data on air and water-vapor permeance based on testing in accordance with referenced standards.
 - 2. Provide SDS, third-party certifications, or product technical data.
- B. Evaluation Reports: For weather barrier and flexible flashing, from ICC-ES.
- C. Manufacturer's Instructions: For installation of each product specified.
- D. Qualification Data: For Installer
- E. Sample Warranty: For manufacturer's warranty.
- 1.05 QUALITY ASSURANCE
 - A. Installer Qualifications: A qualified firm that is certified by weather barrier system manufacturer to install manufacturer's product.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Do not store near heat source or open flame.
- 1.07 WARRANTY
 - A. Manufacturer's Product Warranty: To repair or replace weather barrier product that fails in materials within specified warranty period.
 - 1. Warranty Period: 10 years from date of purchase.
 - B. Manufacturer's Product and Labor Warranty: Manufacturer agrees to repair or replace weather barrier that fails in materials within specified warranty period, including removal and replacement of affected construction up to manufacturer's limits.
 - 1. Warranty Period: 10 years from date of purchase.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS
 - A. Source Limitations: Obtain weather barrier assembly components, including weather barrier flashing from same manufacturer as weather barrier or manufacturer approved by weather barrier manufacturer.
- 2.02 PERFORMANCE REQUIREMENTS
 - A. General Performance: Installed weather barrier and accessories shall withstand specified

wind pressures, liquid water penetration, and water vapor pressures, without failure due to defective manufacture of products.

- B. High-Performance Installations:
 - 1. For installation with one of the following building envelope performance or structural characteristics:
 - a. Exceeding 65 mph equivalent structural load.
 - b. Exceeding 15 mph equivalent wind-driven rainwater infiltration.
 - c. Buildings with 60 feet or more total height above grade plane, as defined in the International Building Code.
 - d. Construction with gypsum or cement-based exterior sheathing.
 - e. Non-wood based primary structure such as: stel, light gage steel, masonry or concrete.

2.03 BELOW SLAB VAPOR BARRIER

- A. W. R. MEADOWS®, INC., PO Box 338, Hampshire, Illinois 60140-0338. (800) 342-5976. (847) 683-4500. Fax (847) 683-4544. Web Site <u>www.wrmeadows.com</u>.
- B. Accessories:
 - 1. Seam Tape
 - a. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4".
 - b. PERMINATOR EVOH TAPE by W. R. MEADOWS.
- C. Double Sided Seam Tape
 - 1. Double sided butyl tape for overlap sealing in gas barrier installations. Minimum width 2" (50 mm).
 - 2. PERMINATOR EVOH BUTYL TAPE by W. R. MEADOWS.
- D. Pipe Collars
 - 1. Construct pipe collars from gas barrier material and pressure sensitive tape per manufacturer's instructions.

2.04 WEATHER BARRIER

- A. Commercial Building Wrap: ASTM E 2357 passed, ABAA (Air Barrier Association of America) evaluated air barrier assembly, and assembly water resistance per ASTM E 331; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested in accordance with ASTM E 84; UV stabilized for nine-month exposure; and acceptable to authorities having jurisdiction.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek

CommercialWrap or a comparable product by one of the following:

- a. Approved equal.
- 2. System Description, Single-Layer Weather Barrier: Single-layer weather barrier, including flashing and sealing of penetrations and seams.
- B. Conformable Weather Barrier Flashing: Composite flashing material composed of microcreped, polyethylene laminate with a 100 percent butyl-based adhesive layer; AAMA 711 Class A (no primer), Level 3 thermal exposure, 176 deg F for 7 days.
 - Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; FlexWrap[™] NF or comparable product by one of the following.
 - a. Approved equal.
- C. Strip Flashing: Composite flashing material composed of spunbonded polyethylene laminate with 100 percent butyl-based, dual-sided, adhesive layer; AAMA 711, Class A (no primer), Level 3 thermal exposure, 176 deg F for 7 days.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; StraightFlash or comparable product by one of the following:
 - a. Approved equal.

2.05 FLUID-APPLIED FLASHING

- A. Fluid-Applied Flashing: Trowel or brush applied, non-water soluble, single component, silyl terminated polyether technology (STPE), vapor permeable, flashing material.
 - Basis-of-Design Product: Subject to compliance with requirements, provide DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek[®] Fluid Applied Flashing & Joint Compound+ or comparable product by one of the following:
 - a. Approved equal.

2.06 WEATHER BARRIER ACCESSORIES

- A. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by weather barrier manufacturer for sealing joints and penetrations in commercial building wrap.
 - 1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek[®] Tape.
- B. Closed-Cell Polyurethane Foam Insulation: Low pressure, low expansion, single component polyurethane foam, with maximum flame-spread and smoke-developed indexes of 15 and 25, respectively, per ASTM E 84.
 - 1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; DuPont[™] Window & Door Foam.
- C. Fasteners with Self-Gasketing Washers: Commercial building wrap manufacturer's

recommended pneumatically or hand-applied fasteners with 1-inch diameter, highdensity polyethylene cap washers with UV inhibitors.

- 1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company; Tyvek[®] Wrap Caps.
- D. Primer for Flashings: Synthetic rubber-based product; spray applied. Strengthen adhesive bond at low temperature applications between weather products such as self-adhered flashing products, commercial building wraps, and common building sheathing materials.
 - 1. Basis-of-Design Product: DuPont Safety & Construction: E. I. du Pont de Nemours and Company, DuPont[™] Adhesive Primer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements.
- B. Verify that substrate and surface conditions are in accordance with commercial weather barrier manufacturer recommendations prior to installation.
 - 1. Verify that rough sill framing for doors and windows is sloped downwards towards the exterior and is level across width of the opening.
- C. Verify that surfaces to receive weather barrier flashing are clean, dry, and free of frost.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Direct water onto an acceptable weather barrier drainage plane with an unobstructed path to exterior of wall.
 - 1. Provide a drainage path for water intrusion through window and door attachment system that collects at window and door sills and directs water to the exterior or weather barrier.
- 3.03 COMMERCIAL BUILDING WRAP INSTALLATION
 - A. General: Comply with weather barrier manufacturer's written instructions and warranty requirements.
 - B. Cover exposed exterior surface of sheathing with weather barrier securely fastened to framing immediately after sheathing is installed.
 - 1. Maintain continuity of air and water barrier assemblies.
 - 2. Start weather barrier installation at a building corner, leaving 12 inches of weather barrier extended beyond corner to overlap.
 - 3. Install weather barrier horizontally starting at lower portion of wall surface.
 - 4. Provide minimum 6 inches overlap at horizontal- and vertical-wrap seams in a shingle manner to maintain continuous downward drainage plane and air and water barrier.

- C. Seams: Seal seams with building wrap tape per manufacturer's recommended installation instructions.
 - 1. Shiplap horizontal seams in weather barrier to facilitate proper drainage.
- D. Fasteners: Use weather barrier manufacturer's recommended fasteners to secure weather barrier and install fasteners according weather barrier manufacturer's installation guidelines.
 - 1. Do not use temporary fasteners to permanently attach weather barrier.
 - 2. Do not place fasteners with gasketing washers where weather barrier flashing will be installed.
 - 3. Install fasteners with gasketing washers through flashing where recommended by manufacturer.
- E. Openings: Completely cover openings with weather barrier, then cut weather barrier membrane to openings according to weather barrier manufacturer's installation guidelines.
 - 1. Provide head and jamb flaps and seam overlaps to maintain continuous drainage.
 - 2. Repair damage to weather barrier using method recommended by weather barrier manufacturer.
 - 3. Install flashing according to weather barrier manufacturer's installation guidelines.

3.04 WEATHER BARRIER FLASHING INSTALLATION

- A. Installation: Remove wrinkles and bubbles, reposition weather barrier as necessary to produce a uniform, smooth surface.
 - 1. Ensure that ambient and substrate surface temperatures are acceptable in accordance with manufacturer instructions and recommendations.
 - 2. Wipe surfaces to remove moisture, dirt, grease and other debris that could interfere with adhesion.
 - 3. Apply weather barrier manufacturer's recommended primer over concrete, masonry, and glass-mat gypsum wall sheathing substrates to receive weather barrier flashing.
 - 4. Lap weather barrier flashing a minimum of 2 inches onto weather barrier.
 - 5. Apply pressure over entire surface using roller or firm hand pressure.

B. Rough

- 1. Apply 6-inch wide conformable weather barrier flashing at door and window sills.
- 2. Ensure that sill flashing does not slope to the interior.
- 3. Install backer rod in joint between frame of opening product and flashed rough opening on the interior.
- 4. Apply sealant or closed-cell polyurethane foam insulation around entire opening/fenestration product to create air seal around interior perimeter of window

WEATHER BARRIERS

openings in accordance with weather barrier manufacturer's instructions.

- 5. Around door and window openings, apply butyl-based flashing to flaps of weather barrier.
- 6. Use strip flashing with wrap cap screws to secure head flap of the windows.
- C. Penetrations: Apply weather barrier manufacturer's recommended weather barrier flashing patches behind fastening plates, such as brick-tie base plates, metal-flashing clips, and metal channels.
 - 1. Seal weather barrier around each penetration with weather barrier manufacturer's recommended self-adhered flashing product or sealant. Integrate products with flanges into the weather barrier.
- D. Terminations: Provide minimum 2 inches overlap using strip flashing on adjoining roof and base of wall systems to maintain continuous downward drainage plane.
 - 1. Secure Secure weather barrier with fasteners and weather-barrier flashing.

3.05 FLUID-APPLIED FLASHING INSTALLATION

- A. General: Before installing fluid-applied flashing, do the following:
 - 1. Ensure drainage path is not blocked or disrupted. Do not install on walls that do not feature a continuous path for moisture drainage. Blocked or disrupted paths for drainage can result in excess moisture buildup in wall cavity. Do not install below grade.
 - 2. Remove surface dust, dirt, and loose mortar.
 - 3. Verify that surface is free of grease and other contaminants and that surface is smooth.
 - 4. Fill joints in concrete masonry units, and voids in cast-in-place concrete with trowelapplied fluid-applied flashing to ensure surface is flush and smooth.
 - 5. Allow masonry mortar and cast-in-place concrete a minimum of 24 hours to cure before installing fluid-applied flashing.
- B. Fluid-Applied Flashing Installation: Using a trowel or brush, apply fluid-applied flashing around perimeter of window and door openings to a minimum thickness of 25 mils
 - 1. Extend flashing a minimum of 2 inches onto exterior face of adjacent surface.
 - 2. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.
 - 3. Joint Applications: Using a trowel or a brush, fill cracks and voids up to 1/4 inch in width.
 - a. For joints and cracks between 1/4 and 1/2 inch wide, cover first with mesh tape.
 - b. For joints and cracks between 1/2 and 1 inch wide, cover first with butyl-based strip flashing.

- c. Apply a bead, then trowel smooth.
- d. Seam coverage should be a minimum of 2 inches wide and 15 to 20 mils thick.
- e. Inspect for gaps and pinholes in fluid-applied flashing and apply additional coats until no gaps and pinholes appear.

3.06 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material with grooves or channels running vertically in compliance with manufacturer's written instructions.

3.07 CLEANING

A. Immediately remove release paper and scrap from work area and dispose of material in accordance with disposal requirements.

3.08 PROTECTION

- A. Protect installed weather barrier from the following:
 - 1. Damage from cladding, structure, or a component of the structure (e.g., window, door, or wall system).
 - 2. Contamination from building site chemicals, premature deterioration of building materials, or nonstandard use or application of products.
 - 3. Foreign objects or agents, including the use of materials incompatible with weather barrier products.
 - 4. UV exposure in excess of products' stated limits.

END OF SECTION 07 25 00

SECTION 07 62 00 SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Fabricated sheet metal items, including flashings, counterflashings, copings, and other items indicated in Schedule.
 - B. Reglets and accessories.
- 1.02 RELATED SECTIONS
 - A. 07 46 00 Steel Siding (*if applicable*)
 - B. 07 53 00 Elastomeric roofing (*if applicable*)
 - C. 07 90 00 Joint Sealants
- 1.03 REFERENCE STANDARDS
 - A. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
 - B. SMACNA (ASMM) Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.04 SUBMITTALS

- A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
- B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- C. Shop Drawings:
 - 1. Identification of material, thickness, and finish for each item.
 - 2. Profiles and dimensions for each item.
- D. 4"x4" Color sample of each metal flashing type for verification.
- 1.05 QUALITY ASSURANCE
 - A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.
 - B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with seven years of experience.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

- B. Prevent contact with materials that could cause discoloration or staining.
- 1.07 WARRANTY
 - A. Warrant installed system to be free of leaks and free from defects in materials and workmanship for 2 years from date of Substantial Completion of project.
 - B. Warrant factory applied fluorocarbon finish to be free of cracks, splits, crazing, chipping, peeling, and color fading for 10 years from date of Substantial Completion of Project

PART 2 - PRODUCTS

2.01 SHEET MATERIALS

- A. Pre-Finished Galvanized Steel: ASTM A653, with G90 zinc coating; minimum 0.02 inch thick base metal, shop pre-coated with PVDF coating.
 - PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA
 2605: multiple coat, thermally, sured fluorenelymen finish system

2605; multiple coat, thermally cured fluoropolymer finish system.

- 2. Color: To match approved sample
 - a. All locations adjacent to or in contact with Metal Wall Panel: Use same color as Metal Wall Panel.
 - b. All locations adjacent to or in contact with Coping: Use same color as Coping

2.02 ACCESSORIES

- A. Fasteners: fasteners of a compatible metal to avoid electrolytic reaction and per manufacturers recommendations.
- B. Primer: Type per manufacturer.
- C. Protective Backing Paint: Zinc molybdate alkyd.
- D. Sealant: Type as specified in Section 07 90 05.
- E. Plastic Cement: ASTM D4586, Type I.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

PART 3 - EXECUTION

- 3.01 EXAMINATION
 - A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
 - B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.
- C. Roof Edge Membrane:
 - 1. Coordinate with roofing manufacturer's requirements.
- D. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.
- 3.03 INSTALLATION
 - A. General:
 - 1. Install metal work in accordance with SMACNA.
 - 2. Install units plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.
 - 3. Apply asphalt mastic on metal surfaces of units in contact with cementitious materials and dissimilar metals.
 - 4. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
 - 5. Miter, lap seam and close corner joints with solder. Seal seams and joints watertight.
 - 6. Install expansion joints at frequency recommended by SMACNA. Do not fasten seams such that movement is restricted.
 - 7. Coordinate with installation of roofing system and roof accessories.
 - B. Flashing
 - 1. Insert flashings into reglets to form tight fit. Secure in place with wedges at maximum 12 inches on center. Seal flashings into reglets with sealant.
 - 2. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations approved by Architect.
 - C. Termination Bar (if applicable)
 - 1. Install termination bar at top edge of roofing membrane. Install sealant behind

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roofing membrane at line of termination. Attach bar with appropriate fasteners using predrilled holes.

- D. Counterflashing:
 - 1. Fabricate counterflashings as 2 piece assemblies to permit installation of counterflashing after base flashings are in place.
 - 2. Install continuous preformed butyl sealant tape behind fastener line of surface mounted reglets in accordance with manufacturer's written instructions. Apply silicone weather seal at top edge. Prevent contact between different sealing materials.
 - 3. Overlap composition base flashing 4 inches minimum.
 - 4. Install bottom edge tight against base flashing.
 - 5. Lap seam vertical joints 3 inches minimum and apply sealant.
- E. Coping *(if applicable)*
 - 1. Space seams: 8'-0" apart maximum.
 - 2. Lock exterior edges over continuous galvanized cleats secured to nailer.
 - 3. Slope towards inside of parapet, 1/2 inch minimum, unless indicated otherwise.
 - 4. Fasten interior edges to nailer with HWH screw and washer at 12 inch centers.
 - 5. Provide integral drainage system at seams to prevent water infiltration.
 - 6. Miter corners
- F. Apply plastic cement compound between metal flashings and felt flashings.

3.04 SCHEDULE

- A. Copings: 22 ga.
- B. Joint Covers: 22 ga
- C. Flat Trim: 20 ga
- D. Counterflashings at Roofing Terminations (over roofing base flashings): 20 ga
- E. Counterflashings at Curb-Mounted Roof Items, including skylights and roof hatches: 20 ga
- F. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: 24 ga
- 3.05 CLEANING
 - A. Upon completion of each area of soldering, carefully remove flux and other residue from surfaces. Neutralize acid flux by washing with washing soda solution, and then flushing clear water rinse. Use special care to neutralize and clean crevices

END OF SECTION 07 62 00

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SECTION 07 65 00 FLEXIBLE FLASHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provides flashing systems, moisture-retardant membranes, including sealing joints and protrusions through membranes, with accessories as required for complete installation.
- 1.02 SUBMITTALS
 - A. Product Data: Submit manufacturer's literature for each type of membrane.
 - B. Samples: Submit samples of each type of material. Quality Assurance/Control Submittals: Submit either test reports or manufacturer's certificates indicating materials comply with specified requirements.

PART 2 - PRODUCTS

- 2.01 MANUFACTURER
 - A. Fortifiber Building Systems Group, 1-800-773-4777.
 - B. Substitutions: Comply with provisions of Division 1.

2.02 MATERIALS

- A. Flexible Flashings: Fortifiber/ FortiFlash self-adhesive, self-sealing SBS modified asphalt waterproof membrane laminated to high density, cross-laminated polyethylene film reinforcement
 - 1. Types:
 - a. Waterproof: Fortifiber / FortiFlash 25 mil and 40 mil Waterproof Flashing.
 - 2. Reference Standards: ICC Acceptance Criteria 148 (waterproof).
 - 3. Water Vapor Permeance: <.08 perms 25-Mil, <.05 perms 40-Mil (waterproof); ASTM F 1249.
 - 4. Water Resistance: 200 hours (waterproof); ASTM D-779

PART 3 - EXECUTION

3.01 PREPARATION

- A. Ensure items which pass through membrane are properly and rigidly installed, substrate is free of projections and irregularities which may be detrimental to proper installation of membrane.
- 3.02 INSTALLATION
 - A. Apply membrane in accordance with manufacturer's recommendations, laid smooth without folds or bunches of material.

- 1. Seam Overlap: As recommended by building paper manufacturer for specific building paper material and application indicated.
- 2. Sealing: Seal items projecting through vapor retarders and vapor barriers.
- B. Inspect and repair building paper prior to application of finish material over building paper; tape tears, perforations and similar damage.

END OF SECTION 07 65 00

SECTION 07 90 00 JOINT SEALANTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section includes the work necessary to furnish and install, complete, sealant and backing for all structure and building joints.

1.02 GENERAL REQUIREMENTS

- A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.
- B. Performance: Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 33 00, SUBMITTALS in Division 1, GENERAL REQUIREMENTS.
- B. Submit the following:
 - 1. Product data: Submit manufacturer's literature, specifications, surface preparation and application instructions for joint sealant materials.
 - 2. Samples: For each material proposed submit sample of color intended, when required to match joint substrate or range of colors for selection.
 - 3. Sealant schedule: Submit sealant schedule indicating joint size and special conditions as well as, manufacturer, type and color of proposed product for each application.
 - 4. Certificates of compliance: proposed materials meet reference standards and specification requirements.
 - 5. Contract closeout submittals: special guarantee.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sealants to the jobsite in sealed containers, each bearing manufacturer's name and product designation.
- B. Store and protect sealant products from damage, deterioration, and contamination in accordance with manufacturer's written recommendations.
- 1.05 QUALITY ASSURANCE
 - A. Installer qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this project and whose work has resulted in joint sealant installations with a record of successful inservice performance.

1.06 ENVIRONMENTAL CONDITIONS

A. Ambient Temperature: Between 40 and 80°F when sealant is applied.

1.07 SPECIAL GUARANTEE

- A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of Owner, removal and replacement of work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective work shall be as specified in the General Conditions.
- B. Conditions: No adhesive or cohesive failure of sealant.
- C. Sealed joints: watertight and weathertight with normal usage.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.
- 2.02 MASTIC JOINT FILLER
 - A. The mastic joint filler shall be a ¹/₂-inch, pre-molded, non-extruded, resilient type mastic joint filler conforming to ASTM D 1751.

2.03 SEALANT MATERIALS

- A. Type 1 Silicone, Non-sag, Not Immersible: Silicone base, single-component, chemical curing; meeting the requirements of Federal Specification TT-S-001543, non-sag type, Class A; capable of withstanding movement up to 50 percent of joint width; Shore "A" hardness of 50 maximum; non--staining. Use No. 790 manufactured by Dow Corning Corporation; "Silpruf" manufactured by General Electric; or equal.
- B. Type 2 Multi-Part Polyurethane, Self-Leveling, Immersible: Polyurethane base, multicomponent, chemical curing; meeting the requirements of Federal Specifications TT-S-00227, self-leveling Type I, Class A; capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width; uniform, homogeneous, and free from lumps, skins, and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. Use Sonolastic Paving Joint Sealant manufactured by Sonneborn; Urexspan NR-200 manufactured by Pecora Corp.; Iso-Flex 880GB manufactured by H.S. Peterson Co.; Vulkem 245 manufactured by Mameco International; or equal.
- C. Type 3 Multi-Part Polyurethane, Non-sag, Immersible: Polyurethane base, multicomponent, chemical curing; meeting the requirements of Federal specifications TT-S-00227, non-sag Type II, Class A; capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width; uniform homogeneous, and free

from lumps, skins, and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. Use Iso-Flex 881 manufactured by H.S. Peterson Co.; Vulkem 922 manufactured by Mameco International; PRC 270 manufactured by Product Research Corp.; Sonolastic NP-II manufactured by Sonneborn; or equal.

- D. Type 4 Multi-Part Polyurethane, Non-sag, Not Immersible: Polyurethane base, multicomponent, chemical curing; meeting the requirements of Federal specifications TT-S-00227, non-sag Type II, Class A and ASTM C 920, Type M, Grade NS, Class 25; withstand movement of up to 25 percent of joint width; uniform, homogeneous, and free from lumps, skins, and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding; color as selected. Use Sonolastic NP-II manufactured by Sonneborn; Dynatrol II manufactured by Pecora Corp.; Dymeric manufactured by Tremco; Isoflex 2000 manufactured by H.S. Peterson Co.; Vulkem 227 manufactured by Mameco International; or equal.
- E. Type 5 One-Part Polyurethane, Immersible: Polyurethane base, single-component, chemical curing; conforming to Federal specification TT-S-00230; capable of being continuously immersed in water, withstand movement of up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. For non-sag Type II, Class A, use Sonolastic NP-I manufactured by Sonneborn; Sikaflexla No. 430 manufactured by Sika Chemical Corp.; Vulkem 116 manufactured by Mameco International; or equal. For self-leveling Type I, Class A, use Sonolastic SL-1 manufactured by Sonneborn; Vulkem 45 manufactured by Mameco International; Sikaflex 12SL manufactured by Sika Chemical Corp.; or equal.
- F. Type 6 One-Part Polyurethane, Not Immersible: Polyurethane base, single-component, chemical curing; meeting the requirements of Federal specification TT-S-00230, non-sag Type II, Class A; withstand movement of up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining, nonbleeding. Use Dynatrol I manufactured by Pecora Corp.; Dymonic manufactured by Tremco; Sonolastic NP-I manufactured by Sonneborn; or equal.
- G. Type 7 Multi-Part Polysulfide, Immersible: Polysulfide base, two-component, chemical curing; meeting the requirements of Federal Specification TT-S-00227, Type I self-leveling, Type II non-sagging, Class A, uniform, homogeneous and free from lumps, skins, and coarse particles when mixed; capable of being continuously immersed in water, withstand movement up to 25 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining and nonbleeding. Use CM-60, two-part manufactured by W.R. Meadows; Sonolastic Two manufactured by Sonneborn; or equal.
- H. Type 8 One-Part Polysulfide, Non-sag, Not Immersible: Polysulfide base, singlecomponent, chemical curing; meeting the requirements of Federal Specification TT-S-00230, Type II non-sag, Class A; capable of withstanding movement up to 20 percent of joint width; Shore "A" hardness of minimum 15 and maximum 50; non-staining and nonbleeding. Use CM-60, one-part manufactured by W.R. Meadows; Sonolastic One manufactured by Sonneborn; Sikaflex 440 manufactured by Sika Chemical Corp.; PRC

7000 manufactured by Product Research Corp.; or equal.

- I. Type 9 One-Part Acrylic Terpolymer, Non-sag: Acrylic base, single-component, solvent curing; meeting the requirements of Federal specification TT-S-00230, Type I non-sag, Class B; capable of withstanding movement up to 7.5 percent of joint width; Shore "A" hardness of maximum 55; non-staining and nonbleeding. Use 60+ Unicrylic manufactured by Pecora Chemical Corp.; Mono manufactured by Tremco; or equal.
- J. Type 10 Sanitary Sealant: Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color. Use Dow Corning Bathtub Caulk 786; General Electric Sanitary Sealant; or equal.
- K. Type 11 Fire-Resistant Penetration Seal: Medium fire-resistant foam that retains stability at high temperatures. Use 3-6548 Silicone RTV Fire Stop Sealant or Foam manufactured by Dow Corning Corporation; Fire Barrier Caulk CP25 and Putty 303 manufactured by 3M Corp.; General Electric Pensil 851; or equal.

2.04 BACKUP MATERIAL

A. Non-gassing, extruded, closed-cell round polyethylene foam rod compatible with sealant used. Size as shown or as recommended by manufacturers for all joints greater than 3/16inch wide. Use "Minicel" as manufactured by Haveg Industries, Inc.; "Ethafoam SB" manufactured by Dow Corning; "Sonofoam" manufactured by Sonneborn; HBR manufactured by Hercules, Inc.; or equal.

2.05 BOND BREAKER

- A. Pressure sensitive tape recommended by sealant manufacturer to suit application.
- 2.06 JOINT CLEANER
 - A. Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.
- 2.07 PRIMER
 - A. Non-staining type recommended by sealant manufacturer to suit application.
- 2.08 SEALANT COLOR
 - A. Unless specifically noted, sealant color shall generally match or complement the color of the principal material adjoining the area of application or as selected by Architect.
- 2.09 TAPE SEALANT
 - A. Closed cell polyvinyl chloride (PVC) foam, in black color, coated on both sides with a modified acrylic pressure-sensitive adhesive, in 3/4-inch width by length as required by sufficient thickness, as recommended by manufacturer, for particular application, meeting the following requirements:
 - 1. Tensile Strength (ASTM D 412, Die C): 80 psi
 - 2. Elongation (ASTM D 412, Die C): 125 percent

JOINT SEALANTS

- 3. Compression Set (ASTM D 1056): 30 percent max
- 4. Compression Deflection (ASTM D 1056) at 25 percent Deflection: 2.5 psi
- 5. Low Temperature Flexibility, 5 hours at -40 degrees F: No cracking
- 6. Heat Resistance/Maximum Shrinkage, 70 hours at 212 degrees F: 1.5 percent
- 7. Staining (ASTM D 925) on Most Substrates: None
- 8. Water Absorption by Weight at 30 percent Compression: 24 percent
- 9. Density per Cubic Foot (ASTM D 3574) 10 pounds
- 10. Thermal Conductivity (k factor): 0.24

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. Use of more than one material for the same joint is not allowed unless approved by the sealant manufacturer.
 - B. Install joint sealants in accordance with ASTM C962.
 - C. Sealants shall be self-leveling (S/L) for horizontal and sloping joints with a maximum slope of 1 percent. Non-sag sealants (N/S) shall be used for steeper sloped joints, vertical joints, and overhead joints. Immersible sealant may be used for non-immersible applications.
 - D. The one-part polysulfide (Type 8) and polyurethane (Types 5 and 6) and the acrylic (Type 9) sealants can be used in joints to maximum 1-inch width. Multi-part polyurethane (Types 2, 3, and 4) and polysulfide (Type 7) and silicone sealants can be used in joints to 2-inch maximum width. For joints wider than 2-inch, consult manufacturer for proper product application. Follow sealant manufacturer's recommendations.
 - E. Sealants used in water holding structures must be approved for use in domestic wastewater applications.

3.02 PREPARATION

- A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.
- B. All surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.
 - 1. Mask adjacent surfaces where necessary to maintain neat edge.
 - 2. Starting of work will be construed as acceptance of all sub-surfaces.
- C. Verify that joint shaping materials and release tapes are compatible with sealant.
- D. Examine joint dimensions and size materials to achieve required width/depth ratios.
- E. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

JOINT SEALANTS

F. Use bond breaker where recommended by sealant manufacturer.

3.03 MASTIC JOINT FILLER

A. Preformed joint filler shall be installed in accordance with manufacturer's specifications.

3.04 CAULKING AND SEALANT INSTALLATION

- A. Install backup material as recommended by sealant manufacturer. Where possible, provide full length sections without splices.
- B. Seal all joints around window, door, and louver frames; expansion joints; and elsewhere as indicated.
- C. Apply all materials following manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.
- D. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
- E. Locate tape sealant where indicated on Drawings and install in strict accordance with manufacturer's instructions.
- F. Drive caulking compound into the grooves with a caulking gun with sufficient pressure to force out air and to fill grooves solidly using a nozzle of proper size to fit width of grooves. Exposed surface of compound shall be tooled free of wrinkles and uniformly smooth. Leave all adjoining surfaces free of caulking material. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

3.05 CLEANING

- A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.
- B. Replace any damaged surfaces resulting from joint sealing or cleaning activities.

3.06 APPLICATION SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of this project.

Joint Location	Sealant Type(s)
1. Expansion/Contraction and Control Joints at:	
Concrete Walls	1, 3, 4, 5, 6, 7
Concrete Floor Slabs	2,5
Masonry and Precast Walls	1, 3, 4, 5, 6, 7

JOINT SEALANTS

Joint Location	Sealant Type(s)
2. Material Joints at:	
Metal Door, Window, and Louver Frames (Exterior)	1, 5, 6, 8
Metal Door, Window, and Louver Frames (Interior)	1, 5, 6, 8, 9
Wall Penetrations (Exterior)	1, 5, 6, 8
Wall Penetrations (Interior)	1, 5, 6, 8
Floor Penetrations	5, 6, 7
Ceiling/Roof Penetrations	1, 3, 4, 5, 6, 7
Sheet Metal Flashings	1, 3, 5, 7
3. Other Joints:	
Threshold Sealant Bed	5
Immersed Concrete (Vertical and Sloped)	3, 5
Immersed Concrete (Horizontal)	2, 5
Openings Around Pipes, Conduits, and Ducts Through Fire Rated Construction	11
Concrete Form Snap-Tie Holes	4,6
	7,0
Between Counter Tops and Backsplashes	10
Around Plumbing Fixtures	10

END OF SECTION 07 90 00

DIVISION 8

OPENINGS

SECTION 08 11 00 STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section includes steel doors and frames.
- 1.02 GENERAL REQUIREMENTS
 - A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are mandatory for this project.
- 1.03 SUBMITTALS
 - A. Submittals shall be made in accordance with Section 01 30 00, SUBMITTALS in Division 1, GENERAL REQUIREMENTS.
 - B. Submit the following:
 - 1. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles and finishes.
 - 2. Shop Drawings showing fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - 3. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those indicated.
 - 4. Manufacturer's certification that products meet or exceed specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames, cartoned or packaged, to prevent damage and deterioration.
 - 1. Properly identify each item.
 - 2. Provide cardboard, separators, banding, spreaders, and paper wrappings to protect units from damage during and after installation.
 - 3. Replace damage units with new, undamaged units.
- B. Store doors upright, in protected dry area, at least 1-inch off ground or floor and at least 1/4-inch between individual pieces.
 - 1. Follow special storage and handling requirements of manufacturer.
 - 2. Protect exposed finish surfaces of prefinished items with masking tape.

1.05 QUALITY ASSURANCE

A. Comply with ANSI/SDI 100.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. All steel doors and frames shall be the products of one manufacturer.
- 2.02 MANUFACTURERS
 - A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amweld Building Products, Inc.
 - 2. Ceco Door Products.
 - 3. Curries Co.
 - 4. Fenestra Corp.
 - 5. Kewanee Corp.
 - 6. Republic Builders Products.
 - 7. Approved equivalent.
- 2.03 DOOR AND FRAME MATERIALS
 - A. Hot-Rolled Steel Sheets: ASTM A 569 (ASTM A 569M).
 - B. Cold-Rolled Steel Sheets: ASTM A 366 (ASTM A 366M), commercial quality, or ASTM A 620 (ASTM A 620M), drawing quality.
 - C. Galvanized Steel Sheets: ASTM A 526 (ASTM A 526M), commercial quality, or ASTM A 642 (ASTM A 642M), drawing quality, with A 60 or G 60 (Z 180 or ZF 180) coating designation, mill phosphatized.
- 2.04 DOORS AND FRAMES
 - A. General Requirements for All Doors and Frames:
 - 1. Accessibility: Comply with ANSI A117.1.
 - 2. Door Texture: Smooth faces.
 - 3. Hardware Preparation: In accordance with DHI A115 Series, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 - 4. Finish: Factory primed, for field finishing.
 - B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.05 STEEL DOORS

- A. Grade: NAAMM HMMA 861, physical performance Level A.
- B. Core: Polyurethane.
- C. Top Closures for Doors: Flush with top of faces and edges, all seams welded and ground smooth.
- D. Galvanizing: All components hot-dipped zinc-iron alloy-coated (Galvannealed), A60/ZF180.
- E. Glazing Stops:
 - 1. Minimum 0.0359-inch thick steel.
 - 2. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass and other panels in doors.
 - 3. Provide screw-applied, removable, glazing beads on inside of glass and other panels in doors.
- F. Texture: Smooth faces.
- G. Insulating Value: U-value of .067, when tested in accordance with ASTM C 236.
- H. Weatherstripping: Separate, see Section 08 71 00, FINISH HARDWARE.
- I. Finish: Factory primed, for field finishing.

2.06 STEEL FRAMES

- A. Comply with the requirements of grade specified for corresponding door.
- B. Finish: Factory primed, for field finishing.
- C. Provide mortar guard boxes for hardware cut-outs in frames to be grouted.
- D. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- E. Fully welded, with mitered corners.
- F. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed), A60/ZF180.
- G. Finish: Factory primed, for field finishing.

2.07 ACCESSORY MATERIALS

- A. Grout for Frames: Portland cement grout of maximum 4-inch slump for hand troweling; thinner pumpable grout is prohibited.
- B. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- C. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at top for grouting.

- D. Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 18-gauge galvanized steel.
- E. In-Place Concrete or Masonry Bolts: Anchor frame jambs with minimum 3/8-inch concealed bolts into expansion shields or inserts at 6 inches from top and bottom and 26 inches on center, unless otherwise shown. Reinforce frames at anchor locations. Except for fire-rated openings, apply removable stop to cover anchor bolts unless otherwise indicated.
- F. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of not less than 14-gauge galvanized steel sheet, as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with 2 holes to receive fasteners, welded to bottom of jambs and mullions.
- G. Head Anchors: Provide 2 anchors at head of frames exceeding 42 inches wide for frames mounted in steel stud walls.
- H. Head Strut Supports: Provide 3/8-inch by 2-inch vertical steel struts extending form top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable wedged or bolted anchorage to frame jamb members in compliance with UL 63.
- I. Structural Reinforcing Members: Provide as part of frame assembly, where indicated at mullions, transoms, or other locations that are to be built into frame.
- J. Head Reinforcing: For frames over 4'-0" wide in masonry wall openings, provide continuous steel channel or angle stiffener, not less than 12 gauge for full width of opening, welded to back of frame at head.
- K. Spreader Bars: Provide removable spreader bar across bottom of frames, tack welded to jambs and mullions.

2.08 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI A 250.3, manufacturer's standard coating of color as selected.
- C. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.
- 2.09 HARDWARE
 - A. Hardware for doors and frames shall be as specified in Section 08 71 00, FINISH HARDWARE.
- 2.10 GLAZING
 - A. Glazing for doors shall be as specified in Section 08 81 00, Glass and Glazing.

PART 3 - EXECUTION

STANDARD STEEL DOORS AND FRAMES

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- 3.02 PREPARATION
 - A. Coat inside of frames with bituminous coating to a thickness of 1/16 inch.
- 3.03 INSTALLATION
 - A. General: Install steel doors, frames, and accessories according to shop drawings, manufacturer's data, and as specified.
 - B. Grout all frames solid.
 - C. Placing Frames: Comply with provisions of SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
 - 1. Except for frames located in existing concrete, masonry, or gypsum board assembly construction, place frames before constructing enclosing walls and ceilings.
 - 2. Install at least 1 floor anchor and 3 anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
 - D. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI/SDI 100.
 - E. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
 - F. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

3.04 FIELD PAINTING

- A. Where prime coat has been damaged, sand smooth and touch up with same primer as applied at shop.
 - 1. Remove rust before painting.
 - 2. Touch Up: Not obvious.
 - 3. Perform immediately after door and frame installation.
- B. Final paint coat shall be as specified in Section 09 90 00, PAINTING. Color shall be as indicated on the Drawings, or as selected by the Owner and Engineer from the Contractor provided shop drawings.

3.05 PROTECTION

A. Protect installed doors and frames against damage from other construction work.

END OF SECTION 08 11 00

STANDARD STEEL DOORS AND FRAMES

SECTION 08 33 36 OVERHEAD COILING SERVICE DOORS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Overhead coiling service doors for the Screening Room (10'x9') and Blower Building (9'x9').
- 1.02 RELATED SECTIONS
 - A. Section 05 50 00 Metal Fabrications: Support framing and framed opening.
 - B. Section 08 71 00 Door Hardware: Product Requirements for cylinder core and keys.
 - C. Section 09 90 00 Painting: Field applied finish.
 - D. Section 16 13 00 Raceway and Boxes: Conduit from electric circuit to door operator and from door operator to control station.
 - E. Section 16 15 00 Wiring Connections: Power to disconnect.
- 1.03 REFERENCES
 - A. ANSI/DASMA 108 American National Standards Institute Standard Method For Testing Sectional Garage Doors And Rolling Doors: Determination Of Structural Performance Under Uniform Static Air Pressure Difference.
 - B. NFRC 102 Test Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.
 - C. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Element.
 - D. ASTM E 330 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - E. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - F. ASTM A 666 Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - G. ASTM A 924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - H. ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - I. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - J. NEMA MG 1 Motors and Generators.
- 1.04 DESIGN / PERFORMANCE REQUIREMENTS

- A. Overhead coiling service doors:
 - Wind Loads: Design door assembly to withstand wind/suction load of 20 psf (958 Pa) without damage to door or assembly components in conformance with ASTM E 330.
 - 2. Operation: Design door assembly, including operator, to operate for not less than 20,000 cycles.
 - 3. <u>The 10'x9' overhead coiling door (including motor, operator and controller) for the</u> <u>Screening Room shall be explosion-proof and suitable for installation in Class 1,</u> <u>Division 1, Group D environment. All enclosures shall be NEMA 7/9, surface</u> <u>mounted.</u>
- B. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.
- 1.05 SUBMITTALS
 - A. Submit under provisions of Section 01 30 00.
 - B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Details of construction and fabrication.
 - 4. Installation instructions.
 - C. Shop Drawings: Include detailed plans, elevations, details of framing members, anchoring methods, required clearances, hardware, and accessories. Include relationship with adjacent construction.
 - D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches long, representing actual product, color, and patterns.
 - F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
 - G. Operation and Maintenance Data: Submit lubrication requirements and frequency, and periodic adjustments required.
- 1.06 QUALITY ASSURANCE
 - A. Manufacturer Qualifications: Company specializing in performing Work of this section with a minimum of five years experience in the fabrication and installation of security

closures.

- B. Installer Qualifications: Installer Qualifications: Company specializing in performing Work of this section with minimum three years and approved by manufacturer.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Store products in manufacturer's unopened packaging until ready for installation.
 - B. Protect materials from exposure to moisture. Do not deliver until after wet work is complete and dry.
 - C. Store materials in a dry, warm, ventilated weathertight location.
- 1.08 PROJECT CONDITIONS
 - A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- 1.09 COORDINATION
 - A. Coordinate Work with other operations and installation of adjacent materials to avoid damage to installed materials.
- 1.10 WARRANTY
 - A. Warranty: Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever occurs first.
 - B. Warranty: Manufacturer's limited door system warranty for 2 years for all parts and components.
 - C. Powder coat Finish
 - 1. Powder Coating: Applied to curtain, guides, bottom bar, headplates: Manufacturer's limited Premium Finish warranty for 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - Overhead Door Corp., 2501 S. State Hwy. 121, Suite 200, Lewisville, TX 75067. ASD. Tel. Toll Free: (800) 275-3290. Phone: (469) 549-7100. Fax: (972) 906-1499. Web Site: www.overheaddoor.com. E-mail: info@overheaddoor.com.
 - 2. Cookson., 1901 south Litchfield Road, Goodyear, AZ 85338. (800) 294-4358. Website: www.cooksondoor.com.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 ADVANCED PERFORMANCE ROLLING SERVICE DOORS

- A. RapidSlat Model 626 Stormtite Insulated Doors by Overhead Door Corporation.
 - 1. Curtain: Interlocking roll-formed metal slats as specified with endlocks attached to each end of alternate slats to prevent lateral movement.
 - a. Flat Profile insulated type F-265i with 24 gauge back covering steel or stainless steel; .024 inch (.06 mm) aluminum, for doors up to 20 feet wide fabricated of:
 - i. 20 gauge stainless steel.
 - b. Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place, polyurethane insulation.
 - i. R-Value: 7.7, U-Value: 0.13.
 - ii. Sound Rating: STC-21.
 - c. Slat Finish:
 - i. PowderGuard Max powder coat.
 - Color as selected by Architect.
 - 2. Bottom Bar: Two metal angles, minimum thickness 3/16 inch, bolted back to back to reinforce curtain in the guides.
 - a. Material:
 - i. Stainless steel with brushed finish.
 - 3. Guides: Three Structural steel angles provided with high usage guide wear strip to minimize wear and reduce sound.
 - a. Material:
 - i. Steel.
 - ii. High usage guide wear strips.
 - 4. Brackets:
 - a. Galvanized steel to support counterbalance, curtain and hood.
 - 5. Finish; Bottom Bar, Guides, Headplate and Brackets:
 - a. Finish: PowderGuard Zinc base coat, gray with PowderGuard Premium powder coat color as selected by the Architect.
 - 6. Motor: Direct drive, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is factory pre-assembled and provided with all wiring harnesses needed direct from the factory.
 - a. Opening Speed: Up to 24 inches per second.
 - b. Closing Speed: 12 inches per second.

- c. Electrical Characteristics: 220V AC, single phase per motor/drive.
- d. Right hand mount.
- 7. Control Panel: Provide electronic Variable Frequency drive controller with microprocessor self-diagnostics. LCD readout indicates door action, alarm conditions, and fault conditions. Timer to close programming options and non-resettable cycle counter are included. Enclosure is NEMA 4X rated. Control system is UL508A certified. Junction box is IP67 rated.
- 8. Door Roll: Directly driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.
- 9. Hood: Protecting drive motor, barrel, chain, and sprocket from dirt and debris and extending between the support brackets. Fabricated of:
 - a. Material:
 - i. Stainless steel with brushed finish.
- 10. Safety Devices: Provide door with following safety devices:
 - a. Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
 - b. Wireless, monitored safety edge reverses downward motion upon impact.
 - c. Built-in (to motor assembly) brake mechanism eliminates uncontrolled curtain travel independent of other safeties.
- 11. Actuators:
 - a. One Open/Close/Stop push button station incorporated into Control Panel.
- 12. Windload Design:
 - a. Standard windload shall be 20 PSF.
- B. Cookson Thermiser Model ESD20 Insulated Doors by Overhead Door Corporation.
 - 1. Curtain: Interlocking roll-formed metal slats as specified with endlocks attached to each end of alternate slats to prevent lateral movement.
 - a. Flat Profile insulated type F-265i with 24 gauge back covering steel or stainless steel; .024 inch (.06 mm) aluminum, for doors up to 20 feet wide fabricated of:
 - i. 24 gauge galvanized steel.
 - b. Insulation: Slat cavity shall be filled with CFC-free, foamed-in-place, polyurethane insulation.
 - i. R-Value: 8.0, U-Value: 0.13.
 - ii. Sound Rating: STC-21.
 - c. Slat Finish:

- i. SpectraShield powder coat.
 - Color as selected by Engineer during submittal process.
- 2. Bottom Bar: Two metal angles, minimum thickness 3/16 inch, bolted back to back to reinforce curtain in the guides.
 - a. Material:
 - i. Stainless steel with brushed finish.
- 3. Guides: Three Structural steel angles provided with high usage guide wear strip to minimize wear and reduce sound.
 - a. Material:
 - i. Steel.
 - ii. High usage guide wear strips.
- 4. Brackets:
 - a. Galvanized steel to support counterbalance, curtain and hood.
- 5. Finish; Bottom Bar, Guides, Headplate and Brackets:
 - a. Finish: SpectraShield Zinc base coat, gray with SpectraShield powder coat color as selected by the Engineer during submittal process.
- 6. Motor: Chain drive with gear head, integrated gear motor/brake assembly sized for openings. Provide with a manual hand chain for operation during power outages. Operator and drive assembly is factory pre-assembled and provided with all wiring harnesses needed direct from the factory.
 - a. Opening Speed: Up to 24 inches per second.
 - b. Closing Speed: 12 inches per second.
 - c. Electrical Characteristics: 220V AC, single phase per motor/drive.
 - d. Right hand mount.
- Control Panel: Provide Class 1 Division 1 Group D explosion-proof electronic Variable Frequency drive controller with microprocessor self-diagnostics. LCD readout indicates door action, alarm conditions, and fault conditions. Timer to close programming options and non-resettable cycle counter are included. Enclosure is NEMA 7/9 rated. Control system is UL508A certified. Junction box is NEMA 7/9 rated.
- 8. Door Roll: Chain driven, springless roll shall be steel tube with integral shafts, keyed on the Drive End and supported by self-aligning greaseable sealed bearings. Door shall not require any counterbalance device.
- 9. Hood: Protecting drive motor, barrel, chain, and sprocket from dirt and debris and extending between the support brackets. Fabricated of:
 - a. Material:
 - i. Stainless steel with brushed finish.

- 10. Safety Devices: Provide door with following safety devices:
 - a. Photoelectric sensors that cast an invisible beam across the door opening and reverses the downward motion of the door when an object enters the path of the beam.
 - b. Wireless, monitored safety edge reverses downward motion upon impact.
 - c. Built-in (to motor assembly) brake mechanism eliminates uncontrolled curtain travel independent of other safeties.
- 11. Actuators:
 - a. One Open/Close/Stop push button station incorporated into Control Panel.
- 12. Windload Design:
 - a. Standard windload shall be 20 lb/ft²

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify opening sizes, tolerances and conditions are acceptable.
- B. Examine conditions of substrates, supports, and other conditions under which this work is to be performed.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- 3.02 PREPARATION
 - A. Clean surfaces thoroughly prior to installation.
 - B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- 3.03 INSTALLATION
 - A. Install in accordance with manufacturer's instructions.
 - B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
 - C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
 - D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
 - E. Coordinate installation of electrical service with Division 26. Complete wiring from disconnect to unit components.
 - F. Coordinate installation of sealants and backing materials at frame perimeter as specified in Section 07 90 00.
 - G. Install perimeter trim and closures.

OVERHEAD COILING SERVICE DOOR

- H. Instruct Owner's personnel in proper operating procedures and maintenance schedule.
- 3.04 ADJUSTING
 - A. Test for proper operation and adjust as necessary to provide proper operation without binding or distortion.
 - B. Adjust hardware and operating assemblies for smooth and noiseless operation.
- 3.05 CLEANING
 - A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.
 - B. Remove labels and visible markings.
 - C. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 **PROTECTION**

A. Protect installed products until completion of project.

END OF SECTION 08 33 36

SECTION 08 34 83 FLOOR HATCHES AND PORTABLE HOIST

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This section includes floor hatches, frames, lids, latches, lifting devices, locks, etc.
 - B. Related Requirements:
 - 1. Section 03 60 000 "Grout and Repair Mortar".
 - 2. Section 07 11 00 "Dampproofing".
- 1.03 ACTION SUBMITTALS
 - A. Product Data: For each type of product.
 - 1. Include construction details, dimensions materials, bearing strength or maximum weight, individual components and profiles, finishes and features.
 - B. Product Schedule: For all floor hatches and lifting device including:
 - 1. Lift Station Wetwell
 - 2. Portable Hoist for Wetwell and Rotary Screen
- 1.04 CLOSEOUT SUBMITTALS
 - A. Record Documents: For all installed floor hatches, list of location, any departures from the Action Submittal.
- 1.05 QUALITY ASSURANCE
 - A. Door Inspector Qualifications: Inspector for field quality control inspections of door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

- 2.01 PERFORMANCE REQUIREMENTS
 - A. Fire-Rated Floor hatches: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency according to NFPA 288.
- 2.02 ALUMINUM FLOOR HATCHES
 - A. Gutter Channel Frame Aluminum Floor Hatch:

FLOOR HATCHES AND PORTABLE HOIST

- 1. Frame: Mill finish aluminum, gutter profile, with integral drainage coupling and perimeter gasket.
- 2. Door: Single leaf; 1/4-inch-thick (6.4-mm-thick), diamond-pattern mill-finish aluminum plate.
- 3. Loading Capacity: 300 lb/ft2 (14.4-kN/sq. m) pedestrian live load.
- 4. Option Included: Odor gasket and Grating Panel
- 5. Hardware:
 - a. Material and Finish: Type 316 stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and brackets, hinges, pins, and fasteners.
 - b. Hinges: Type 316 stainless steel with tamper proof fasteners and stainless steel pins.
 - c. Operating Mechanism: Adjustable counterbalancing springs, heavy-duty holdopen arm that automatically locks door open at 90 degrees, release handle with vinyl grip that allows for one-handed closure, and recessed lift handle.
 - d. Latch: Stainless steel slam latch.
 - e. Lock: Type 316 stainless steel slam lock with removable key or a recessed padlock hasp with cover.
- B. Angle Frame Aluminum Floor hatch:
 - 1. Cover Leaf: ¹/₄" aluminum diamond plate.
 - 2. Angle Frame: ¹/₄" aluminum with continuous anchor flange.
 - 3. Frame Coating: Bituminous coating where in contact with concrete.
 - 4. Load Rating: 300 lbs. psf (1464 kg. psm) uniform live load.
 - 5. Locking System: Type 316 stainless steel slam lock with removable key.
 - 6. Cover equipped with the following stainless steel features: spring assists, T-316 tamper proof attaching hardware, automatic T-316 hold open arm with aluminum latch.
 - 7. Cushion/Gasket: neoprene.
 - 8. Guarantee: Access covers shall carry a lifetime guarantee against defects in material and/or workmanship.

2.03 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- E. Rolled-Stainless Steel Floor Plate: ASTM A793, manufacturer's standard finish.
- F. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666. Remove tool and die marks and stretch lines, or blend into finish.
- G. Stainless Steel Flat Bars: ASTM A666. Remove tool and die marks and stretch lines, or blend into finish.
- H. Aluminum Extrusions: ASTM B221 Alloy 6063-T6.
- I. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- J. Aluminum Sheet: ASTM B209 alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- K. Frame Anchors: Same material as door face.
- L. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.
- 2.04 FABRICATION
 - A. General: Provide floor hatches manufactured as integral units ready for installation.
 - B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
 - C. Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure floor hatches to types of supports indicated.
 - D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.
 - E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that comes in contact with concrete.
- 2.05 FINISHES
 - A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
- E. Prime Painted Steel: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
- F. Stainless Steel Finish: Bright, cold-rolled, unpolished ASTM A480/A480M No. 2B finish.
- 2.06 MANUFACTURERS
 - A. Halliday Model W1S3654 or approved equal.
- 2.07 PORTABLE HOIST
 - A. The Portable Hoist supplied shall be manufactured by Halliday Products or approved equal.
 - B. The Portable Hoist shall be a Series DB Adjustable Reach Portable Hoist Model D2B36D and utilize an embedded series D hoist socket. The sockets shall be located as shown on the drawings.
 - C. The hoist shall be capable of lifting the rotary screen out of the screening channel for maintenance. The hoist shall also be capable of pulling the submersible pumps from the wet well and placing them in the back of a pickup truck.
 - D. The Portable Hoist shall be equipped with the following standard features:
 - 1. Type 304 stainless steel construction
 - 2. Stainless Steel marine grade brake winch with 30 lineal feet of ¹/₄" T-304 stainless steel cable with a stainless steel 1 ton safety hook.
 - 3. The davit arm shall adjust in 1inch increments from 24 to 36 inches and the overall unit height shall be 60 inches.
 - 4. The Portable Hoist shall be guaranteed against defects in material and workmanship for a period of three (3) years.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 INSTALLATION

FLOOR HATCHES AND PORTABLE HOIST

- A. Comply with manufacturer's written instructions for installing floor hatches.
- B. Apply intumescent fireproofing to underside of floor hatch cover to minimum thickness required by intumescent fireproofing manufacturer for fire rating indicated.
- 3.03 FIELD QUALITY CONTROL
 - A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
 - B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- 3.04 ADJUSTING
 - A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 08 34 83

SECTION 08 50 00 WINDOWS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 REQUIREMENTS

- A. The CONTRACTOR shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to provide glass and glazing as indicated on the Drawings and specified herein.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry"
 - 2. Division 7 Section "Joint Sealers" for providing a positive barrier against the elements.
 - 3. Division 9 "Finishes, Paint & Coatings"

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the reference specifications of the GENERAL REQUIREMENTS.
- B. Comply with the current provisions of the following Standards:
 - 1. American National Standards Institute ANSI Z97.1-184 Glazing Materials Used In Buildings, Safety Performance Specifications.
 - American Architectural Manufacturers Association/National Window and Door Association – AMMA/NWWDA 101 I.S 2.97 Voluntary Specifications for Aluminum, Vinyl and Wood Windows and Glass Doors.
 - 3. Manufacturer's Standards: In addition to the standards listed above, the acrylic block windows and frames and their installation shall be in accordance with the manufacturer's published recommendations and specifications.

1.04 SUBMITTALS

- A. The following submittals and specific information shall be provided:
 - 1. Shop Drawings: Shop drawings shall show details of the products and systems and connections to adjoining materials. Schedules showing sizes, types, and locations of windows shall be submitted along with manufacturer's installation instructions.
 - 2. Manufacturer's Literature: Manufacturer's literature and any engineering calculations that may be required elsewhere in this section shall be submitted.
- 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Windows and frames shall be shipped and stored with temporary stiffeners and spacers in place to prevent distortion.
- B. Windows and frames shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.
- C. Windows and frames shall be carefully stored on wood blocking in an area that is protected from the elements. Storage shall be in a manner that will prevent damage or marring of finish.

PART 2 - PRODUCTS

- 2.01 MATERIALS AND FABRICATION GENERAL
 - A. Furnish acrylic fixed block windows furnished by Hy-Lite Products Inc., Beaumont, CA 92223 or approved equal. Window shall be Vinyl Fixed Builder Series utilizing white frames, 8x8x2 block size with the wave pattern and E3 Triple Glaze, model 8PW5050.
 - B. Shop Fabrication and Assembly: All windows and frames shall be shop fabricated and shop assembled, where possible. Temporary stiffeners, spacers, and other accessories necessary to facilitate handling and accurate erection shall be provided. After fabrication, all tool marks and other surface imperfections shall be filled and ground smooth.
 - C. Warranty Windows shall warranted to be free of defective materials and workmanship for a period of 10 years, exclusive of installation.

PART 3 - EXECUTION

3.01 CONSTRUCTION

- A. General: All work shall be in accordance with manufacturer's published recommendations and specifications. All recommendations for sealing and weatherproofing window shall be observed.
- B. All work shall be coordinated with appropriate related Subcontractors work to assure a proper installation. Field conditions and dimensions shall be verified prior to fabrication.
- 3.02 FRAME INSTALLATION
 - A. Frames shall be set level, plumb and square in a true plane, and be securely anchored to the adjoining construction. All finished frames shall be strong and rigid; neat in appearance; and square, true, and free of defects, warp, or buckle.
 - B. Molded members, trims, and stops, shall be clean cut, straight, and shall be of a uniform profile throughout their lengths.
 - C. Corner joints shall have all contact edges tightly closed with all trim faces mitered, welded, and finished smooth.
- 3.03 CLEANUP

- A. Upon completion of installation of the windows and frames, cleanup all waste materials and debris resulting from this operation and dispose of such waste materials and debris off the site.
- B. After completion of construction, protective materials shall be removed and all work shall be washed with a mild solution of soap and water and then rinsed with clean water. Do not clean in hot sun or at elevated temperatures. Dry window with soft cloth.

END OF SECTION 08 50 00

SECTION 08 71 00 DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for:
 - a. Swinging doors.
 - 2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
 - 3. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:
 - 1. Windows
 - 2. Cabinets (casework), including locks in cabinets
 - 3. Signage
 - 4. Toilet accessories
 - 5. Overhead doors
- C. Related Sections:
 - 1. Division 01 Section "Alternates" for alternates affecting this section.
 - 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
 - 3. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
 - 4. Division 26 sections for connections to electrical power system and for low-voltage wiring.
 - 5. Division 28 sections for coordination with other components of electronic access control system.

DOOR HARDWARE

1.03 REFERENCES

- A. DHI Door and Hardware Institute
 - 1. Sequence and Format for the Hardware Schedule
 - 2. Recommended Locations for Builders Hardware
 - 3. Key Systems and Nomenclature
- B. ANSI American National Standards Institute
 - 1. ANSI/BHMA A156.1 A156.29, and ANSI/BHMA A156.31 Standards for Hardware and Specialties

1.04 SUBMITTALS

- A. General:
 - 1. Submit in accordance with Conditions of Contract and Division 01 requirements.
 - 2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
 - 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
- B. Action Submittals:
 - 1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 - 2. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
 - 3. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Quantity, type, style, function, size, and finish of each hardware item.

- d. Name and manufacturer of each item.
- e. Fastenings and other pertinent information.
- f. Location of each hardware set cross-referenced to indications on Drawings.
- g. Explanation of all abbreviations, symbols, and codes contained in schedule.
- h. Mounting locations for hardware.
- i. Door and frame sizes and materials.
- j. Name and phone number for local manufacturer's representative for each product.
- k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.
 - i. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
- 4. Key Schedule:
 - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - i. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

- 5. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.
- C. Informational Submittals:
 - 1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
 - 2. Product data for electrified door hardware:
 - a. Certify that door hardware approved for use on types and sizes of labeled firerated doors complies with listed fire-rated door assemblies.
 - 3. Warranty: Special warranty specified in this Section.
- D. Closeout Submittals:
 - 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Factory order acknowledgement numbers (for warranty and service)
 - d. Name, address, and phone number of local representative for each manufacturer.
 - e. Parts list for each product.
 - f. Final approved hardware schedule, edited to reflect conditions as-installed.
 - g. Final keying schedule
 - h. Copies of floor plans with keying nomenclature
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

- A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- 4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 - 2. Can provide installation and technical data to Architect and other related subcontractors.
 - 3. Can inspect and verify components are in working order upon completion of installation.
 - 4. Capable of producing wiring diagrams.
 - 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
- E. Keying Conference
 - 1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.
- F. Pre-installation Conference
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Inspect and discuss preparatory work performed by other trades.
 - 3. Inspect and discuss electrical roughing-in for electrified door hardware.

- 4. Review sequence of operation for each type of electrified door hardware.
- 5. Review required testing, inspecting, and certifying procedures.
- G. Coordination Conferences:
 - 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys to Owner by registered mail or overnight package service.

1.07 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate

provisions are made for locating and installing door hardware to comply with indicated requirements.

- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.
- 1.08 WARRANTY
 - A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
 - a. Closers:
 - i. Mechanical: 25 years.
 - b. Locksets:
 - i. Mechanical: 10 years.
 - c. Continuous Hinges: Lifetime warranty.
 - 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fasteners
 - 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.

- 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
- 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
- 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.
 - 1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
 - 2. Use materials which match materials of adjacent modified areas.
 - 3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.
- C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: Ives 5BB series.
 - 2. Acceptable Manufacturers and Products: Hager BB series, Stanley FBB Series.
- B. Requirements:
 - 1. Provide hinges conforming to ANSI/BHMA A156.1.
 - 2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
 - 3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
 - 4. 2 inches or thicker doors:

- a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
- b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
- 6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
- 7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
- 8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
- 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with

2.04 CONTINUOUS HINGES

- A. Aluminum Geared
 - 1. Manufacturers:
 - a. Scheduled Manufacturer: Ives.
 - b. Acceptable Manufacturers: Select, Stanley.
 - 2. Requirements:
 - a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
 - b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
 - c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, selflubricating operation.
 - d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
 - e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.

- f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Requirements:
 - 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 MORTISE LOCKS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: Falcon MA series.
 - 2. Acceptable Manufacturers and Products: Substitutions by Architect approval
- B. Requirements:
 - 1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3 hour fire doors.
 - 2. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
 - 3. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
 - 4. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
 - 5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.

- 6. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Lever Design: Falcon Dane

2.07 CYLINDRICAL LOCKS – GRADE 1

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: Falcon T series.
 - 2. Acceptable Manufacturers and Products: Substitutions by Architect approval
- B. Requirements:
 - 1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
 - 2. Cylinders: Refer to "KEYING" article, herein.
 - 3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
 - 4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
 - 5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
 - 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
 - 7. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Lever Design: Falcon Dane

2.08 AUXILIARY LOCKS

- A. Aluminum Door Deadbolt Narrow Style:
 - 1. Manufacturers and Products:
 - a. Scheduled Manufacturer and Product: Adams Rite MS1850 Series.
 - b. Acceptable Manufacturers and Products: No Substitute.
 - 2. Requirements:
 - a. Provide narrow style aluminum door deadbolts as specified.
 - b. Cylinders: Refer to "KEYING" article, herein.
 - c. Provide deadbolts with necessary backset with full 1-13/32 inches (36 mm) throw deadbolt.
 - d. Provide manufacturer's standard strikes unless extended lip strikes are necessary to protect trim.

2.09 CYLINDERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Match existing key system as directed by Owner.
- B. Requirements:
 - 1. Provide cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.
- 2.10 KEYING
 - A. Provide cylinders/cores keyed into Owner's existing factory registered keying system.
 - B. Requirements:
 - 1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - a. Master Keying system as directed by the Owner.
 - 2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - 3. Provide keys with the following features:
 - a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 4. Identification:
 - a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
 - b. Identification stamping provisions must be approved by the Architect and Owner.
 - c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

2.11 DOOR CLOSERS

- A. Manufacturers and Products:
 - 1. Scheduled Manufacturer and Product: LCN 4050 series.
 - 2. Acceptable Manufacturers and Products: Substitutions by Architect approval

- B. Requirements:
 - 1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
 - 2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
 - 3. Closer Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
 - 4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
 - 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
 - 6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
 - 7. Pressure Relief Valve (PRV) Technology: Not permitted.
 - 8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.12 DOOR TRIM

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Requirements:
 - 1. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
 - 2. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
 - 3. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.

2.13 PROTECTION PLATES

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Requirements:

- 1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
- 2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.14 DOOR STOPS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Burns, Rockwood.
- B. Provide door stops at each door leaf:
 - 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
 - 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
 - 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.
- 2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING
 - A. Manufacturers:
 - 1. Scheduled Manufacturer: Zero International.
 - 2. Acceptable Manufacturers: National Guard, Reese.
 - B. Requirements:
 - 1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
 - 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 3. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
 - 4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.16 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer: Ives.
 - 2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

- 1. Provide "push-in" type silencers for hollow metal or wood frames.
- 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
- 3. Omit where gasketing is specified.

2.17 FINISHES

- A. Finish: BHMA 626/652 (US26D); except:
 - 1. Hinges at Exterior Doors: BHMA 630 (US32D)
 - 2. Continuous Hinges: BHMA 628 (US28)
 - 3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
 - 4. Protection Plates: BHMA 630 (US32D)
 - 5. Overhead Stops and Holders: BHMA 630 (US32D)
 - 6. Door Closers: Powder Coat to Match
 - 7. Wall Stops: BHMA 630 (US32D)
 - 8. Weatherstripping: Clear Anodized Aluminum
 - 9. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

- 3.01 EXAMINATION
 - A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
 - B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
 - C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 PREPARATION
 - A. Where on-site modification of doors and frames is required:

- 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
- 2. Field modify and prepare existing door and frame for new hardware being installed.
- 3. When modifications are exposed to view, use concealed fasteners, when possible.
- 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

- I. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- J. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- K. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- L. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- M. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- N. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- 3.04 FIELD QUALITY CONTROL
 - A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.
 - 1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
- 3.05 ADJUSTING
 - A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.
- 3.07 DOOR HARDWARE SCHEDULE
 - A. Hardware items are referenced in the following hardware. Refer to the abovespecifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HARDWARE GROUP NO. 01

FOR U	JSE ON	MARK/DOOR #(S)	:				
102B			2A	301A	302A		
EACH	ТОН	AVE:					
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR
3	EA	HINGE		5BB1HW 4.5 X 4 NRP		630	IVE
1	EA	SECURITY LOCK V	W/	MA431L DG		626	FAL
		DB					
2	EA	MORTISE		MATCH EXISTING KE	ΞY	626	
		CYLINDER		SYSTEM			
1	EA	SURFACE CLOSER	ζ	4050 SCUSH		689	LCN
		(W/ SPRING STOP))				
1	EA	KICK PLATE		8400 10" X 2" LDW B-0	CS	630	IVE
1	EA	RAIN DRIP		142AA		AA	ZER
1	EA	GASKETING		429A @ HEAD & JAM	BS	А	ZER
1	EA	DOOR SWEEP		39A		А	ZER
1	EA	THRESHOLD		655A - OR AS REQUIR	ED BY	А	ZER
				SILL DETAIL			

HARDWARE GROUP NO. 02

FOR USE ON MARK/DOOR #(S): 203A

EACH TO HAVE:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4 NRP	630	IVE
2	EA	MANUAL FLUSH	FB358/FB458 - AS REQUIRED	626	IVE
		BOLT			
1	EA	DUST PROOF	DP1/DP2 AS REQUIRED	626	IVE
		STRIKE			
1	EA	SECURITY LOCK W/	MA431L DG	626	FAL
		DB			
2	EA	MORTISE	MATCH EXISTING KEY	626	
		CYLINDER	SYSTEM		
2	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
		(W/ SPRING STOP)			
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429A @ HEAD & JAMBS	А	ZER
2	EA	DOOR SWEEP	39A	А	ZER
1	EA	OVERLAPPING	44STST	STST	ZER
		ASTRAGAL			
1	EA	THRESHOLD	655A - OR AS REQUIRED BY	А	ZER
			SILL DETAIL		

HARDWARE GROUP NO. 03

FOR USE ON MARK/DOOR #(S):

105A

EACH TO HAVE:

QTY	-	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	T101 DAN	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 04

FOR U	SE ON	N MARK/DOOR #(S)):			
108A		204A 30	03A			
EACH	TOH	AVE:				
QTY		DESCRIPTION		CATALOG NUMBER	FINISH	MFR
3	EA	HINGE		5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK		T301S DAN	626	FAL
1	EA	SURFACE CLOSE	R	4050 RW/PA	689	LCN
1	EA	KICK PLATE		8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP		WS406/407CCV	630	IVE
3	EA	SILENCER		SR64	GRY	IVE

HARDWARE GROUP NO. 05

FOR USE ON MARK/DOOR #(S):

103A 106A

EACH	TO	HAVE:	

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRY / OFFICE	T511 DAN (CYLINDER PREP AS	626	FAL
		LOCK	REQUIRED)		
1	SET	CYLINDER(S)	MATCH EXISTING KEY	626	
			SYSTEM		
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 06

FOR USE ON MARK/DOOR #(S): 104B 203D EACH TO HAVE: QTY DESCRIPTION CATALOG NUMBER FINISH MFR 3 EA HINGE 5BB1 4.5 X 4.5 NRP 652 IVE EA CLASSROOM LOCK T561 DAN (CYLINDER PREP AS 1 626 FAL REQUIRED) 1 SET CYLINDER(S) MATCH EXISTING KEY 626 SYSTEM

1	EA	SURFACE CLOSER (W/ SPRING STOP & HOLD OPEN)	4050 SHCUSH	689	LCN
1 3	EA EA	KICK PLATE SILENCER	8400 10" X 2" LDW B-CS SR64	630 GRY	IVE IVE
		E GROUP NO. 07			
	JSE ON	N MARK/DOOR #(S):			
201B	ТОН	AVE.			
QTY	ЮП	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	FЛ	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK		626	FAL
1	LA	STOREROOM LOCK	REQUIRED)	020	IAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
FOR U 104A		E GROUP NO. AL-01 N MARK/DOOR #(S): AVE:			
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA		112HD	628	IVE
1	EA	MORTISE DEADBOLT	MS1850S	626	ADA
1	EA	EXIT INDICATOR	4089	119	ADA
2	EA	MORTISE	MATCH EXISTING KEY	626	
		CYLINDER	SYSTEM		
1	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4050 SCUSH	689	LCN
1	SET	CLOSER BRACKET(S)	AS REQUIRED TO INSTALL CLOSER	689	LCN
1	SET	SEALS	BY ALUM DOOR/FRAME MANUFACTURER		
1	EA	DOOR SWEEP	BY ALUM DOOR/FRAME MANUFACTURER		
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL	А	ZER

HARDWARE GROUP NO. EX-01

FOR USE ON MARK/DOOR #(S): 101A EACH TO HAVE: QTY DESCRIPTION 1 SET EXTERIOR HINGE

1	SET	EXTERIOR HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP	630	IVE
			AS REQUIRED BY EXISTING		
			CONDITIONS)		
1	EA	STOREROOM LOCK	T581 DAN (CYLINDER PREP AS	626	FAL
			REQUIRED)		
1	SET	CYLINDER(S)	MATCH EXISTING KEY	626	
			SYSTEM		
1	EA	SURFACE CLOSER	4050 SCUSH	689	LCN
		(W/ SPRING STOP)			
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429A @ HEAD & JAMBS	А	ZER
1	EA	DOOR SWEEP	39A	А	ZER
1	EA	THRESHOLD	655A - OR AS REQUIRED BY	А	ZER
			SILL DETAIL		

CATALOG NUMBER

At existing doors and frames, general contractor and hardware supplier to field verify existing conditions to ensure the compatibility of new hardware with existing preps prior to order of new materials. General contractor to provide necessary fillers, reinforcements and fasteners, compatible with existing materials as required for mounting new opening hardware and to cover existing frame preparations.

HARDWARE GROUP NO. EX-02

FOR U	JSE ON	MARK/DOOR #(S):			
101C					
EACH	TOH	AVE:			
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP	652	IVE
			AS REQUIRED BY EXISTING		
			CONDITIONS)		
1	EA	CLASSROOM LOCK	T561 DAN (CYLINDER PREP AS	626	FAL
			REQUIRED)		
1	SET	CYLINDER(S)	MATCH EXISTING KEY	626	
			SYSTEM		
1	EA	SURFACE CLOSER	4050 RW/PA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S @ HEAD AND JAMBS	BK	ZER

At existing doors and frames, general contractor and hardware supplier to field verify existing conditions to ensure the compatibility of new hardware with existing preps prior to order of new

DOOR HARDWARE

FINISH MFR

materials. General contractor to provide necessary fillers, reinforcements and fasteners, compatible with existing materials as required for mounting new opening hardware and to cover existing frame preparations.

HARDWARE GROUP NO. EX-03

FOR U 107A EACH		N MARK/DOOR #(S):			
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	SET	HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQUIRED BY EXISTING CONDITIONS)	652	IVE
1	EA	CLASSROOM LOCK	T561 DAN (CYLINDER PREP AS REQUIRED)	626	FAL
1	SET	CYLINDER(S)	MATCH EXISTING KEY SYSTEM	626	
1	EA	SURFACE CLOSER (W/ SPRING STOP & HOLD OPEN)	4050 SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

At existing doors and frames, general contractor and hardware supplier to field verify existing conditions to ensure the compatibility of new hardware with existing preps prior to order of new materials. General contractor to provide necessary fillers, reinforcements and fasteners, compatible with existing materials as required for mounting new opening hardware and to cover existing frame preparations.

HARDWARE GROUP NO. OH-01

FOR USE	ON MARK/DO	OR #(S):			
101B	102A	202B	203B	203C	301B
302B					

All hardware provided by overhead door manufacturer.

END OF SECTION 08 71 00

DIVISION 9

FINISHES, PAINT & COATINGS

SECTION 09 06 00 SCHEDULES FOR FINISHES

PART 1 - GENERAL

1.01 SUBMITTALS

A. Submittal requirements are specified in appropriate product sections.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. Products and materials referred to in this section are specified in appropriate product sections.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Requirements for incorporation of scheduled products into the Work are specified in appropriate product sections.
- B. Architectural painting and coating schedules are depicted on the Drawings.
- C. In the event schedules for painting and coating systems conflict, the requirements for High Performance Painting and Coating shall govern.
- D. Paint exposed surface whether or not painting system is designated in "schedules", except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If coating system is not designated, the Engineer will select from coating systems available.

3.02 SUPPLEMENTS

- A. The supplements listed below, are a part of this Specification.
 - 1. High Performance Coating System Schedule: A tabulation of coating systems for equipment and areas as depicted on the Drawings.

Building	Space	Material or Surface	Coating System	Specification
		Ferrous Metals	System 4	09 90 02
Lift	All	Process Piping	System 4	09 90 02
Station	Spaces	Precast Concrete, Immersion and High H ₂ S Exposure	System 11	09 90 02
		Precast Walls	Section 2.08	09 90 00
		Precast Ceiling	Section 2.08	09 90 00
		Floors	Section 2.07	09 90 00
		Cast-in-Place Concrete, High H ₂ S Exposure	System 11	09 90 02
Screen	All	Concrete Pedestals & Mounting	System 13	09 90 02
Room	Spaces	Ferrous Metals	System 4	09 90 02
		Metals, Concrete embedded	System 6	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 4	09 90 02
		Galvanized, Copper, Nonferrous Alloys	System 7	09 90 02
		Walls	Section 2.08	09 90 00
	All Spaces	Ceiling	Section 2.08	09 90 00
		Floors	Section 2.07	09 90 00
		Interior Ferrous Metals	System 2	09 90 02
Control Door		Metals, Concrete embedded	System 6	09 90 02
Room		Aluminum & Dissimilar Metals	System 14	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 2	09 90 02
		Galvanized, Copper, Nonferrous Alloys	System 7	09 90 02
		Walls	Section 2.08	09 90 00
		Ceiling	Section 2.08	09 90 00
		Floor	Section 2.07	09 90 00
		Interior Ferrous Metals, Non-immersion	System 2	09 90 02
Blower	All	Ferrous Metals, Immersion	System 3	09 90 02
Building	Spaces	Metals, Concrete embedded & Encased	System 6	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Piping	System 2	09 90 02
		Non-Ferrous Metals & Piping	System 7	09 90 02
		Aluminum & Dissimilar Metals	System 14	09 90 02

High Performance Painting & Coating Schedule

Building	Space	Material or Surface	Coating System	Specification
Polishing Reactor	All Spaces	Walls	System 10	09 90 02
		Floors	System 10	09 90 02
		Ferrous Metals	System 4	09 90 02
		Metals, Concrete embedded	System 6	09 90 02
		PVC, CPVC, and FRP	System 8	09 90 02
		Process Pipe	System 4	09 90 02
Interpond Structures	All Spaces	Walls	System 11	09 90 02
		Floor	System 11	09 90 02
		Ceiling	System 11	09 90 02
		Ferrous Metals	System 4	09 90 02
		Process Pipe	System 4	09 90 02
Treatment Basins	All Spaces	Ferrous Metals	System 4	09 90 02
		Process Pipe	System 4	09 90 02
		Concrete Pipe Supports & Penetrations	System 11	09 90 02

END OF SECTION 09 06 00

SECTION 09 20 00 PLASTER AND GYPSUM BOARD

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to furnish and install gypsum board assemblies, complete.
- 1.02 GENERAL REQUIREMENTS
 - A. Sound Transmission Characteristics: For assemblies indicated to have STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing agency.
- 1.03 RELATED SECTIONS
 - A. Section 07 20 00, Building Insulation.

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. Subject
 - 1. Georgia-Pacific Corp.
 - 2. Gold Bond Building Products Div., National Gypsum Co.
 - 3. United States Gypsum Co.
 - 4. Or equal.
 - B. Gypsum Board: Provide gypsum board of types indicated, in maximum lengths available, to minimize end joints:
 - 1. Gypsum Wallboard: ASTM C 36, thickness as indicated.
 - a. Type: Type X where required for fire-resistive rated assemblies.
 - 2. Water-Resistant Gypsum Backing Board: ASTM C 630, thickness as indicated at toilets and sinks.
 - a. Type: Type X for fire-resistive-rated assemblies.
 - C. Accessories for Interior Installation: Corner beads, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
 - 1. Material: Formed metal, plastic, or metal combined with paper, with metal complying with the following requirement:
 - a. Sheet steel coated with zinc by hot-dip or electrolytic processes, or with aluminum or rolled zinc.

- 2. Shapes indicated below by reference to Figure 1 designations in ASTM C 1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim unless otherwise indicated.
 - c. L-trim and J-trim at windows, doors, and at panels that abut other materials.
- D. Gypsum Board Joint Treatment Materials: ASTM C 475 and ASTM C 840, and as follows:
 - 1. Joint Tape: Paper reinforcing tape, unless otherwise indicated.
 - a. Use open-weave glass-fiber tape where recommended by gypsum board manufacturer with setting-type joint compound.
 - 2. Setting-Type Joint Compound: Factory-packaged, job-mixed chemical-hardening powder products formulated for uses indicated.
 - a. For topping compound, use sandable formulation.
 - b. Use in wet areas.
 - 3. Drying-Type Joint Compounds: Factory-packaged, vinyl-based products complying with the following requirements:
 - a. Ready-Mixed Formulation: Factory premixed.
 - b. Taping compound formulated for embedding tape and first coat over fasteners and flanges of corner beads and edge trim.
 - c. Topping compound formulated for fill (second) and finish (third) coats.
 - 4. Miscellaneous Materials: where called out on the Drawings, recommended by gypsum board manufacturer:
 - a. Steel drill screws complying with ASTM C 1002 for fastening gypsum board to steel members.
 - b. Exposed and Concealed Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
 - c. Sound Attenuation Blankets: ASTM C 665, Type I, unfaced mineral-fiber blanket insulation.

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. Install and finish gypsum board to comply with ASTM C 840 and as follows:
 - 1. Install gypsum board panels horizontally in longest panels possible.
 - 2. Isolate gypsum board construction from abutting structural and masonry work. Provide edge trim and acoustical sealant as recommended by manufacturer.

- 3. Install sound attenuation blankets where indicated, without gaps, and support, where necessary, to prevent movement or dislocation.
- 4. Install water-resistant backing board where indicated, and adjacent to all plumbing and fixtures.
- 5. Screw gypsum board to metal supports.
- 6. Do not bridge building expansion joints. Leave a space of the width indicated between boards, and trim both edges for installation of sealant or gasket.
- 7. Install control joints in gypsum board panels at spacings recommended by manufacturer.
- B. Finishing Gypsum Board Assemblies:
 - 1. Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects, and elsewhere, as required, to prepare gypsum board surfaces for decoration and levels of gypsum board finish indicated.
 - 2. Levels of Gypsum Board Finish: Provide the levels of finish per Room Finish Schedule in accordance with GA-214.

END OF SECTION 09 20 00

SECTION 09 77 00 FIBERGLASS REINFORCED PLASTIC PANEL

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Glass fiber reinforced plastic panels.
 - B. Trim.
- 1.02 REFERENCE STANDARDS
 - A. ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010.
 - B. ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
 - C. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
 - D. ASTM D5319 Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2012.
 - E. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
 - F. FDA Food Code Chapter 6, Physical Facilities; current edition with Supplements, if any.
 - G. FM 4880 Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems; 2010.
- 1.03 SUBMITTALS
 - A. See Section 01 30 00 Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
 - C. Samples: Submit two samples 6 inch in size illustrating material and surface design of panels.
 - D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 Product Requirements, for additional provisions.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 - PRODUCTS

FIBERGLASS REINFORCED PLASTIC PANEL

2.01 MANUFACTURERS

- A. Glass Fiber Reinforced Plastic Panels:
 - 1. Marlite: <u>www.marlite.com.</u>
 - 2. Crane Composites, Inc. <u>www.cranecomposites.com.</u>
 - 3. Panolam FRP, <u>www.panolam.com.</u>
 - 4. Substitutions: See Section 01 60 00 Product Requirements.
- 2.02 PANEL SYSTEMS
 - A. Wall Panels at all bathrooms (inside and outside) and custodial, and kitchen where indicated on plans
 - 1. Panel Size: 4 by 8 feet
 - 2. Panel Thickness: 3/32 inch.
 - 3. Surface Design: subway tile
 - 4. Color: White.
 - 5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

- A. Panels: Glass fiber reinforced plastic, complying with ASTM D5319.
 - 1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum; when whole system is tested in accordance with ASTM E84.
 - 2. Class 1 fire rated as tested in accordance with FM Approval Standard 4880.
 - 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 4. Scratch Resistance: Barcol hardness score of not less than 35, when tested in accordance with ASTM D2583.
 - 5. Impact Strength: Not less than 6 ft-lb/in, when tested in accordance with ASTM D256.
 - 6. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 Physical Facilities.
- B. Trims: Extruded aluminum, color coordinating with panel, shapes as required for conditions.
- C. Adhesive: Type recommended by panel manufacturer.
- D. Sealant: Type recommended by panel manufacturer; clear.

PART 3 - EXECUTION

3.01 EXAMINATION

FIBERGLASS REINFORCED PLASTIC PANEL

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades or drill bits, or cut with snips.
- C. Apply adhesive to the back side of the panel using trowel recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, if required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails as required.
- I. Seal gaps at floor, ceiling, and between panels with specified sealant to prevent moisture intrusion.
- J. Remove excess sealant as paneling is installed.

END OF SECTION 09 77 00

SECTION 09 90 00 PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes surface preparation and field application and finishing of exposed interior and exterior items and surfaces.
- B. Related Divisions:
 - 1. Division 3 Concrete and Grout
 - 2. Division 4 Masonry
 - 3. Division 5 Metals
 - 4. Division 6 Woods, Plastics, Composites
 - 5. Division 7 Thermal & Moisture Protection
 - 6. Division 11 Equipment
 - 7. Division 40 Process Interconnections
- 1.02 REFERENCES
 - A. American Society for Testing and Materials:
 - 1. ASTM D16 Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
 - 2. ASTM D4442 Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - B. Painting and Decorating Contractors of America:
 - 1. PDCA Architectural Painting Specification Manual.
 - C. SSPC: The Society for Protective Coatings:
 - 1. SSPC Steel Structures Painting Manual.
- 1.03 DEFINITIONS
 - A. Conform to ASTM D16 for interpretation of terms used in this section.
- 1.04 SUBMITTALS
 - A. Section 01 33 00 Submittal Procedures: Submittal procedures.
 - B. Product Data: Submit data on finishing products.
 - C. Manufacturer's Installation Instructions: Submit special surface preparation procedures and substrate conditions requiring special attention.
- 1.05 CLOSEOUT SUBMITTALS
 - A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair

PAINTING & COATING

of painted and coated surfaces.

- 1.06 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - B. Applicator: Company specializing in performing work of this section with minimum three years documented experience.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
 - B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
 - C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
 - D. Paint Materials: Store at minimum ambient temperature of 45°F and maximum of 90°F, in ventilated area, and as required by manufacturer's instructions.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- B. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- D. Minimum Application Temperature for Varnish and oil based Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candle measured mid-height at substrate surface in order to assure proper visual quality assurance.
- 1.09 SEQUENCING
 - A. Section 01 11 00 Summary: Work sequence.
 - B. Sequence application to the following:
 - 1. Do not apply finish coats until paintable sealant is applied.
 - 2. Back prime wood trim before installation of trim.
- 1.10 WARRANTY

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- A. Furnish five year manufacturer warranty for paints and coatings.
- 1.11 EXTRA MATERIALS
 - A. Supply 1 gallon of each color, type, and surface texture; store where directed.
 - B. Label each container with color, type, texture and room locations in addition to manufacturer's label.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. Provide Products (Paint, Primer, Sealers and Block Fillers) as manufactured by:
 - 1. Sherwin Williams (SW)
 - 2. Benjamin Moore & Co.;
 - 3. PPG Industries;
 - 4. Tnemec Company, Inc;
 - 5. Glidden Professional.
 - 6. Columbia Paints.
 - B. Listing of products by manufacturer's trade name is not intended to exclude equivalent products by other manufacturers identified above. For products not specifically named, submit substitution request in accordance with Section 01 60 00.

2.02 FILLERS AND SEALERS

- A. Interior Block Filler:
 - 1. Benjamin Moore and Company: Super Craft Block Filler No. 285
 - 2. PPG Industries, Inc.: Speedhide Acrylic Latex Masonry Block Filler, 6-7.
 - 3. Sherwin-Williams: Interior/Exterior Block Filler No. B25W25.
 - 4. Tnemec Company, Inc.: Latex Masonry Filler No. 54-560.
- B. Single Component Masonry Conditioner:
 - 1. Benjamin Moore: Acrylic Masonry Sealer (066)
 - 2. PPG Industries, Inc.: Masonry Surface Sealer No. 6-8.
 - 3. Sherwin-Williams: Loxon Masonry Conditioner A24
- C. Paste Wood Filler:
 - 1. Benjamin Moore and Company: Benwood Wood Filler #238
 - 2. Sherwin-Williams: Sherwood Wood Filler.
- D. Sanding Sealer (Vinyl Toluene Copolymer):

- 1. Benjamin Moore and Company: IWF Sanding Sealer Clear No. 413.
- 2. PPG Industries, Inc.: Speedhide Alkyd Sanding Sealer, 6-10.
- 3. Sherwin-Williams: Wood Classics Fast Dry Sanding Sealer.
- E. Stain Sealer:
 - 1. Benjamin Moore and Company: Moore's Stain Blocking Primer No 202.
 - 2. Sherwin-Williams: Preprite Problock Latex & Alkyd Primer/Sealer
- 2.03 PRIME COATINGS
 - A. Exterior Alkali Resistant Primer:
 - 1. Benjamin Moore and Company: Super Spec Exterior Latex Primer No. 169
 - 2. PPG Industries, Inc.: Alkali Resistant Primer No. 6-3.
 - 3. Sherwin-Williams: Loxon Exterior Masonry Primer A24 Series
 - B. Interior Alkyd Enamel Undercoater:
 - Benjamin Moore and Company: Super Spec Alkyd Enamel Undercoater C245
 - 2. PPG Industries, Inc.: Speedhide Quick Drying Enamel Undercoater, 6-6.
 - 3. Sherwin-Williams: Wall and Wood Primer B49WZ2.
 - C. Alkyd-Phenolic Primer:
 - 1. Benjamin Moore: M07 Universal Metal Primer
 - 2. PPG Industries, Inc.: Multiprime Universal Primer No. 97-682.
 - 3. Sherwin-Williams: Ken Kromik Universal B50NZ Series.
 - 4. Tnemec Company, Inc.: Series 37 Chem-Prime.
 - D. Etching Metal Primer:
 - 1. PPG Industries, Inc.: Polyclutch Wash Primer No. 97-687.
 - 2. Sherwin-Williams: DTM Wash Primer B71Y1.
 - 3. Tnemec Company, Inc.: Tneme-Grip No. 32-1210.
 - E. Ethyl Silicate Zinc Primer:
 - 1. Benjamin Moore: M01/M02 Inorganic Zinc Primer
 - 2. PPG Industries, Inc.: Metalhide 1001 Inorganic Zinc Rich Primer, 97-673/97-674.
 - 3. Sherwin-Williams: Zinc Clad II HS Ethyl Silicate B69BVZ3.
 - 4. Tnemec Company, Inc.: Tneme-Zinc No. N90E92.
 - F. Acrylic Latex Ferrous Metal Primer:

- 1. Benjamin Moore: Acrylic Metal Primer M04
- 2. Sherwin Williams: Pro Cryl Universal Metal Primer B66W310
- G. Exterior Alkyd Primer:
 - 1. Benjamin Moore and Company: Super Spec Alkyd Exterior Primer No. 176.
 - 2. PPG Industries, Inc.: Speedhide Exterior Alkyd Wood Primer, 6-9.
 - 3. Sherwin-Williams: A-100 Exterior Wood Primer Y24.
 - 4. Tnemec Company, Inc.: Undercoater No. 36-603.
- H. Galvanized Primer:
 - 1. Benjamin Moore: Acrylic Metal Primer M04
 - 2. PPG Industries, Inc.: Galvanized Steel Primer No. 6-209.
 - 3. Sherwin-Williams: Galvite HS B50WZ30.
 - 4. Tnemec Company, Inc.: Galv-Gard Series 22.
- I. Latex Primer:Interior
 - 1. Benjamin Moore: Super Spec Primer Sealer & Latex Undercoat No 253.
 - 2. PPG Industries, Inc.: Speedhide Latex Wall Sealer No. 6-2.
 - 3. Sherwin-Williams: PrepRite Primer B28W200
 - 4. Tnemec Company, Inc.: PVA Sealer No. 51-792.
- J. Latex Primer Exterior :
 - 1. Benjamin Moore: Super Spec Latex Exterior Primer No. 169
 - 2. Sherwin Williams; A-100 Latex Primer B42W41
- K. Long-Oil Alkyd Primer:
 - 1. Benjamin Moore: Moorwhite Penetrating Alkyd Primer No. 100
 - 2. PPG Industries, Inc.: Speedhide Alkyd Red Rust Inhibitive Steel Primer, 6-208.
 - 3. Sherwin-Williams: Kromik Metal Primer E41N1.
 - 4. Tnemec Company, Inc.: Tnemec Primer Series 10.
- 2.04 WATER REDUCIBLE COATINGS
 - A. Industrial 100% Acrylic:
 - 1. Benjamin Moore: DTM Acrylic Gloss (M28) or Semi-Gloss (M29)
 - 2. PPG Industries, Inc.: Water Base Inhibitive Primer No. 6-712.
 - 3. Sherwin-Williams: DTM Acrylic.
 - a. Gloss: B66-100.

- b. Semi-Gloss: B66-200.
- 4. Tnemec Company, Inc.: Tneme-Cryl Series 6 (Flat) and Series 7 (Semigloss).
- B. Interior Premium Acrylic Latex Enamel:
 - 1. Benjamin Moore and Company:
 - a. Eggshell: Super Spec Latex Eggshell Enamel (286)
 - b. Pearl Finish:: Super Sec Latex Pearl Finish (277)
 - c. Semi-Gloss: Super Spec Latex Semi-Gloss Enamel (283)
 - d. Gloss: Impervex Metal & Wood Enamel no. 309
 - 2. PPG Industries, Inc.:
 - a. Eggshell: Speedhide Acrylic Latex Enamel, 6-411.
 - b. Semi-Gloss: Speedhide Acrylic Latex Enamel, 6-510.
 - 3. Sherwin-Williams:
 - a. Eggshell: ProMar 200 EgShel B20W200.
 - b. Semi-Gloss: Pro Mar 200 Latex Semi Gloss B31 Series
 - c. Gloss: Pro Classic Gloss B21
- C. Interior Acrylic Vinyl Latex Flat Paint:
 - 1. Benjamin Moore and Company: Super Spec Latex Flat (275)
 - 2. PPG Industries, Inc.: Speedhide Acrylic Latex Flat Wall Paint, 6-70.
 - 3. Sherwin-Williams: ProMar 200 Flat B30W200
- D. Water Based Epoxy:
 - 1. Benjamin Moore and Company: Super Spec Acrylic Epoxy Enamel No. 256
 - 2. PPG Industries, Inc.: Pitt-Glaze Water Based Acrylic Epoxy Enamel.
 - 3. Sherwin Williams: Water Based Epoxy B70-200.

2.05 WOOD STAINS AND COATINGS

- A. Masking Wiping Stain:
 - 1. Benjamin Moore and Company: Benwood Interior Stain No. 234
 - 2. PPG Industries, Inc.: Rez Interior Stain No. 77-302.
 - 3. Sherwin-Williams: Wood Classics A49-200.
- B. Non-Masking Penetrating Stain:
 - 1. Sherwin-Williams: Sherwood S64.
- C. Alkyd Polyurethane Varnish:

- 1. Benjamin Moore and Company: Benwood Polyurethane Finishes No.424 (Flat), 435 (Satin), and 428 (Gloss).
- 2. PPG Industries, Inc.: Rez Polyurethane Varnish No. 77-9 (Satin), 77-5 (Gloss).
- 3. Sherwin-Williams: Wood Classics Polyurethane Varnish A67 Series.
- 4. Minwax® Wipe-On Poly.
- D. Semi-Transparent Stain:
 - 1. Benjamin Moore and Company: Benjamin Moore Alkyd Semi-Transparent Stain No. 328
 - 2. PPG Industries, Inc.: Rez Stain Wood Preservative & Water Repellant Stain No. 77-860.
 - 3. Sherwin-Williams: WoodScapes Semi-Transparent Stain A15T5.
- E. Spar Varnish:
 - 1. Benjamin Moore and Company: Impervo 440 Spar Varnish.
 - 2. PPG Industries, Inc.: Rez Spar Varnish No. 77-10.
 - 3. Sherwin-Williams: Helmsman /Minwax Spar Varnish.

2.06 ACCESSORY MATERIALS

- A. Muriatic acid, mildewcide, TSP (tri-sodium phosphate), acidic-detergent, zinc sulfate, sodium metasilicate, and solvent: Commercially available, non-damaging to surface being cleaned; as specified in PDCA Specification Manual; acceptable to coating manufacturer.
- B. Metal Conditioner: Proprietary phosphoric acid based, etching type solution; acceptable to coating manufacturer.
- C. Rust Inhibitor: Water containing 0.32 percent of sodium nitrite and 1.28 percent by weight of secondary ammonium phosphate (dibasic); or water containing 0.2 percent by weight of chromic acid or sodium chromate or sodium dichromate or potassium dichromate.
- D. Spackling compound, putty, plastic wood filler, liquid de-glosser, latex patching plaster, latex base filler, thinners, and other materials not specifically indicated but required to achieve finishes specified: Pure, of highest commercial quality, compatible with coatings and acceptable to coating manufacturer.
- E. Do not use products of different manufacturers in combination.

2.07 CONCRETE FLOOR SEALER (SC)

- A. Manufacturers
 - 1. H & C Concrete Sealer Wet Look Water Based (Basis of Design)
 - 2. Substitutions: Per Section 01 61 00 Product Requirements.

- B. Products
 - 1. 100% Clear Acrylic Sealer
 - 2. Slip Resistant Additive
 - a. H & C Shark Grip
- C. Installation: Per manufacturer's instructions.

2.08 CONCRETE WALL SEALER

- A. Manufacturers:
 - 1. Sika Corporation: Sikagard 62 Epoxy Coating
 - a. 2-component, 100% solids, moisture-tolerant epoxy resin
 - b. High-build, protective, dampproofing and waterproofing vapor- barrier system
 - 2. Substitutions: Per Section 01 61 00 Product Requirements.
- 2.09 BLOCK FILLER
 - A. Manufacturers
 - 1. Sherwin Williams, Prep Rite.
 - 2. Substitutions: Per Section 01 61 00 Product Requirements.
- 2.10 MIXING
 - A. Use factory prepared colors matching approved samples. Site tinting will not be permitted.
 - B. Thoroughly mix and stir coatings before use to ensure homogeneous dispersion of ingredients. Prior to application, blend multiple containers of same material and color by pouring from one container to another several times to ensure uniform consistency, color, and smoothness.
 - C. Mix only in clean mixing pails of material recommended by manufacturer to avoid contamination.
 - D. Remove film which may form on surface of material in containers and strain material before using. Stir frequently during use to maintain pigments in suspension. Do not stir film into material.
 - E. Apply coatings of consistency recommended by manufacturer. Thin only within recommended limits using thinners approved by coating manufacturer.
- 2.11 COLORS AND FINISHES
 - A. Refer to the Painting & Coating Schedule at the end of this Section and also on the Project Drawings.

PART 3 - EXECUTION

PAINTING & COATING

3.01 EXAMINATION

- A. Section 01 70 00 Execution Requirements: Coordination and project conditions.
- B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.
- D. Test shop applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of substrates using recently calibrated electronic moisture meter. Do not apply coatings if moisture content of surfaces exceeds lesser of percentages listed below or those required by coating manufacturer. If excess moisture content exists and cannot be reduced, obtain written approval of coating manufacturer before application of coatings.
 - 1. Gypsum board and gypsum plaster: 17 percent.
 - 2. Architectural woodwork, trim, cabinets, and casework: 10 percent; measure with resistance-type meter in accordance with ASTM D4442.
 - 3. Common board and dimension lumber: 12 percent; measure with resistance-type meter in accordance with ASTM D4442.
 - 4. Masonry, concrete, CMU, and Portland cement plaster: 17 percent for solvent reduced coatings. Test concrete floors in accordance with ASTM D4263.
 - 5. Canvas and cotton insulation coverings: 12 percent max.
 - 6. Concrete Floors: 8 percent.
- 3.02 PREPARATION
 - A. Protect completed construction from damage. Furnish drop cloths, shields, and protective methods to prevent spray, splatter, or droppings from disfiguring other surfaces.
 - B. Remove surface hardware, mechanical diffusers, escutcheons, registers, electrical plates, light fixture trim, fittings, fastenings and similar items prior to preparing surfaces for finishing. Provide surface-applied protective masking for non-removable items. Carefully store removed items for reinstallation.
 - C. Remove mildew by scrubbing with mildewcide. Rinse thoroughly with clean water and allow surface to dry completely.
 - D. Before beginning application of coatings, ensure surfaces are clean, dry, and free of dirt, dust, rust or rust scale, oil, grease, mold, mildew, algae, efflorescence, release agents, or any other foreign material which could adversely affect coating adhesion or finished appearance.
 - E. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt,

and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

- F. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- G. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.03 SURFACE PREPARATION FOR NEW WORK

- A. General:
 - 1. Correct minor defects.
 - 2. Remove temporary labels, wrappings, and protective coverings from surfaces to be coated.
 - 3. Seal stains, marks, and other imperfections which may bleed through surface finishes.
- B. Aluminum:
 - 1. Clean in accordance with SSPC SP1 "Solvent Cleaning".
 - 2. Apply etching type primer.
- C. Concrete:
 - 1. Prior to application of coatings, allow surfaces to cure minimum 60 days.
 - 2. Remove dirt, scale, powder, laitance, and bond breakers by light sandblasting to minimum 1.5 mil profile.
 - 3. Remove oil and grease with solution of TSP; rinse well.
 - 4. Remove stains caused by weathering or corroding metals with solution of sodium metasilicate applied after thoroughly wetting surface with potable water; allow to dry.
 - 5. Fill cracks and voids with compatible filler.
 - 6. Brush-off blast floors to lightly abrade surface without entirely removing surface or exposing underlying aggregate.
- D. Gypsum Board:
 - 1. Fill remaining cracks, depressions, holes and other irregularities with spackling compound.
 - 2. Sand rough or high spots left by joint cement or spackling compound without damaging paper face.
 - 3. Remove dust by wiping with damp cloths and vacuuming.

E. Masonry:

- 1. Prior to application of coatings, allow surfaces to cure minimum 28 days.
- 2. Remove dirt, scale, loose mortar, efflorescence, and powder by wire brushing or by other approved methods.
- 3. Remove oil and grease with solution of TSP, rinse, and allow to dry.
- 4. Remove stains caused by weathering or corroding metals with solution of sodium metasilicate applied after thoroughly wetting surface with potable water; allow to dry.
- 5. Wash and neutralize surfaces as recommended by coating manufacturer, rinse, and allow to dry.
- F. Existing and New Plaster (or stucco) :
 - 1. Allow surfaces to cure and dry completely prior to application of coatings; minimum of 28 days.
 - 2. Remove dirt, efflorescence, scale, loose sand, and powder by wire brushing or by other approved methods.
 - 3. Remove oil and grease with solution of TSP, rinse, and allow to dry.
 - 4. Wash portland cement plaster to receive solvent reducible coatings with zinc sulfate solution, rinse, and allow to dry.
 - 5. Wash gypsum plaster to receive solvent reducible coatings with acidicdetergent, rinse and allow to dry.
 - 6. Fill hairline cracks, small holes and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces.
- G. Steel Uncoated:
 - 1. Remove weld spatter by chipping or grinding.
 - Clean interior and weather protected steel in accordance with SSPC SP2 "Hand Tool Cleaning" and SP3 "Power Tool Cleaning". Clean areas of excessive corrosion or scale in accordance with SSPC SP7 "Brush-Off Blast Cleaning".
 - 3. Clean exterior steel permanently exposed to elements in accordance with SSPC SP6 "Commercial Blast Cleaning".
 - 4. Apply metal conditioner to bare surfaces in accordance with manufacturer's recommendations, paying particular attention to abrasions, welds, bolts, and nuts. Allow to set as recommended by solution manufacturer. Rinse with clean water with rust inhibitor mixed with water or applied immediately following rinse. Allow to dry.
 - 5. Prime coat immediately.

- H. Steel Prime Coated:
 - Remove loose primer and rust to feather-edge at adjacent sound primer by cleaning in accordance with SSPC SP2 "Hand Tool Cleaning" and SP3 "Power Tool Cleaning".
 - 2. Apply metal conditioner to abrasions, welds, bolts, and nuts in accordance with manufacturer's recommendations. Allow to set as recommended by manufacturer. Rinse with clean water with rust inhibitor mixed with water or applied immediately following rinse. Allow to dry.
 - 3. Prime coat bare areas immediately.
- I. Steel Galvanized:
 - 1. Remove white rust by cleaning in accordance with SSPC SP2 "Hand Tool Cleaning" and SP3 "Power Tool Cleaning". Exercise care not to remove galvanizing.
 - 2. Pretreat surfaces to receive solvent reducible coatings immediately.
- J. Wood Opaque Finish:
 - 1. Remove excess residue from knots, pitch streaks, cracks, open joints, and sappy spots. Remove or seal over grade stamp markings.
 - 2. Sand wood surfaces and edges smooth. Remove dust after each sanding.
 - 3. Apply compatible stain sealer to knots, pitch and resinous sapwood before applying prime coat. Do not apply shellac to exterior surfaces, or under latex or urethane finishes.
 - 4. After primer is dry and before second coat, countersink nails and fill nail holes, cracks, open joints and other defects with putty or plastic wood filler.
- K. Wood Transparent Finish:
 - 1. Remove excess residue from knots, pitch streaks, cracks, open joints, and sappy spots. Ensure exposed fasteners are countersunk.
 - 2. Sand wood surfaces and edges smooth. Remove dust after each sanding.
 - 3. After stain is dry and before sanding sealers are applied, fill nail holes, cracks, open joints and other defects with putty or plastic wood filler.
 - 4. Tint fillers to match stain and finish coatings. Work fillers well into and perpendicular to grain before set. Wipe excess from surface.

3.04 SURFACE PREPARATION OF PREVIOUSLY COATED SURFACES

- A. General:
 - 1. Remove cracked and deteriorated sealants and calking.
 - 2. Remove chalk deposits and loose, blistered, peeling, scaling, or crazed finish to bare base material or sound substrate by scraping and sanding.

- 3. Wash surfaces with solution of TSP to remove wax, oil, grease, and other foreign material; rinse, and allow to dry. Exercise caution that TSP solution does not soften existing coating.
- 4. Abrade glossy surfaces by sanding or wiping with liquid de-glosser.
- 5. Remove mildew as specified above.
- 6. Test compatibility of existing coatings by applying new coating to small, inconspicuous area. If new coatings lift or blister existing coatings, request recommendation from Architect.
- 7. Apply specified primer to surfaces scheduled to receive coatings.
- B. Concrete, Masonry, and Portland Cement Plaster:
 - 1. Fill cracks and voids with latex base filler.
 - 2. Apply masonry conditioner to masonry surfaces in accordance with manufacturer's instructions.
 - 3. Apply primer over bare surfaces and filler material.
- C. Gypsum Wallboard and Gypsum Plaster:
 - 1. Fill cracks and voids with spackling compound.
 - 2. Apply primer over bare surfaces and newly applied texture coatings.
- D. Metal:
 - 1. Remove rust from surfaces to bare metal in accordance with SSPC SP6 "Commercial Blast Cleaning".
 - 2. Exercise care not to remove galvanizing.
 - 3. Complete preparation as specified for new work.
- E. Wood:
 - 1. Fill cracks, crevices and nail holes with putty or wood filler.
 - 2. Apply primer over bare surfaces and filler material.

3.05 APPLICATION

- A. General Requirements:
 - 1. Coat all surfaces specified, scheduled, illustrated, and otherwise exposed unless specifically noted otherwise.
 - 2. Apply coatings of type, color, and sheen as scheduled.
 - 3. Use application materials, equipment, and techniques as recommended by coating manufacturer and best suited for substrate and type of material being applied.
 - 4. Do not apply finishes to surfaces that are improperly prepared.

- 5. Number of coats specified are minimum number acceptable.
- 6. Apply coating systems to total dry film thickness scheduled. Apply material at not less than manufacturer's recommended spreading rate. Do not exceed maximum single coat thickness recommended by coating manufacturer. Do not double-back with spray equipment building up film thickness of two coats in one pass.
- 7. Ensure that edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent of flat surfaces.
- 8. Finish edges of coatings adjoining other materials or colors sharp and clean, without overlapping.
- B. Prime Coats:
 - 1. Apply initial coat to surfaces as soon as practical after preparation and before subsequent surface deterioration.
 - 2. Backprime exterior woodwork with specified primer.
 - 3. Backprime interior woodwork scheduled to receive transparent finish with gloss varnish reduced 25 percent with mineral spirits.
 - 4. Apply primer to wood and metal sash before field glazing.
- C. Intermediate and Top Coats:
 - 1. Allow previously applied coat to dry before next coat is applied.
 - 2. Sand and dust lightly between coats as recommended by coating manufacturer.
 - 3. Apply each coat to achieve uniform finish, color, appearance, and coverage free of brush and roller marks, runs, misses, visible laps or shadows, hazing, bubbles, pin holes, or other defects.
 - 4. If stains, undercoats, or other conditions show through final topcoat, correct defects and apply additional topcoats until coating film is of uniform finish, color, and appearance.
- D. Finish Matching:
 - 1. Finish closets same as adjoining rooms, unless otherwise specified.
 - 2. Finish tops, bottoms, and edges of doors same as door faces. Apply sanding sealer to cut-outs. When faces are different colors, finish edges of doors to match space from which they are visible when door is in partly open position.
 - 3. Finish other surfaces not specifically mentioned to match adjoining surfaces.

- E. Mechanical and Electrical Items:
 - Refer to Division 21 Fire Suppression, Division 22 Plumbing, Division 23 - Heating, Ventilating, and Air Conditioning, and Division 26 - Electrical for schedule of color coding and identification banding of equipment, ductwork, piping, and conduit. Color code equipment, piping, conduit and exposed ductwork in accordance with requirements indicated.
 - 2. Prior to finishing mechanical and electrical items, remove louvers, grilles, covers, and access panels and finish separately. Replace when dry.
 - 3. Paint interior surfaces of ducts, and heating cabinets that are visible or reflective behind grilles and registers with one coat of flat black paint.
 - 4. Finish dampers visible behind grilles and registers to match surface finish.
 - 5. Paint both sides and edges of plywood equipment backboards before installing equipment.
 - 6. Do not apply coatings over name plates, tags, or other equipment identification.
- F. Reinstall trim, fittings, and other items removed for finishing.
- 3.06 FIELD QUALITY CONTROL
 - A. General: Comply with requirements of Section 01 40 00.
 - B. Periodically test film thickness of each coat with wet film gage to ensure coatings are being applied to proper thickness.
 - C. Request review of each applied coat by Architect before application of successive coats. Only reviewed coats will be considered in determining number of coats applied.
 - D. Immediately prior to Substantial Completion, perform detailed inspection of painted surfaces and repair or refinish abraded, stained, or otherwise disfigured surfaces.
 - E. Testing: Owner reserves right to employ independent testing agency to verify acceptability of substrates and conformance of coating materials to specified requirements; and to test coating quality and dry film thickness.
 - F. If test results show that material does not comply with specified requirements, remove noncomplying coatings, recoat with acceptable material, and pay costs of additional testing to ensure compliance.
- 3.07 CLEANING
 - A. Promptly remove spilled, splashed, or spattered coatings. Clean spots, oil, and other soiling from finished surfaces using cleaning agents and methods which will not damage materials.

- B. If completed construction is damaged beyond normal cleaning or repair by painting operations, replace damaged items at no additional cost to Owner.
- C. Maintain premises and storage areas free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- D. Collect waste, cloths, and material which may constitute fire hazards and place in closed metal containers; remove from site daily along with empty containers.

3.08 PROTECTION

- A. Protect finished work in accordance with Section 01 70 00.
- B. Protect work of other trades against damage from coating activities. Correct damage by cleaning, repairing, replacing, and recoating as acceptable to Architect.
- C. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.
- 3.09 SCHEDULE SHOP PRIMED ITEMS FOR SITE FINISHING
 - A. Exposed surfaces of lintels, Hollow metal frames units, and miscellaneous exposed steel construction.
- 3.10 SCHEDULE EXTERIOR COATING SYSTEMS
 - A. Metal Surfaces:
 - 1. Non-Ferrous Metals and Zinc-Coated (Galvanized) Steel
 - a. System Latex Finish:

Sheen: Semi-Gloss.

Prime Coat: Galvanized Primer at 2.0 mils.

Under Coat: Industrial Acrylic at 3.0 mils.

Top Coat: Industrial Acrylic at 3.0 mils.

System DFT: 8.0 mils.

- 2. Ferrous Metals Uncoated:
 - a. System Latex Finish:

Sheen: Semi-Gloss.

Prime Coat: Alkyd-Phenolic Primer at 2.5 mils.

Under Coat: Industrial Acrylic at 2.5 mils.

Top Coat: Industrial Acrylic at 2.5 mils.

System DFT: 7.5 mils.

- 3. Ferrous Metals Previously Coated:
 - a. Coating System Latex Finish:

Sheen: Semi-Gloss.

Prime Coat: Touch-up existing with compatible primer.

Under Coat: Industrial Acrylic at 2.5 mils.

Top Coat: Industrial Acrylic at 2.5 mils.

System DFT: 5.0 mils (excluding existing and touch-up primer).

3.11 SCHEDULE - INTERIOR COATING SYSTEMS

- A. Concrete and Masonry Surfaces
 - 1. Concrete Masonry Units:
 - a. System Latex Finish:

Sheen: Satin.

Prime Coat: Interior Block Filler at 11.0 mils.Under Coat: Interior Latex Enamel at 1.5 mils.Top Coat: Interior Latex Enamel at 1.5 mils.System DFT: 3.0 mils (excluding primer).

b. System Alkyd Finish:

Sheen: Satin.

Prime Coat: Interior Block Filler at 11.0 mils.

Under Coat: Interior Alkyd Enamel at 1.7 mils.

Top Coat: Interior Alkyd Enamel at 1.7 mils.

System DFT: 3.4 mils (excluding primer).

- 2. Metal Surfaces:
 - a. Non-Ferrous Metals and Zinc-Coated (Galvanized) Steel:
 - i. System Latex Finish:

Sheen: Satin.

Prime Coat: Galvanized Primer at 2.0 mils.

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 5.0 mils

- b. Exposed Interior Structural Steel Uncoated:
 - i. System Latex Finish:

Sheen: Satin.

Prime Coat: Waterbased Ferrous Metal PrimerUnder Coat: Waterbased Polyurethane Acrylic at 1.5 mils.Top Coat: Polyurethane Clear Coat at 1.5 mils.System DFT: 5.0 mils.

- c. Ferrous Metals Uncoated:
 - i. System Latex Finish:

Sheen: Satin.

Prime Coat: Acrylic Latex Ferrous Metal Primer

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 6.0 mils.

- d. Ferrous Metals Previously Coated and intumescent fireproofing:
 - i. System Latex Finish:

Sheen: Satin.

Prime Coat: Acrylic Latex Ferrous Metal Primer

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 3.0 mils (excluding existing and touch-up primer).

3. Gypsum Surfaces:

- a. Gypsum Board:
 - i. System Flat Latex Finish at ceilings:

Sheen: Flat

Prime Coat: Latex Primer at 1.0 mils.

Under Coat: Interior Latex Flat Paint at 1.4 mils.

Top Coat: Interior Latex Flat Paint at 1.4 mils.

System DFT: 3.8 mils.

ii. System Latex Finish at Walls:

Sheen: Eggshell.

Prime Coat: Latex Primer at 1.0 mils.

Under Coat: Interior Latex Enamel at 1.4 mils.

Top Coat: Interior Latex Enamel at 1.4 mils.

System DFT: 3.8 mils.

iii. System Water Based Epoxy at Toilet Rooms:

Sheen: Satin.

Prime Coat: Latex Primer at 1.0 mils. Under Coat: Water Based Epoxy at 2.5 mils. Top Coat: Water Based Epoxy 2.5 mils. System DFT: 6 mils.

4. Wood Surfaces:

- a. Painted Wood Panels and Trim:
 - i. System Opaque Latex Paint Finish:

Sheen: Semi-Gloss.

Prime Coat: Alkyd Enamel Undercoater at 2.0 mils.

Under Coat: Interior Latex Enamel at 1.5 mils.

Top Coat: Interior Latex Enamel at 1.5 mils.

System DFT: 5.0 mils.

3.12 PAINT COLORS

- A. Exterior Surfaces: Selected by Architect Verify.
- B. Interior Surfaces: Selected by Architect Verify.

END OF SECTION 09 90 00

SECTION 09 90 02 HIGH PERFORMANCE PAINTING AND COATING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes requirements for providing high performance painting and coating. Includes preparation, cleaning, protection, application and materials for areas that require high performance painting and coating systems, including, but not limited to,
- B. Related Sections Include:
 - 1. Division 1.
 - 2. Division 3 Concrete.
 - 3. Division 5 Metals.
 - 4. Section 09 06 00 Schedule for Finishes.
 - 5. Section 09 90 00 Painting and Coating.
 - 6. Division 40 Process Integration.
 - 7. Division 41 Material Processing and Handling.
 - 8. Division 43 Process Gas and Liquid Handling Equipment.
 - 9. Division 46 Water and Wastewater Process Equipment.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Water Works Association (AWWA):
 - 2. ANSI/ASTM D16 Standard Terminology for Paint, Related Coatings, Materials, and Applications.
 - 3. Environmental Protection Agency (EPA).
 - 4. Occupational Safety and Health Act (OSHA).
 - Current Joint Standards for the Society for Protective Coatings (SSPC)/National Association of Corrosion Engineers International (NACE).
 - 6. Ten States Standards 54.5 Piping Code.
- 1.03 DEFINITIONS
 - A. Conform to ANSI/ATSM D16 for interpretation of terms used in this Section.
- 1.04 SUBMITTALS
 - A. Submit product data under provisions of Section 01 33 00. Indicate each material and cross-referenced specified coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - B. Provide Product data on all Products including manufacturer's technical information, label analysis, and instructions for handling, mixing, storing, and applying each coating material. Submit manufacturer's application instructions under provisions of Section 01 33 00.

HIGH PERFORMANCE PAINTING & COATING

- C. Provide a paint system data sheet for each coating system, including all components for providing a complete system. Components include surface preparation, primer, intermediate coats, and finish coats.
- D. Provide paint manufacturers certification that proposed coating systems meet specified performance requirements.
- E. Submit five (5) full color sample sheets illustrating available colors for each scheduled surface finish Product. During the shop drawing review process, Engineer and Owner will select color choices for surfaces to be coated. Submit samples under provisions of Section 01 33 00.
- F. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible for each instance.
- G. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details
- 1.05 QUALITY ASSURANCE
 - A. Product Manufacturer: Company specializing in manufacturing quality paints and finish products with minimum ten (10) years experience.
 - B. Applicator: Minimum 10 years' experience in application of specified products.
 - C. Regulatory Requirements:
 - 1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
 - 2. Perform surface preparation and painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. SSPC PA 3, Guide to Safety in Paint Applications.
 - c. Federal, state, and local agencies having jurisdiction.
 - D. Maintain examples of SSPC visual standards on Site.
 - E. Provide wet and dry paint thickness measurement instrument on Site.
 - F. Specification language for High Performance Coating Systems is based on Sherwin Williams and Tnemec.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Delivered materials shall be stockpiled and stored at locations approved by the OWNER until required for installation. Materials shall be transported, delivered, stored and handled in accordance with manufacturer's instructions and the requirements of Section 01 61 00.

- B. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.
- C. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.
- D. Take precautionary measures to prevent fire hazards and spontaneous combustion. Removal all paint waste from site daily and dispose of properly.

1.07 REGULATORY REQUIREMENTS

- A. Conform to applicable Montana Department of Public Health and Human Services, Montana Department of Environmental Quality, Environmental Protection Agency, Occupational Health and Safety Administration, Ten States Standards, Uniform Building Code, and Uniform Fire Codes and Standards.
- B. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.08 THREE YEAR PERFORMANCE GUARANTEE

- A. The quality of both materials and workmanship for the installed coating materials (as defined in this specification) will be the sole responsibility of the Contractor. It is hereby guaranteed that should the coating material delaminate, chip, peel, blister, crack or otherwise fail due to improper surface preparation, improper mixing and application or curing of coating materials or protection of the coating work during cure by the Contractor or due to lack of material quality on the part of the material manufacturer, the Contractor shall repair or replace the damaged or failing coating to Owner's satisfaction at no cost to Owner and at Owner's convenience. Should the existing substrate below the coating fail causing such coating failure, except if related to inadequate surface preparation or coating quality causing substrate corrosion, the Contractor shall not be held liable.
- B. It is further understood by the Contractor that any incompatibility with or error in formulation of the coating materials used on this project, which results in a coating failure, will be a financial matter strictly between the Coating System Manufacturer and the Contractor. The business responsibility and financial accountability for such a material related failure to Owner would remain solely with the Contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Mechanical Protective Coating Systems: All paint materials selected for coating systems for each type of system shall be the product of one manufacturer.

Acceptable manufacturers are:

- 1. Tnemec
- 2. Sherwin-Williams (SW) Industrial Coating.
- B. Coating systems of all manufacturers must be in accordance with the Contract Documents. Being named as a manufacturer does not eliminate their responsibility of providing coating systems in compliance with the following specification section. Any deviations without sufficient evidence proving equal or superior quality shall be rejected without further review or comment.
- C. Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- D. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions and obtain approval from Engineer before bidding in accordance with Division 01.

2.02 ABRASIVE MATERIALS

- A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.
- 2.03 PAINT MATERIALS
 - A. General:
 - 1. Manufacturer's highest quality products suitable for intended service.
 - 2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
- 2.04 MIXING
 - A. Multiple-Component Coatings:
 - 1. Prepare using each component as packaged by paint manufacturer.
 - 2. No partial batches will be permitted.
 - 3. Do not use multiple-component coatings that have been mixed beyond their pot life.
 - 4. Mix only components specified and furnished by paint manufacturer.
 - 5. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

- A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.
- B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.
- C. Shop Coating Requirements:
 - 1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
 - 2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

D. Pipe:

- 1. Ductile Iron Pipe:
 - a. Use SSPC standards as a guide for desired prepared surface.
 - b. Follow recommendations of pipe and coating manufacturers for means and methods to achieve SSPC-equivalent surface.
 - c. The surface preparation and application of the primer and finish coats shall be performed by pipe manufacturer.
 - d. For high performance (epoxy) coatings, follow additional recommendations of pipe and coating manufacturers.
 - e. Prior to blast cleaning, grind smooth surface imperfections, including, but not limited to delaminating metal or oxide layers.
 - f. For conventional (alkyd) coatings, clean asphalt varnish supplied on pipe and apply one full coat of a tar stop before two full coats of the color coats specified.

2.06 SPARES

A. Furnish small quantity kits (minimum one gallon per product per color) for touchup painting and for painting other small areas.

PART 3 - EXECUTION

3.01 GENERAL

- A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.
- B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.
- C. Environmental Requirements:
 - 1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
 - 2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.
- D. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

- A. Factory Finished Items:
 - 1. Review other Section in which primers are provided to ensure compatibility of the total system for various substrates
 - 2. Schedule inspection with Engineer before repairing damaged factory finished items delivered to Site.
 - 3. Test shop applied primer and finishes for compatibility with subsequent coating and covering materials.
 - 4. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.
- B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering.
- E. Protect surfaces adjacent to or downwind of Work area from overspray.

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3.04 SURFACE PREPARATION

- A. Field Abrasive Blasting:
 - 1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
 - 2. Refer to coating systems for degree of abrasive blasting required.
 - 3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.
- B. Metal Surface Preparation:
 - 1. Where indicated, meet requirements of SSPC Specifications summarized below:
 - a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
 - b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
 - c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, sing power-assisted hand tools.
 - d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
 - e. SP 6, Commercial Blast Cleaning: Removal of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 66²/₃% of a sample unit area at least 3"x3" (9 in²). Light shadows, slight streaks, or minor discolorations caused by stains of rust, mill scale, or previously applied coating in less than 33¹/₃% of the unit area is acceptable.
 - f. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, mill scale or previously applied coatings.
 - 2. The words "solvent cleaning", "hand tool cleaning", "wire brushing", and "blast cleaning" or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC specification.

- 3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.
- 4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
- 5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
- 6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
- 7. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - i. No undercutting or reverse ridges on weld bead.
 - ii. No weld spatter on or adjacent to weld or any area to be painted.
 - iii. No sharp peaks or ridges along weld bead.
 - b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
- 8. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
- 9. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

- 10. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
 - b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.
- C. Galvanized Metal, Copper, and Nonferrous Metal Alloy Surface Preparation:
 - 1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.
 - 2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush. Use clean solvent and clean rag for final wiping to avoid contaminating surface.
 - 3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.
- D. Concrete Surface Preparation:
 - 1. Do not begin until 30 days after concrete has been placed.
 - 2. Meet requirements of SSPC SP 13.
 - 3. Voids and other defects that are at or near the surface shall be exposed during surface preparation.
 - 4. Brush-off blast clean to remove loose concrete and laitance, and provide a tooth for binding. Upon approval by Engineer, surface may be cleaned by acid etching method. Approval is subject to producing desired profile as listed in section 3.07 below based on the required coating system. If not specifying, surface profile to the equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces shall not be allowed. Coordinate blast clean with buffing requirements provided in Division 03 Concrete.
 - 5. Remove grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent, or other suitable cleaning methods.
 - 6. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after blasting.
 - 7. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.
- E. Plastic and FRP Surface Preparation:
 - 1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.

- 2. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.
- F. Masonry Surface Preparation:
 - 1. Complete and cure masonry construction for 14 days or more before starting surface preparation work.
 - 2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.
 - 3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
 - a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.
 - b. Brush-off blasting.
 - c. Water blasting.
 - 4. Do not damage masonry mortar joints or adjacent surfaces.
 - 5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.
 - 6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair intended finished appearance.
 - 7. Masonry Surfaces to be Clear Coated: Free of discolorations and uniform in texture after cleaning.
- G. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.
 - 1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.

3.05 SURFACE CLEANING

- A. Brush-off Blast Cleaning:
 - 1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
 - 2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
 - 3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
 - 4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

- 5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
- 6. Repair or replace surface damaged by blast cleaning.
- B. Acid Etching:
 - 1. After precleaning, spread the following solution by brush or plastic sprinkling can: One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
 - 2. Application:
 - a. Rate: Approximately 2 gallons per 100 square feet.
 - b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained. c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
 - c. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.
 - d. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.
 - e. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.
 - 3. Ensure surface is completely dry before application of coating.
 - 4. Apply acid etching to obtain a "grit sandpaper" surface profile. If not, repeat treatment.
- C. Solvent Cleaning:
 - 1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
 - 2. Meet requirements of SSPC SP 1.
- 3.06 APPLICATION
 - A. General:
 - 1. In general, all new and modified existing structures and items, whether specifically mentioned or not, shall be painted, unless otherwise noted. Do not paint exterior concrete surfaces, unless specifically indicated.
 - a. Interior concrete walls, floors, and ceilings within the WRRF.
 - b. Interior concrete block masonry within the WRRF and modified concrete block masonry.

- c. All new doors and frames and window frames (if required) within the expanded WRRF.
- d. Exterior, interior, and submerged ferrous metals.
- e. Miscellaneous other metals.
- f. Paint shop-primed equipment and fixtures.
- g. Unfinished louvers, grilles, covers, and access panels on mechanical and electrical components; paint separately.
- h. Prime and paint all surfaces located behind, underneath, or otherwise previously obstructed by items that have been removed or demolished.
- i. Prime and paint all surfaces of new process pipes (non-insulated and insulated), electrical conduit, valves, fittings, meters, boxes, hangers, brackets, collars, and supports, except where items are prefinished.
- j. Paint discharge heads and base plates of all new or modified pumps.
- k. Prime and paint all new unburied exterior steel, ductile, galvanized, or PVC piping.
- 1. Replace identification markings on mechanical or electrical equipment when painted accidentally.
- m. Paint exposed conduit and electrical equipment occurring in finished areas.
- n. Paint both sides and edges of plywood backboards for electrical equipment before installing equipment.
- o. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.
- p. All surfaces not specifically excluded
- 2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
- 3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
- 4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
- 5. Apply a stripe coat of an approved coating system via brush or roller to all weld seams, edges, angles, and mechanical connections. Stripe coat shall be applied after primer coat and be of a different color than the primer coat.

- 6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- 7. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
- 8. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
- 9. Keep paint materials sealed when not in use.
- 10. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.
- B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:
 - 1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.
 - 2. Prepare surface and apply primer in accordance with Protective Coating System specification.
 - 3. Apply intermediate and finish coats of the coating system appropriate for the exposure.
- C. Porous Surfaces, Such As Concrete and Masonry:
 - 1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
 - 2. Prime Coat: May be thinned to provide maximum penetration and adhesion.
 - a. Type and Amount of Thinning: Determined by paint manufacturer and dependent on surface density and type of coating.
 - 3. Surface Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.
- D. Film Thickness and Coverage:
 - 1. Number of Coats:
 - a. Minimum required without regard to coating thickness.
 - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
 - 2. Application Thickness:
 - a. Follow coating manufacturer's recommendations.
 - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.

- 3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - a. Perform with properly calibrated instruments.
 - b. Recoat and repair as necessary for compliance with Specification.
 - c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
- 4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
- 5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
- 6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 HIGH PERFORMANCE COATINGS SYSTEMS AND APPLICATION SCHEDULE

- A. Refer to Section 09 06 00, Schedules for Finishes for specific surfaces to be coated in accordance with the following Systems 1 thru 14. Additional requirements are included in the Piping Schedule.
- B. In the event of discrepancies or omissions in the following, defer to Section 09 06 00 and request clarification from Engineer before starting work in question.

System Type	Surface	Primer Coat	Intermediate	Topcoat,
	Preparation	3.0 to 5.0 DFT	Coat,	2.0 to 3.0 DFT
Polyamidoamine	SSPC SP6	Tnemec Series N69, SW Macropoxy 646		Tnemec Series 1075, SW Macropoxy 646

C. System No. 1: Ferrous Metals, Exterior Exposure, Non immersion

- 1. Use two coat coating system for maintenance coating of structural steel. For non-immersed, non-corrosive environments.
- 2. Use on new exposed metal surfaces, located outside of structures, including structural steel, metal decking, guard posts, hollow metal doors and frames, piping, equipment, and miscellaneous metal.
- D. System No. 2: Ferrous Metals, Interior Exposure, Non-Immersion

System Type	Surface	Primer Coat,	Intermediate	Topcoat,
	Preparation	3.0 to 5.0 DFT	Coat	3.0 to 5.0 DFT

Polyamidoamine	SSPC SP10	Tnemec Series NA	Tnemec Series
		N69, SW	N69, SW
		Duraplate 235	Duraplate 235
		MPF	MPF

- 1. For interior two coat coating system for coating of carbon steel and other ferrous metals. For non-immersed, mildly corrosive splash/spill and wet environments.
- 2. For exposed metal surfaces located inside of structures, exposed to weather or in a highly humid atmosphere, such as pipe galleries, and for the specific surfaces:
 - a. Exterior surfaces of process pipes. All pipes scheduled to be insulated must be painted prior to providing insulation.
 - b. Exterior surface of valves.
 - c. Exterior surface of equipment not shop finished, per manufacturer's instructions.
 - d. Pipe supports, excluding stainless and galvanized steel.
- E. System No. 3: Ferrous Metals, Immersion

System Type	Surface Preparation	Primer Coat, 3.0 to 5.0 DFT	Intermediate Coat	Topcoat, 3.0 to 5.0 DFT
Polyamidoamine	SSPC SP10	Tnemec Series N69, SW Duraplate 235 MPE		Tnemec Series N69, SW Duraplate 235 MPE

- 1. Verify with manufacturer a compatible field tie-in coat for shop primed items where applicable.
- 2. Use on immersed metal surfaces, metal surfaces above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, structural steel, and interior surfaces of steel piping noted in the Piping Schedule.
 - a. Submerged, partially submerged and splash area equipment not shop finished.
- F. System No. 4: Ferrous Metals, Immersion and/or H2S Exposure

System Type	Surface	Primer Coat	Intermediate Coat	Topcoat
	Preparation			

Moisture Cured Polyurethane	SSPC SP10	Tnemec Series 1 Omnithane (2.5 to 3.5 mils DFT), Or SW	Tnemec Series 446 (8.0 to 10.0 mils DFT), Or SW Equivalent	Tnemec Series 446 (8.0 to 10.0 mils DFT), Or SW
		Equivalent		Equivalent
Reinforced Amine Epoxy	SSPC SP 10	SW Corothane 1- GalvaPac(3.0 to 4.0 mils DFT), Or Tnemec Equivalent		SW Sher- Glass FF (8.0 to 20.0 mils DFT), Or Tnemec

- 1. Use on immersed metal surface, metal surfaces above maximum liquid surface that are a part of immersed equipment, concrete embedded surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel, and interior surfaces of steel piping noted in the Piping Schedule in areas with potential H2S exposure. These areas include:
 - a. Surfaces as defined in the Project Drawings.
- G. System No. 5: Metals, Buried and/or Below Grade

System Type	Surface	Primer Coat,	Intermediate Coat	Topcoat,
	Preparation	3.0 to 5.0 mils		16.0 to 20.0 mil
		DFT		DFT
Coal tar epoxy	SSPC SP10	Tnemec Series	NA	Tnemec Series
		N69 (optional),		46H- 413,
		SW Macropoxy		SW Hi-Mil Sher-
		646 (optional)		Tar Epoxy

- 1. For steel pipe and fittings, follow AWWA C209 and AWWA C214 with double outer wrap.
- 2. For buried, below grade portions of metal items, except buried stainless steel, and the follow specific surfaces:
 - a. Fasteners and accessories for buried piping
 - b. Buried Valves
- H. System No. 6: Metals, Concrete Embedded and Encased

e Primer C	Coat Intermediate Co	pat, Topcoat, 8.0 to
ation	8.0 to 10.0 mils	10.0
	DFT	mils DFT
	ration	ration 8.0 to 10.0 mils

Coal tar epoxy SS	SPC SP6		46H-413, SW Hi-Mil Sher-	Tnemec Series 46H-413, SW Hi-Mil Sher- Tar Epoxy
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- 1. For concrete embedded and encased surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles.
- I. System No. 7: Galvanized Metal, Copper, and Nonferrous Metal Alloy Conditioning:

System Type	Surface	Primer Coat,	Intermediate Coat	Topcoat,
	Preparation	3.0 to 5.0 mils		3.0 to 5.0 mils
		DFT		DFT
Epoxy	Abrasive brush	Tnemec Series	NA	Tnemec Series
Polyamide	blast to create a	N69,		N69, SW
	1.5 mil profile	SW Macropoxy		Macropoxy 646
	-	646		

- 1. Verify with manufacturer compatibility as a field tie-in coat.
- 2. Use on the following items or areas:
 - a. Galvanized surfaces requiring painting.
 - b. After application of System No. 7, apply System No. 1 topcoat for exterior, System No. 3 topcoat for interior.
- J. System No. 8: PVC, CPVC and FRP, Exposed

System Type	Primer Coat, 2.0 to 4.0 mils	Intermediate Coat	Topcoat, 2.0 to 4.0 mils
Polyamidoamine	DFT Tnemec Series N69, SW Macropoxy 646	NA	DFT Tnemec Series N69, SW Macropoxy 646

- 1. For use on exposed PVC, CPVC, and FRP.
- K. System No. 9: Insulated Pipe, Exposed:

Syster	n Type	Surface	Primer Coat,	Intermediate Coat	Topcoat,
		Preparation	2.0 to 3.0 mils		2.0 to 3.0 mils
			DFT		DFT
Acryli	c	Clean and Dry	Tnemec Series 6,	NA	Tnemec Series 6,
			SW DTM		SW DTM
			primer/finish		primer/finish

- 1. For use on insulation of insulated pipes.
- 2. Coat pipes with appropriate coating system before insulating.
- L. System No. 10: Concrete, Precast and Poured in Place, Immersion, Light H2S

HIGH PERFORMANCE PAINTING & COATING

Vapor:

System Type		Primer Coat 3.0 to 5.0 mils DFT	Topcoat, 3.0 to 5.0 mils DFT
Polyamidoamine	ICRI CSP2-3	Tnemec Series N69, SW Duraplate 235 MPE	Tnemec Series N69, SW Duraplate 235 MPE

- 1. Prep surface in accordance with concrete surface preparation.
- 2. For use on walls and ceilings in areas with light to moderate H2S exposure.
- 3. Scheduled for:
 - a. Polishing Reactor walls & floor;
- M. System No. 11: Concrete, Precast and Poured in Place, Immersion, High H2S

System Type	Surface Preparation	Primer Coat	Intermediate Coat	Topcoat
Fiber reinforced MP Epoxy		Tnemec Series 218 MortarClad (60 to 65 mils DFT), SW Core- Cote FRE (60 to 120 mils DFT)		Tnemec Series 436 (50 to 80 mils DFT), SW Core- Cote SC (15 to 20 mils DFT)

- 1. Prep surface in accordance with concrete surface preparation.
- 2. For use on walls and ceilings in areas with moderate to heavy H2S exposure.
- 3. Schedule for:
 - a. Lift Station structure interior;
 - b. Screening Room all cast-in-place concrete;
 - c. Interpond structure interiors;
 - d. Treatment basin immersed concrete pipe supports and penetration collars
- N. System No. 12: Concrete, Precast and Poured in Place, Immersion

System Type	Surface	Primer Coat	Intermediate Coat Topcoat,
	Preparation	3.0 to 5.0 mils	3.0 to 5.0 mils
		DFT	DFT

Polyamidoamine	SSPC SP13 ICRI	Tnemec Series	NA	Tnemec Series
	CSP2-4	N69, SW		N69, SW
		Duraplate 235		Duraplate 235
		MPE		MPE

- 1. Prep surface in accordance with concrete surface preparation.
- 2. For use on floors, walls and ceilings in areas with no to minimal H2S exposure.
- O. System No. 13, Concrete Secondary Containment, Chemical Resistant Paint

System Type	Preparation	Per Mnfr	Intermediate Coat Per Mnfr recommendation	Topcoat Per Mnfr recommendation
Ероху	SSPC SP13 ICRI CSP5	Tnemec Series 218, SW Corobond 300 resurfacer	104,	Tnemec Series 104 SW Sherglass FF

- 1. Prep surface in accordance with concrete surface preparation.
- 2. For use on floors and walls in secondary containment basins.
- 3. Scheduled for:
 - a. Screen Room concrete pedestals.
- P. System No. 14 Aluminum and Dissimilar Metal Insulation:

5 51	Surface Preparation	Primer Coat	Intermediate Coat	Topcoat
	Abrasive blast to provide a 3.0 mil angular anchor profile	NA		Tnemec Series 46H- 413, SW Hi-Mil Sher-Tar Epoxy

1. Use on aluminum surfaces embedded or in contact with concrete and for dissimilar metal insulation.

3.08 COLORS

- A. Provide as designated herein and shown in Piping Schedule or as selected by Engineer.
- B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.
- C. Equipment Colors:
 - 1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

- 2. Paint non-submerged portions of equipment the same color as the piping it serves, except as itemized below:
 - a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
 - b. Fire Protection Equipment and Apparatus: OSHA Red.
 - c. Radiation Hazards: OSHA Purple.
 - d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.
- D. Pipe Identification Painting:
 - 1. Color code non-submerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
 - Pipe Color Coding: In accordance with the "Recommended Standards For Wastewater Facilities" and as specified in Section 40 27 60 – Process Identification.
 - 3. On exposed stainless steel piping, apply color 24 inches in length along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.
 - 4. Pipe Supports: Painted light gray, as approved by Engineer.

3.09 FIELD QUALITY CONTROL

- E. Sharp edges, weld spatter, scab marks, and other imperfections shall be ground to a smooth radius or removed and re-blasted before coating application.
- F. Testing:
 - 1. Thickness and Continuity Testing:
 - a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
 - b. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.
- G. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer.
 - 1. Provide additional staging and lighting as requested by Engineer.
- H. Unsatisfactory Application:
 - 1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and

coverage. Obtain specific surface preparation information from coating manufacturer.

- 2. Evidence of runs, bridges, holidays, laps, or other imperfections is cause for rejection.
- 3. Repair defects in accordance with written recommendations of coating manufacturer.
- I. Damaged Coatings, Pinholes, and Holidays:
 - 1. Feather edges and repair in accordance with recommendations of paint manufacturer.
 - 2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
 - 3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES

- J. In accordance with Section 01 40 00, Manufacturers' Field Services, coating manufacturer's representative shall be present at Site as follows:
 - 1. On first day of application of any coating system.
 - 2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
 - 3. As required to resolve field problems attributable to or associated with manufacturer's product.
 - 4. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.11 CLEANUP

- K. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.
- L. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

END OF SECTION 09 90 02

DIVISION 10 MISC SPECIALITIES

SECTION 10 11 01 VISUAL DISPLAY BOARDS

PART 1 - GENERAL

- 1.01 SYSTEM DESCRIPTION
 - A. Fixed Dry Erase Magnetic Glass Markerboards
- 1.02 SUBMITTALS
 - A. General: Submit in accordance with Section 01 30 00.
 - B. Product Data:
 - 1. Submit manufacturer's descriptive literature and product specifications for each product.
 - 2. Include information for factory finishes, accessories, and other required components.
 - C. Submit following Submittals:
 - 1. Shop Drawings: Provide shop drawings for each type of VSD required.
 - 2. Product Data: Provide technical data for materials specified including MSDS.
 - 3. Samples: Provide Samples to illustrate finish and texture.
 - 4. Manufacturer's Instructions: Provide Manufacturer's installation and cleaning instructions.
 - D. Closeout Submittals:
 - Warranty: Submit a warranty, stating that under normal usage and maintenance, and when installed in accordance with manufacturer's instructions and recommendations, Claridge glass markerboard writing surfaces are guaranteed for ten (10) years. Guarantee covers replacement of defective boards but does not include cost of removal or reinstallation.

1.03 QUALITY ASSURANCE

- A. Operation and Maintenance Data: Submit manufacturer's printed, recommended regular cleaning instructions, stain removal instructions, and surface break-in instructions for markerboards.
- B. Manufacturer Qualifications: Company specializing in manufacturing Products specified in this Section with minimum 5 years documented experience.
- 1.04 HANDLING
 - A. Comply with requirements of Section 01 60 00.
- 1.05 SEQUENCING
 - A. Ensure finishes, including painting, are completed and accepted prior to installation of work of this Section.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS:
 - A. Acceptable Manufacturers:
 - 1. Basis of Design: Claridge Products and Equipment, Inc., www.claridgeproducts.com.
 - 2. Or equal product with prior approval by Architect per Section 01 60 00 Product Requirements.
- 2.02 MATERIALS
 - A. Glass Markerboards
 - 1. Glass: ¹/₄ -inch thick, tempered, low-iron, extra clear, safety writing glass with polished edges
 - 2. Glass Markerboard writing surface: Smooth finish intended for use with dry-erase markers
 - 3. Sizes:
 - a. one unit at 3' x 3' (mounted in Screen Control Room)
 - b. one unit at 3' x 3' (mounted in Blower/UV Building)
 - 4. Back-Coated Color: Brilliant White.
 - 5. Backing: Provide steel backing permanently adhered to the back of the glass for magnetic function.
 - B. Mounting Methods
 - Invisimount (Z-bar hanger clips) no visible mounting hardware; concealed hanger mounted to back of board. Full-length, minus 3", concealed z-bar hanger for the wall. Furnished with 3M Dual Lock[™] fasteners to hold bottom of board firmly in place. Z-bar mounting method to pass 500 lb. load test without failure. Designate MGMI (magnetic) or PGBI (non-magnetic)
 - C. Accessories
 - 1. Provide Optional Marker Caddy and Magnetic Eraser (Magnetic Glass Markerboards only)
 - 2. Provide two dry erase markers each in black, red, and green (6 total markers).

PART 3 – EXECUTION

- 3.01 PROJECT CONDITIONS
 - A. Interior moisture and temperature should approximate normal occupied conditions.
 - B. Verify that wall surfaces are true and plumb and are prepared and ready to receive boards.
- 3.02 INSTALLATION
 - A. Deliver factory built units completely assembled and of dimensions shown in details and in accordance with manufacturer's shop drawings as approved by the architect.
 - B. Follow manufacturer's instructions for storage and handling of units before installation.
 - C. Do not install on damp walls or in damp and humid weather without heat in the building.

- D. Install level and plumb, keeping perimeter trim straight in accordance with manufacturer's recommendations.
- 3.03 ADJUST AND CLEAN
 - A. Verify that all accessories are installed as required for each unit.
 - B. At completion of work, clean surfaces and trim in accordance with manufacturer's recommendations, leaving all materials ready for use.

END SECTION 10 11 01

SECTION 10 14 00 SIGNS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to furnish and install all informational and warning signs and their mounting requirements in the Screen Room, Screen Control Room and Blower/UV Building. Signs include custom-fabricated informational and warning signs, and luminous "Exit" signs.
- B. Pipe identification lettering and color-coding are not covered by this section; instead see Section 40 27 60 Process Identification and Division 09 Coatings.

1.02 SUBMITTALS

- A. In addition to the requirements of Section 01 33 00 Submittal Procedures and 01 40 00 Quality Requirements, the following documentation shall also be provided for signs, and accompany other required submittals:
 - 1. Scaled drawings and specifications covering materials, mounting fixtures, and locations shall be submitted for each sign in accordance with project submittal requirements.
 - 2. Product samples consisting of a 3" x 3" coupon of sign sheeting complete with proposed lettering shall be provided for each sign style and material to be used.
- 1.03 PRODUCT DELIVERY, STORAGE AND HANDLING
 - A. Materials shall be delivered to the site clearly labeled with the manufacturer's name, product identification, and lot number where appropriate.
 - B. Materials shall be protected from damage during transit, handling, storage and installation.
 - C. Fabricated sign panels shall be delivered with protective poly sheeting adhered to the lettered surface to protect from scratching. Any scratched or otherwise damaged signs shall be replaced by the Contractor at no additional cost to the Owner.

PART 2 - MATERIALS

2.01 INTERIOR/EXTERIOR INFORMATIONAL & WARNING SIGNS

- A. Signs shall be provided with a stainless steel fasteners or adhesives suitable for the substrate at the mounting location. Adhesives shall be removable without permanent damage to the substrate.
- B. The sign manufacturer shall verify all sign graphics before fabrications. Signs with typographical or format errors shall not be installed, and replaced.
- C. Sign Panels

- Sign panels shall be composite panels with aluminum face and back, and thermoplastic core. Aluminum faces shall be coated with factory-baked polyester paint. Panels shall be Alucobond Architectural Dibond[®], Omega Panel Products Laminators Omega-Bond[™], or equal.
- 2. Panel background color shall be as indicated in the Sign Schedule herein.
- 3. Sign panels shall be cut to the dimensions shown in the Sign Schedule herein. All panel corners shall be cut to a smooth ¹/₄" radius. Mounting holes shall be neatly drilled and symmetrical with panel geometry. Panel edges, corners, and mounting holes shall be de-burred and smooth.
- D. Sign Panel Lettering
 - 1. Sign lettering shall be "Arial Black" font, all capital letters, in the sizes indicated in the Sign Schedule herein.
 - 2. Sign lettering shall be permanently adhered, vinyl lettering, suitable for the sign panel material. Lettering and lettering adhesive for outdoor signs shall be UV protected and suitable for outdoor use without peeling or cracking.
- E. Interior/Exterior Sign Schedule

Sign Text	No.	Location(s)	Panel Size	e Letter	Color	
	Reqd		(H x W)	Height	Letters	Background
CAUTION – SEWAGE TREATMENT FACILITY	10	On all access gates and posted at 100' intervals along security fence	12" x 18"	2.5"	Yellow	Black
SCREENING ROOM	2	On both access doors to the Screen Room	9" x 12"	1.50"	black	white
UV DISINFECTION & BLOWER BUILDING		On access door to Blower Building	9" x 12"	1.50"	black	white
NON-POTABLE WATER – DO NOT DRINK	7	At each NPW demand point in Screen Room and Blower Building and on lagoon dikes	2" x 9"	0.50"	black	white
NON-POTABLE WATER – DO NOT DRINK	3	At each potable water hose bib downstream of the RPZ in the Screen Building	2" x 9"	0.50"	black	white
NON-POTABLE WATER – PUMP STATION	1	On pump pedestal for NPW Pumps	2" x 9"	0.50"	black	white

Sign Text	No. Reqd	Location(s)	Panel Size (H x W)			Color Background
RESTROOM – (🛉 📔 🛊)		Outside surface of restroom door	6" x 12"	1.00"	black	white
COMPOSITE INFLUENT SAMPLER	1	On wall above influent sampler in Screen Room	9" x 12"	1.00"	black	white
COMPOSITE EFFLUENT SAMPLER	1	On wall above effluent sampler in UV/Blower Building		1.50"	white	red
<u>MAIN LIFT STATION</u> – CAUTION – CONFINED SPACE ENTRY		On north exterior wall of Screening Building	12" x 18"	1.00"	white	red
PLANT EFFLUENT FLOW		Wall at flowmeter display	3" x 8"	0.50"	black	white
INFLUENT SCREEN – STARTS WITHOUT WARNING	1	North interior wall of Screen Room near dumpster	9" x 12"	1.00"	black	white
UV CONTROL PANEL	1	On west wall of UV room near UV control panel	3" x 8"	0.50"	black	white
WORK ROOM	1	East side of Blower Bldg & Scrn. Control Room west door	4" x 6"	1.00"	black	white

2.02 EXTERIOR SIGN BLADES

- A. All guide signs must meet the requirements of the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD).
- B. Flat Aluminum Blades shall be:
 - 1. manufactured using a domestic aluminum alloy, Type 6061-T6 or better quality;
 - 2. a minimum thickness of 0.080";
 - 3. treated with an Alodine 1200E or similar anodizing process in order to enhance longevity.
- C. Reflective Sheeting shall be:
 - 1. High Intensity Prismatic (HIP) sheeting. Any "Or Equal" vendor materials must be approved by OWNER prior to any manufacturing or installations. Currently

approved materials are:

- 3M #3930, HIP Silver/White
- 3M #3931, HIP Yellow
- 3M #3932 HIP Red
- 3M #4083 HIP Yellow Green
- 2. Type I Engineering Grade reflective sheeting unless otherwise noted;
- 3. Type III high-intensity prismatic reflective sheeting on all warning signs: pedestrian/trail crossings; No Motor Vehicles; Stop; etc.
- 4. Foreground colors, lettering, symbols and designs shall be:
 - i. Type I Engineering Grade reflective sheeting cut-out unless otherwise noted;
 - ii. Affixed to the sign surface with high-durability, pressure-sensitive adhesive.
- 5. All ElectroCut (E/C) Film shall use the following approved materials. Any "Or Equal" vendor materials must be approved by OWNER prior to use.
 - 3M #1177C E/C Green
 - 3M #1179C E/C Brown
 - 3M #1172C E/C Red
 - 3M #1178C E/C Black
 - 3M #1175C E/C Blue
- All warning and informational blades shall be made using the appropriate colors for pedestrian crossing signs; share the road signs, directional arrows (3M #3931 HIP Yellow background) and 3M #1178C Black for lettering and symbols.

2.04 LUMINOUS EXIT SIGNS

- A. Exit signs shall be photoluminescent, glow-in-the-dark signs requiring no wiring or batteries. Signs shall be wall-mounted, single-sided, 8" tall by 15" wide. Exit signs shall be UL 944 and C-UL U.S. listed. Signs shall be non-radioactive. Signs construction shall be anodized 0.035" steel and plastic, with pop-out arrows for customized direction indication. Signs shall be furnished with mounting brackets. Body color shall be red.
- B. Exit signs shall be Lab Safety Supply #159179R, manufactured by Glo Brite, or equal.

PART 3 - EXECUTION

3.01 MOUNTING

A. Mount all custom-fabricated, lettered signs at 5'-0" A.F.F., unless otherwise noted in Sign Schedule or on the Drawings. Where dual signs are required at same location, place lower sign 4'-0" A.F.F. and place upper sign directly above, separated by 3". If specified sign locations conflict with other wall-mounted items, adjust locations to nearest clear wall

space.

- B. Mount all signs using either galvanized steel or stainless steel fasteners. Any signs located within 3'-0" of chemical storage tanks or chemical feed pumps must be mounted with stainless steel fasteners and hardware.
- C. Mount Exit signs in accordance with manufacturer's recommendations, and NFPA standards.
- D. Mount signs level, and centered on walls or next to identified objects shown in the Sign Schedule and the Drawings.
- E. Mount external Non-Potable Water signs on the stem of the frost free hydrants with ubolts located on top of the lagoon dikes in 3 locations.

END OF SECTION 10 14 00

SECTION 10 28 00 TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Accessories for restroom (grab bars, toilet paper dispenser, mirror, hooks, paper towel dispenser).

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; current edition; (ADA Standards for Accessible Design).
- B. ASTM A123/A123M- Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- C. ASTM A653/A653M- Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- D. ASTM A666- Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- E. ASTM C1036- Standard Specification for Flat Glass; 2011e1.
- F. ASTM C1503- Standard Specification for Silvered Flat Glass Mirror; 2008.
- 1.03 ADMINISTRATIVE REQUIREMENTS
 - A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.
- 1.04 SUBMITTALS
 - A. See Section 01 33 00, SUBMITTALS, for submittal procedures.
 - B. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Basis of Design: Bradley Corporation: www.bradleycorp.com.
 - 2. American Specialties, Inc: www.americanspecialties.com.
 - 3. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
 - 4. Or approved equal.
- B. All items of each type to be made by the same Manufacturer.

2.02 MATERIALS

- A. Accessories-General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Mirror Glass: Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- C. Adhesive: Two component epoxy type, waterproof.
- D. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.

2.03 FINISHES

- A. Stainless Steel: No. 4 satin brushed finish.
- 2.04 TOILET ROOM ACCESSORIES
 - A. Toilet Paper Dispenser: Dual Roll, surface mounted bracket type. (1 total).
 - 1. Product: 5234 manufactured by Bradley.
 - B. Grab Bars: Stainless steel, safety grip finish.
 - 1. Heavy Duty Grab Bars: 1 each at 42", 36", 18" (3 total bars in Blower Building toilet room)
 - 2. Push/Pull Point Load: 250 pound-force, minimum.
 - 3. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar. Peened finish.
 - 4. Products:
 - a. Bradley 812 Series.
 - C. Mirrors:
 - 1. 24" x 36". Bradley 781 Series channel frame. (1 total)
 - D. Hooks: Bradley 9119-81 (1 total)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation. Conduct meeting with Engineer to verify location of all accessories.

3.02 INSTALLATION

- A. Install accessories in accordance with Manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.

TOILET AND BATH ACCESSORIES

- C. Mounting Heights and Locations: As required by accessibility regulations.
- 3.03 FIELD TESTING
 - A. After installation.

END OF SECTION 10 28 00

DIVISION 11 EQUIPMENT

SECTION 11 53 20 REFRIGERATED COMPOSITE SAMPLER

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes furnishing and installing an automatic, refrigerated wastewater sampler for composite sampling applications, as shown in the Drawings.
- B. All equipment covered by this Specification shall be provided by a single source with unit responsibility for all items.
- C. The automatic refrigerated wastewater sampler must provide accurate 24 hour composite samples of the influent municipal wastewater in the new screening building and blower/UV building. The wastewater will enter the new screening building via an individual gravity influent line connected to the screening channel. Sampling points shall be upstream of the screening equipment in the screen channel and downstream of the UV lamp banks in the blower/UV building.
- D. Automatic sampler shall be ISCO 5800 Refrigerated Sampler as manufactured by Teledyne ISCO, Lincoln, NE, or approved equal.

1.02 SUBMITTALS

- A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Division 1.
 - 1. Product data on sampler including catalog information, descriptive literature, application data, and manufacturer's specifications.
 - 2. Spare parts lists for sampler.
 - 3. Complete equipment installation manuals including information on field erection and installation requirements that are useful to the Contractor during construction and the Owner during future operations and maintenance. Information shall include any required installation tolerances, and instructions on operation. Manufacturer's O&M manuals are also required, 2 (two) hard copies and 1 (one) electronic copy.
 - 4. Complete guide for auto-sampling protocol.
 - 5. Electrical drawings including circuit schematics, interconnection diagrams, and all information necessary for connection of auto sampler and the flow meter signal.
 - 6. Manufacturer's data sheets on all process instruments provided under this Section. This includes but is not limited to the 4-20 mA interface that is used for the two 4-20 mA signals from the flow meters in the screening building and blower/UV building.
 - 7. Provide manufacturer's data, and performance data on integral components of the sampler, including, but not limited to the refrigerator, compressor, controller, pump, liquid detector, suction lines and sample containers.

PART 2 - PRODUCTS

2.01 FUNCTIONAL DESIGN

The automatic refrigerated wastewater sampler shall be furnished for sequential and composite sampling applications, and shall be suitable for indoor or outdoor installation without the requirements for additional enclosures for weather protection. The sampler shall be capable of collecting samples from a variety of liquid sources including open channels, sewers, and stormwater conduits. The sampler will route samples to storage containers for collection and off-site analysis. The sample stream will be a direct path from sample source to sample bottle. Samples will not pass through metering chambers or other diversions. The sampler shall be suited to collect priority pollutant or general purpose samples in multiple bottles or a single bottle. The sampler will be line powered as shown in the contract drawings.

- A. Refrigerator
 - 1. The refrigerator shall cool to a setpoint selectable from 34 to 48°F, with a setpoint stability of ± 1 °C over a 48 hour period.
 - 2. The refrigerator shall have a 5 minute typical recovery time to return to 39°F after the door has been opened for 1 minute in 75°F ambient conditions.
 - 3. The collected samples shall be stored in an enclosure capable of operating in ambient temperatures from -20°to 120°F.
 - 4. Built-in heaters shall prevent collected samples from freezing if the ambient air temperature drops below freezing.
 - 5. For single bottle composite sampling only, the refrigerator can, upon program initiation, drop the temperature within the sample compartment by 2.5° C below the set temperature for the first 24 hours of operation before resuming normal operation.
- B. Controller
 - 1. The sampler's memory shall maintain the program settings, stored programs, and the results of the last two sampling sequences when the sampler is turned off or an external power interruption occurs.
 - 2. A user-initiated diagnostics routine shall indicate the operational status of the sampler. The controller will display any error conditions detected by the diagnostic routines.
 - 3. The current refrigeration temperature shall appear on the sampler's display, and temperature readings shall be stored in a report.
 - 4. The controller shall be able to automatically switch input power to a connected Isco battery in the event of a loss of AC power.
 - 5. Sample volumes shall be selectable between 10 and 9,990 ml in 1ml increments.
 - 6. The sampler shall be capable of being programmed to rinse the suction line with the source liquid up to three times.

- 7. The sampler shall typically deliver sample volumes with an accuracy of ± 10 ml or $\pm 10\%$, whichever is greater, of the programmed value. The typical sample volume repeatability shall be ± 5 ml or $\pm 5\%$, whichever is greater, of the average of the maximum and minimum sample volume in the sample set.
- 8. The sampler shall collect sequential or composite samples at user-definable intervals and volumes. A delay to first sample collection shall be programmable by the real-time clock.
 - a. Time Pacing

The sampler will use an internal real-time clock to provide time and date information. Uniform time-paced samples shall be collected at regular time intervals from 1 minute to 99 hours 59 minutes. Sample volumes may be equal or variable in proportion to flow.

b. Flow Pacing, DC Pulse

The sampler shall accept a 5 to 15 VDC flow proportional pulse or isolated dry contact closure, at least 25 ms in duration, from an external flow meter for flow pacing. Samples shall be equal in volume and shall be taken at variable times proportional to flow. The number of flow pulses shall be selectable, from 1 to 9,999 pulses, as the flow interval for each sample collection.

c. Flow Pacing, Analog Input

The sampler shall have a standard 4-20mA flow proportional input compatible with most flow meters without additional interfacing. Samples shall be equal in volume and shall be taken at variable times proportional to flow.

d. Flow-Weighted Volumes, DC Pulse

The sampler shall accept a 5 to 15 VDC flow proportional pulse or isolated dry contact closure, at least 25 ms in duration, from an external flow meter. Samples shall be taken at equal time intervals, and variable sample volumes shall be proportional to cumulative flow.

- e. Flow-Weighted Volumes, Analog Input The sampler shall have a standard 4-20 mA flow proportional input compatible with most flow meters without additional interfacing. Samples shall be taken at equal time intervals, and variable sample volumes shall be proportional to cumulative flow.
- 9. The sampler shall have 3 selectable modes of sample distribution.
 - a. Samples per bottle mode: The sampler shall be capable of placing a sample volume from one or more sample events in a bottle.
 - b. Bottles per sample mode: The sampler shall be capable of filling all sample bottles with a single initiation.
 - c. Multiple bottle composite mode: The sampler shall be able to simultaneously create a user-selected set of bottles for depositing of multiple samples, switching bottles after a programmed period of time has elapsed, or a programmed number

of samples has been collected.

- 10. Sampler Outputs
 - a. The sampler shall have four standard digital alarm outputs capable of direct wiring to a Programmable Logic Controller (PLC) or data logger (5 volt, 100 mA).
 - b. Output alarms shall include: Program started, Program completed, Pump error, Distributor jammed, 3-way valve control, Taking sample, Pumping forward, Powered up, Pumping reverse, Bottle full, and Delay before sample.
 - c. The sampler shall output an event mark of 12VDC for a duration of 3 seconds, beginning at the start of forward pumping, from the flow meter connector.
 - d. The sampler shall store a one-minute temperature data report retrievable by an IBM-compatible computer using a terminal emulator tool such as Tera Term (not provided by Teledyne Isco). The program shall include failsafe loading with site ID codes to prevent field errors due to multiple files.

C. Pump

- 1. Samples will be collected via a peristaltic pump. This pump shall produce typical line velocities of 3.0 feet per second in a 3/8 inch ID suction line at 3 feet of head. At 25 feet of head, the pump shall typically produce a line velocity of 2.2 feet per second. The pump shall be capable of lifting a sample a maximum of 28 feet.
 - a. Before and after each sample is collected, the pump shall air-purge the suction line. Pre-purges and post-purges will be automatically controlled, and no pre-calibration adjustments are required.
 - b. With the opening of the pump's latch and band, all power will be removed from the sampler's pump motor, to eliminate the possibility of a pump activation injuring personnel.
 - c. The liquid detection system shall minimize the effects of changing head, intermittent flow in the suction line, or variable battery conditions on sample volume.
 - d. After initial detection of liquid, the sensor shall monitor for the presence of liquid during the sample collection sequence. In composite mode without use of a distributor arm, this feature can be used for full bottle detection during the post-purge cycle.
 - e. The liquid detector shall monitor for anomalies in the sample collection process. If no liquid is detected, the sampler shall be capable of retrying the sampling sequence up to three times.
 - f. After liquid detection, the pump revolution counter shall count actual pump revolutions to determine sample volume delivery to the storage containers. If liquid flow is interrupted during the sample collection sequence, the detector shall inhibit the pump revolution counter from incrementing until liquid flow is

restored. Automatic compensations for air slugs in the sample shall be made by the delivery system. Additionally, the pump revolution counter shall monitor the total number of pump revolutions and alert the user when a pre-selected number of counts has been reached to alert the user of the need for pump tubing replacement. One pump revolution is equivalent to 12 pump counts. This indicator shall appear on the controller display screen.

2.02 EQUIPMENT DESCRIPTION

A. Sampler

- 1. The top section housing the control panel, pump, distributor electronics, and power supply box shall be rated NEMA 4X, and IP 67.
- 2. The sampler shall include long-life electronic temperature sensing devices that measure the refrigeration compartment and evaporator plate temperatures. A microprocessor will utilize this sensor to control operation of the compressor, built-in heaters, and the self-defrosting cycle of the evaporator plate.
- B. Refrigerator The shell of the refrigerator shall be constructed of rotationally molded UV-resistant polyethylene with molded-in-place thermal insulation, providing exceptional resistance to corrosion and weathering. The top of the refrigerator door shall be recessed for ease of access from above. For 24 bottle configurations, the bottle rack shall slide out for ease of sample recovery. The condenser and evaporator coils shall be constructed of 316 stainless steel and e-coated. Additionally the copper refrigeration lines, condenser, and evaporator coils and filter dryer will be powder-coated with heattreated polyester for corrosion resistance.
 - 1. The refrigerator's door shall have hasps capable of accepting a padlock to prevent unauthorized tampering with the sample compartment contents. A compression gasket will be used to seal the refrigerator door. Protective plates both on the unit's bottom and covering the condenser shall prevent damage during handling. The refrigerator power supply and solid-state thermostat shall be contained in an enclosure housed in a discrete compartment of the sampler's molded frame. All exposed metal components used in the construction of the refrigeration system shall be either plated aluminum or stainless steel.
 - 2. The refrigerator will use a condensing coil with forced-air cooling.
 - 3. The compressor is rated at 1/5 Hp for 115V.
 - 4. The compressor shall use a polyband flexible crankcase heater to ensure no refrigerant is dissolved in the compressor oil.
 - 5. The refrigeration system will contain HFC-134a refrigerant, a non-CFC refrigerant with an ozone depletion potential of zero.
- C. Controller
 - 1. The controller shall be housed in a discrete compartment of the sampler's molded frame beneath a padlockable flip cover.

- 2. The controller will show sampler status and program information via a 2-row, 20column, 40 total character display. This display shall be angled for easy viewing, and backlit for easy use in all light conditions. All programming and manual control of the sampler will be entered via an 18 position keypad.
- 3. The controller shall not require a separate heater.
- 4. Pump
 - a. The modular peristaltic pump shall be housed in a discrete compartment of the sampler's molded frame, beneath a latched padlockable cover. The pump casing shall be constructed of high strength Noryl plastic and designed for corrosion resistance.
 - b. The pump shall include a latched housing cover and thumbscrew opening for the replacement of pump tubing. The pump shall include a built-in magnetic safety interlock.
 - c. The pump shall include an optional heater, housed beneath the pump cover, for the prevention of liquid freezing inside the pump under extremely cold conditions. A heater shall be available for both 115VAC and 230VAC samplers.
 - d. Liquid Detector

The sampler will sense the presence of the liquid via a non-wetted, nonconductive detector. The sensor shall not be dependent on, or affected by, any chemical or physical property of the liquid or its contents. The sensor shall not require routine maintenance or cleaning.

- e. The pump tubing used shall be specially formulated to minimize water extractable pollutants. Specially designed bands shall indicate the correct placement of the tubing inside the pump. The tubing shall typically last for a minimum of 1,000,000 pump counts.
- D. Distributor
 - 1. The modular distributor shall be housed in a discrete compartment of the refrigerator's molded frame. Sample distribution will be belt-driven by a stepper motor. Positive location of the distributor arm will be achieved using an optical sensor. One of two available fixed-length distributor arms will be used for all bottle configurations and sampler mounting possibilities. The distributor arm may be moved by hand for ease of sample recovery, and shall relocate itself before the next sample is taken.
- E. Suction Lines and Strainers
 - 1. There is to be a minimum of 25 feet of vinyl suction line connecting the strainer to the pump as shown in the construction drawings. The strainer shall be a weighted stainless steel strainer.
- F. Sample Collection Containers
 - 1. The sampler shall be supplied with sample collection containers. The containers shall

be round 20L polyethylene bottles. Each bottle shall be suppled with two caps and two discharge tubes.

2. A second container assembly shall be furnished as a spare.

2.03 MANUFACTURER WARRANTY

A. Manufacturer warrants that the sampler shall be free from defects in material and workmanship, and conform to specifications for a period equal to twenty-four (24) months from the date of original shipment.

PART 3 - EXECUTION

- 3.01 INSTALLATION
 - A. Install the composite sampler as shown on the Drawings and in accordance with the manufacturer's instructions and recommendations and approved shop drawings.
 - B. Piping connections are to be in accordance with the manufacturer's recommendations.

END OF SECTION 11 53 20

DIVISION 22

PLUMBING

SECTION 22 00 00 PLUMBING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to furnish and install piping, fixtures, appliances, equipment, and appurtenances for complete and functional plumbing systems as indicated in the Drawings and specified herein.
- B. Work included in this section is as follows:
 - 1. Hot and cold water piping systems.
 - 2. Natural gas piping systems.
 - 3. Drainage and vent piping systems and connections
 - 4. Floor drains, cleanouts and bell-ups.
 - 5. Plumbing fixtures and appliances.
- 1.02 GENERAL
 - A. Piping and appurtenances provided under these Specifications do <u>not</u> require coating per Section 09 90 00 PAINTING & COATING, except as specified herein.
 - B. The Drawings do not show all details of all piping systems, and instead only portray the functionality required. The Contractor shall provide all accessories, adapters, appurtenances and supports to achieve a complete and functional installation. The Contractor shall verify all piping routings and locating dimensions shown for conflicts with other piping or utilities, and shall provide any offsets required to achieve clearance at no additional cost to the Owner. In the event changes to the locations of equipment or piping shown are necessary, the Contractor shall submit such changes in writing to the Engineer before proceeding with such changes.
 - C. All fixtures and appliances shall be installed in complete accordance with the manufacturer's recommendations and requirements, including structural support and venting.
 - D. Manufacturers' references are included herein for reference and to establish the required level of quality; "or equal" products may be proposed subject to the requirements for Submittal review.

1.03 CODES, PERMITS AND COMPLIANCE

- A. Plumbing work shall be performed in accordance with all applicable codes and ordinances which pertain to such work. In case of conflict between these specifications and any applicable code or ordinance, the latter shall govern. Plumbing work shall conform to the provisions of the current version of the Uniform Plumbing Code.
- B. All gas piping shall be installed in accordance with the recommendations of the National Fire Protection Association (NFPA).

- C. Any permits legally required for the work under these Specifications shall be the responsibility of the Contractor to obtain. Costs of such permits and scheduling of any inspections required in conjunction with such permits or associated requirements shall be the responsibility of the Contractor.
- D. Completed piping systems shall be tested by the Contractor in accordance with all applicable codes and standards <u>before</u> charging such piping. Natural gas piping test results must comply with all requirements of the gas supplier.
- 1.04 SUBMITTALS
 - A. In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURE, the following documentation shall also be provided for this equipment and accompany other required submittals:
 - 1. Fixtures and Appliances Provide unit weight and manufacturers' support requirements, storage and installation instructions, and operating manual.
 - 2. Pipe Supports Provide manufacturers' dimensions, load ratings, recommended service conditions and spacing, and types and arrangement of fasteners, including substrate requirements.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. Like items of material provided under these Specifications shall be the product of one manufacturer.
- 2.02 COPPER PIPE, TUBING AND FITTINGS
 - A. Exposed pipe for building air shall be hard drawn, Type L copper, conforming to ASTM B88, except where otherwise shown and called on the Drawings.
 - B. Fittings for copper pipe and tubing shall be solder-joint socket pure wrought copper, conforming to ASTM B75 and dimensions conforming to ANSI B16.22. Solder shall be 95-5 wire, lead free, ASTM B32, Alloy Grade 95 TA. Paste flux shall be used with solder, and shall meet Fed. Spec. O-F-506, Type I, Form A.
 - C. Insulating unions, where required, shall be brass body, dielectric type, with threaded ends, adapted to copper pipe and tubing with solder-by-NPT brass adapters.
- 2.03 MALLABLE IRON PIPE AND FITTINGS
 - A. Exposed pipe for natural gas service shall be Schedule 40 black welded steel, meeting the requirements of ASTM A53 Grade B and ANSI/ASME B1.20.1, except piping 1½-inch and smaller shall meet ASTM A106 Grade B. Pipe shall be seamless or electric resistance welded. Gas piping shall be UPC-rated for gas service.
 - B. Pipe joints may be NPT threaded or welded, conforming to ASTM A-120. All threaded joints shall be sealed with gas-rated thread compound.
 - C. Fittings shall be Schedule 40 black malleable iron, 150 psi rated, with NPT threading.

Fittings shall conform to ASTM A197 and ANSI/ASME B16.3 and B1.20.1. Fittings shall be UL-listed.

- 2.04 GALVANIZED STEEL PIPE AND FITTINGS
 - A. Galvanized steel piping for miscellaneous applications as shown and called on the Drawings shall be carbon steel, Schedule 40, meeting ASTM A120, ASTM A53 Grade B, or ASTM A106 Grade B.
 - B. Galvanized steel pipe fittings and joints shall be threaded. Fittings shall be Schedule 40, galvanized, meeting ASTM A196 or ASTM A47. Fitting dimensions shall conform to ANSI B16.3. Unions shall be 300-pound malleable iron, galvanized, with brass to iron seats.
- 2.05 PVC PIPE AND FITTINGS
 - A. Building interior piping for <u>drain, waste, and vent</u> applications shall be UL-listed. PVC Drain/Waste/Vent (DWV) Pipe and Fittings
 - 1. DWV pipe and fittings are intended for non-pressure drainage applications where the temperature will not exceed 140°F.
 - 2. DWV pipe shall be IPS Schedule 40 conforming to ASTM D 1785 and ASTM D 2665.
 - 3. DWV pipe and fittings shall be manufactured from PVC compound with minimum cell class of 12454 per ASTM D 1784 and conform with NSF Standard 14.
 - 4. Injection molded fittings shall conform to ASTM D 2665.
 - 5. Fabricated fittings shall conform to ASTM F 1886.
 - B. Approved Manufacturers:
 - 1. Georg Fischer
 - 2. Charlotte
 - 3. Hayward.
 - 4. Approved equals.
 - C. Pipe joints shall be socket-type glued joints, except where threaded adapters or unions are shown or needed to connect to fixtures. PVC gluing materials shall conform to pipe and fitting manufacturers' recommendations, and if so recommended, may utilize solvent cement rated for use without primer. Glue shall be tinted to verify application.
 - D. Pipe fittings shall be Schedule 80 PVC, and recommended by the pipe manufacturer for compatibility with the pipe.
 - E. For interior cold-water supply applications, use Schedule 40 or Schedule 80 PVC, as indicated in the Drawings. For hot-water applications, use CPVC piping.
- 2.06 CPVC PIPE AND FITTINGS
 - A. All potable and non-potable water pipe, fittings, and valves shall be manufactured from a

CPVC compound which meets the requirements of class 23447-B, Type 4, Grade 1 in accordance with ASTM D1784. Compound from which the pipe is produced shall have a design stress rating of 2,000 psi at 23 degrees C, listed by the Plastic Pipe Institute (PPI).

- B. Fittings and valves shall meet the requirements of ASTM F439 (schedule 80 socket) or ASTM F437 (schedule 80 threaded).
- C. All socket type connections shall be joined with CPVC solvent cement conforming to the requirements of ASTM F493.
- D. All CPVC shall be Schedule 80.
- E. Approved Manufacturers:
 - 1. Georg Fischer.
 - 2. Hayward.
 - 3. Asahi/America.
 - 4. Spear.

2.07 PLUMBING PIPE SUPPORTS AND ACCESSORIES

- A. Wall-mounted pipe supports for lines 1¹/₂-inch and smaller shall be one-hole, clamp type, and shall be *Grinnell Figure 126*, or equal.
- B. Wall-mounted pipe supports for lines larger than 1¹/₂-inch shall be welded steel, heavy duty clamp type, and shall be *Grinnell Figure 199*, or equal.
- C. Hanger pipe supports shall be cradle type with hanger rods and clevises, and shall be *Grinnell Figure 104* or *Figure 260*.
- D. Fasteners for pipe clamps and hangers shall be as recommended by the support manufacturer, and shall be suitable for proper anchorage to the substrate material to which attached. Fasteners shall be galvanized steel.
- E. Sealants shall be used on all threaded pipe joints and shall be rated for the fluid carried by the conduit. Sealants may be approved pipe thread compound(s). *Teflon* tape thread sealant may not be used.
- F. Pipe and tubing wall penetrations through precast walls shall be sleeved with Schedule 40 PVC pipe spools with a nominal diameter at least 2 inches larger than the carrier pipe, and a length equal to the wall thickness. After insertion of the carrier pipe, the annular space inside the sleeve shall be sealed at each wall surface with *Dow Chemical Great Stuff* expandable foam, or equal. Pipe and tubing penetrations through wood-framed, gypsum board walls do not require sleeves, but shall be sealed with sheetrock mud.

2.08 CORPORATION STOPS AND CURB VALVES

A. Corporation stops and curb valves for new water service shall meet all standards of the public water supply system, including end connection configurations and use of tapping saddles. Stops and valves shall be all brass construction and 175 psig pressure rated. Stops and valves shall include double O-ring seals, and meet ANSI/AWWA C800

standards. Corporation stops and curb valves shall be Mueller 300 series, or equal.

B. Boxes for buried curb valves shall be cast iron, improved extension type with arch pattern base. Boxes shall have brass pentagon plugs, and shall be *Mueller H-10336*, or equal.

2.09 WATER SERVICE METERS

- A. Water service meters shall meet the requirements of the public water supply system, along with AWWA C700 standards, and ANSI/NSF Standard 60 certification.
- B. Meters shall be of the nominal size shown on the Drawings.
- C. Meter read-out and transmitter configuration shall conform to meter reading requirements of the public water supply system.
- 2.10 FLOOR DRAINS AND CLEANOUTS
 - A. Floor drains shall be PVC body with steel-threaded inserts, equipped with ½-inch trap primer connection, and complete with a cast iron clamp collar, leveling frame and heavy-duty grate. Outlet sizing shall match pipe diameter as shown on the Drawings.
 - B. Floor drains shall be Zurn FD2330, or equal.

2.11 SLOT FLOOR DRAIN

- A. The Slot drain shall be ACO Drain Slab Drain H100KS-8 complete with gratings secured with QuickLok as manufactured by ACO Incorporated, or approved equal.
- B. The drain system bodies shall be manufactured from polyester polymer concrete with minimum properties as follows:
 - 1. Compressive Strength: 14,000 psi
 - 2. Flexural Strength: 4,000 psi
 - 3. Water Absorption: 0.07%
 - 4. Frost Proof
 - 5. Salt Proof
 - 6. Dilute Acid and Alkali Resistant
- C. The nominal clear opening shall be 4.00 inches with overall width of 5.10 inches. Precast units shall be manufactured with neutral invert and have a wall thickness of at least 0.5 inches. Each unit will feature a male to female interconnecting end profile. Units shall have horizontal cast in anchoring features on the outside wall to ensure maximum mechanical bond to the surrounding bedding material and concrete surfaces. The galvanized steel edge rail will be integrally cast in by the manufacturer to ensure maximum homogeneity between polymer concrete body and edge rail. Each edge rail shall be at least 1/8 inches thick.
- D. Grate the grate shall be compliant with the following at a minimum:
 - 1. Load Class A 3,372 pounds (residential and light pedestrian traffic)
 - 2. ADA Requirements the open slots should be no greater than 0.5 inches wide in one

direction. Where the length of the slot is greater than 0.5 inches, the opening should run perpendicular to the main direction of traffic. This helps prevent wheelchair wheels and walking aids becoming trapped or slipping on the grate surface.

- 3. Heel Resistant ASME A112.6.3 Section 7.12 Heel Resistant Strainers & Grates a grate designed to resist entry of heeled shoes and high stiletto heels shall not have openings greater than 0.25 inches to prevent heels from becoming trapped, causing injury or falls.
- 4. The grate shall be constructed of stainless steel.
- 5. The grate shall be slip resistant based on the 'Pendulum Test'. A pendulum is swung over a wet surface and measures surface frictional properties. Test results are given a BPN value. The grate shall have a minimum BPN of 24. Anything less than 24 is regarded as having high slip and skid potential.
- 6. The grate locking system shall be ACO's QuickLok Boltless Locking System. All components needed for the locking system shall be provided with the grate and drain. The QuickLok system is comprised of a glass nylon stud, factory fitted to the grate, which allows for a snap fit into a stainless steel spring clip located in the locking bar. Contractor shall provide owner with two (2) grate removal tools.
- 7. Drain shall be installed in accordance with manufacturers installation instructions and recommendations.

2.12 TWO-HANDLE WALL MOUNT SERVICE SINK FAUCET

- A. Features include Vacuum breaker for backflow prevention, ceramic disc cartridges, integral stops, solid brass waterways and is chrome plated.
- B. $\frac{3}{4}$ " hose thread on spout
- C. Meets ANSI: A112.18.1M, cUPC/IAPMO listed
- D. Warranty five years in commercial applications
- E. Manufacturer ProFlo Model PF1119 or approved equal
- 2.13 GATE VALVES WATER SERVICE
 - A. Interior gate valves for 2-inch and smaller hot and cold water service shall be all bronze, rising stem type, with graphite-impregnated *Aramid* packing and aluminum handwheel operators. Valves shall be Class 125, rated for 200-pound WOG, and shall have threaded or solder ends. Valves shall be *Nibco Series T111*, or equal.

2.14 BALL VALVES – WATER SERVICE

- A. Interior valves for 2-inch and smaller hot and cold water service shall be all bronze, end entry type, with *Teflon* seats and packing and lever operators with fixed stops. Valves shall be rated 400-pound WOG, and shall have threaded ends. Valves shall be *Nibco T-585-70, Grinnell Figure 3500*, or equal.
- 2.15 BALL VALVES GAS SERVICE

A. Interior valves for gas service shall be of cast brass body and plug design, with brass stem and chrome-plated brass ball. Operators shall be tee-style lever handles. Valves shall conform to ANSI Z21.15B, and shall be *Nibco Series GB*, or equal.

2.16 GAS APPLIANCE FLUES AND VENTS

A. Gas-fired unit heaters shall be vented with a UL-listed Type B gas vent system, of the nominal size specified by the heater manufacturer. Gas vent shall be all metal, double-wall vent pipe as manufactured by *Ameri-Vent*, or equal. Outer vent pipe shall be galvanized steel, and inner pipe shall be aluminum allow 1100, 3003, or 3105. Vent routing shall include offsets of like construction as necessary to achieve the alignments shown and to clear any obstructing structural or piping members. Vents shall include a firestop support plate at the ceiling, and a flashing, storm collar, and vent cap above the roofline.

2.17 INSTANTANEOUS WATER HEATER

- A. Instantaneous water heaters shall be electric under-sink, point-of-use type. Construction shall be lead-free, with copper sheathed heating elements and plastic housing. Unit shall operate from 240V, single-phase service, and be equipped with a 220V wall plug.
- B. Unit shall provide a 37°F temperature rise at a flow rate of 1.0 gpm. Maximum outlet temperature shall be 135°F.
- C. Water heater shall be UL listed, and furnished complete with mounting hardware. Inlet and outlet connections shall be 1/2" NPT.
- D. Water heater shall be *Rheem RTEX-06*, or approved equal.

2.18 HAND WASHING SINK AND FAUCET

- A. Hand-washing sink shall be wall-hung, vitreous china or porcelain basin with integral backsplash and side guards, and integral carrier. Overall sink dimensions shall be 18¹/₄" x 20³/₄" x 7³/₄".
- B. Hand-washing sink shall be NSF listed.
- C. Sink shall be furnished with manufacturer's stainless steel installation kit.
- D. Sink shall be furnished with manufacturer's chromed metal, deck-mounted goose-neck fixture with acrylic Hot Water and Cold Water faucet knobs at 4" O.C.
- E. Sink with fixture shall be *Kohler Greenwich Model K-2032*, or equal.

2.19 COMBO LAUNDRY/UTILITY TUB DESCRIPTION

- A. One piece molded construction, using Mustee's Co-Polypure[™] resin
- B. 20 Gallon capacity, extra deep 13" tub with smooth surface
- C. Combo-Pack includes everything needed to install the tub
 - 1. Tub to be 18" wide
 - 2. 6" Swing spout faucet with aerator and hose end

- 3. Two 20" flexible supply lines and sealant tape
- 4. 1-1/2" PVC P-Trap with 12" tailpiece
- 5. Drain Stopper
- D. Leakproof, integrally molded-in drain with stopper
- E. Connects to standard 1-1/2" P or S trap
- F. Accommodates dual-handle faucet with 4" center
- G. Includes finished steel legs with adjustable levelers
- H. Mold and mildew-resistant components
- I. Easy to assemble and install
- J. Color-fast white finish
- K. Model Specifications
 - 1. Color = White
 - 2. Manufacturer/Model = Mustee/23" UTILITUB 14CP or approved equal
 - 3. Mounting = Floor
 - 4. Dimensions = $33" \times 23" \times 25"$
 - 5. Weight = 16 lbs
- 2.20 MOP SERVICE BASIN
 - A. All Mustee basins are one-piece molded from high impact resistant DURASTONE structural fiberglass (24" x 24")
 - B. Integral, molded-in drain for connection to 3" ABS, PVC (Sch, 80), or cast iron
 - C. Available drain seals for connection to 2" pipe or 3" soil pipe
 - D. Complete range of accessories to meet specific application needs
 - E. Colorfast marbleized white finish
 - F. Easy to install
 - G. Model Specifications
 - 1. Color = White
 - 2. Model Number Mustee 63M
 - 3. Dimensions = 10" x 24" x 24"
 - 4. Weight = 45 lbs.
 - 5. Height = 10" with not less than 1" wide shoulder
- 2.21 TOILETS
 - A. Toilets shall be ADA-compliant, two-piece, elongated design with 2¹/₈" trapway and 12"

PLUMBING

standard rough-in;

- B. Chrome trip lever shall be furnished on the tank's left side;
- C. 1.28 gallons/flush;
- D. Provide with matching toilet seat, bolt caps, wax ring, connector hoses and mounting hardware;
- E. Color shall be standard white;
- F. Unit shall be a Kohler Kingston K-78279-0 or approved equal
- 2.22 HOSE VALVES / WALL HYDRANTS
 - A. Interior hose valves shall be 3/4-inch nominal size with bronze body and internals, and aluminum handwheels. Service connection shall be NPT threaded. Hose valve shall include a vacuum breaker for protection against back-siphonage. Hose valve shall be *Watts Model SC8*, or equal.
 - B. Exterior hose valves (wall hydrants) shall be 3/4-inch nominal size, and of frost-proof automatic self-draining design. Operating mechanism shall be set back 12 inches from outlet. Integral backflow prevention (vacuum breaker) shall be included. Wall hydrant construction shall be brass body with nickel plated finish, brass vacuum breaker mechanism, metal handle, and 0.8mm copper tube thickness. Wall hydrant shall be *Watts Series FHB*, or equal.
- 2.23 PUMP MECHANICAL SEAL FLUSH WATER TUBING
 - A. Tubing for process pump mechanical seal flush systems shall meet the following:
 - 1. Rigid tubing: As shown on the Construction drawings, 316 stainless steel rated for 350 psi with flared connections, or copper tubing in accordance with the plumbing specifications.
 - 2. Flexible tubing: braided stainless steel jacketed 200 psi neoprene
 - B. Pressure gages for seal flush lines shall be as specified in Section 03/400 Process
 Instruments. Isolation and control valves for seal flush lines are specified in Section 40
 63 00 Process Control Systems Equipment.

PART 3 - EXECUTION

3.01 GENERAL

- A. All plumbing and installation of piping, appurtenances, and fixtures shall fully conform to the current edition of the *Uniform Plumbing Code* (UPC), and all applicable state and local regulations. All work shall be approved by the State Plumbing Inspector.
- B. Drawings do not attempt to show the exact details of all piping. No extra payment will be allowed for fittings, adapters, appurtenances, clearances or offsets required to complete the Work. Where diagrams have been made to show piping connections, the Contractor is cautioned that these diagrams must not be used for obtaining material quantities. Changes in locations of equipment or piping, advisable in the opinion of the

Contractor, must be submitted to the Engineer in writing, and cannot be executed without the Engineer's approval. All measurements and dimensions shall be verified at the site. All equipment shall be adjusted and left in a conditions satisfactory to the Engineer. All work shall be completed to provide a fully functional installation as shown and specified.

- C. Unions shall be provided in piping systems where shown, and adjacent fixtures and appliances where necessary to assure proper alignment without stressing piping members of fixture connections. Insulating (dielectric) unions shall be provided on domestic hot and cold water piping at all connections between steel and copper (or brass) piping and for all connections to electrically powered appliances.
- D. Plumbing fixtures shall be plumbed, trapped, and vented as required by UPC, and as shown. In the event of conflicts between the plumbing requirements shown and UPC, requirements of the Code shall take precedence.
- E. And preparation of the structural components of the building required for equipment and material regarding this unit of the Contract shall be done by the particular affected trade and shall be done to the satisfaction of the Engineer, and work which is deemed unsatisfactory shall be removed and reinstalled until the approval of the Engineer is obtained. The work carried on under this Contract shall be done in a neat an orderly fashion.

3.02 PIPING

- A. Piping runs shall be level and plumb, except where slopes are specifically called or shown.
- B. Pipes shall be adequately supported by clamps or hangers at intervals not to exceed 10 feet, <u>and</u> either side of all changes in direction. Where additional supports may be needed to provide pipe stability, they shall be provided at no additional cost.
- C. Solvent-weld PVC pipe jointing shall be allowed to fully cure in an unstressed and unloaded position.
- D. All piping intended to carry potable water shall be disinfected before placing into service. Disinfection procedures shall conform to AWWA C651.
- E. Pipe sizes shown on the Drawings are nominal sizes, unless noted otherwise. Provide all piping which passes through walls, floors or ceilings with pipe sleeves as shown in the drawings.
- F. Install unions in piping system wherever they will expedite removal of equipment and valves. Install manual air vents at high points in domestic hot water system.
- G. Equipment: Drawings do not attempt to show all integral piping, vents, and accessories for equipment to be installed. The Contractor shall install equipment in accordance with manufacturer's piping diagrams and instructions.

3.03 CORPORATION STOPS AND CURB VALVES

A. Corporation stop and curb valve installation shall meet the appropriate requirements of *Montana Public Works Standard Specifications* and requirements of the public water

supply system. Taping of existing mains shall be <u>authorized by or performed by</u> water system personnel. Curb boxes shall be plumbed and adjusted to grade.

3.04 FIXTURES AND APPLIANCES

- A. Factory finishes on all fixtures and appliances shall be adequately protected during shipping, storage, and installation to prevent damage. Finish damage shall be grounds for requiring replacement of affected fixtures and appliances at the Contractor's sole cost.
- B. All plumbing fixtures and appliances shall be installed, leveled, adjusted, and tested in full accordance with manufacturers' recommendations, and UPC and IBC requirements. Each plumbing fixture shall be trapped and vented as required by code. General vent locations are shown, but all details required for venting are not included in the drawings. The Contractor shall be responsible for final vent pipe routing. Fixtures and drains shall be installed true and plumb with separate stops for each fixture supply. Galvanized nipples shall not be used between copper water connections. Install chrome-plated canopy flanges at each fixture drain where P-trap arm enters wall.
- C. Following installation of the completed plumbing systems, the proper function of all fixtures and appliances shall be demonstrated in the presence of the Engineer.
- 3.05 DRAINS AND CLEANOUTS
 - A. Drain lines and fixtures shall be kept free of foreign materials at all times, and adequately protected during construction from the entry of such materials, as well as from cosmetic, structural, or functional damage.
 - B. All drains shall be equipped with P-traps, <u>including floor drains</u>. Floor drains shall have a deep-seal P-trap installed as close to the drain as possible.
 - C. Floor drains and floor cleanouts shall be set with their upper rims flush with the finished floor slab. During pouring and finishing concrete floor slabs, drain and cleanout fixtures shall be adequately secured to avoid movement or floating as concrete is placed. Concrete floors shall be finished to uniformly slope to floor drains, as indicated on the Drawings.
 - D. PVC piping and gas appliance flue roof vents (VTR's) shall be surface mounted to CMU walls, using suitable pipe clamps to secure installation. Vent and flue lines shall be plumb, and sealed through ceiling and roof surfaces. Roof penetrations shall be sealed with elastomeric roof jacks.

3.06 DRAINAGE AND VENT PIPING

- A. Drainage and vent piping shall be installed where required and shall, in general, conform to the locations indicated on the Drawings. Horizontal soil and waste pipes 3 inches and small shall have a grade of 1/4-inch per foot. Horizontal soil and waste piping 4 inches and larger may have a grade of 1/8-inch per foot.
- B. Drainage piping which is required to be buried beneath floors or underground shall be cast iron soil pipe or ductile iron pipe, as indicated on the Drawings and as specified in other sections, to a point not less than 5 feet beyond the outside face of the structure.

- C. Cast iron soil pipe shall be service weight, hubless type. Rubber couplings shall be used.
- D. Acid resistant drain piping shall be used where shown on the Drawings.
- E. Bell-ups shall be installed with the top rim 2-inches above the floor surface.
- F. All vents passing through roofs shall be located at least 10 inches from the intersection of a cant with the roof deck, and shall be adequately flashed as indicated on the Drawings and as specified.

3.07 PUMP MECHANICAL SEAL WATER FLUSH LINES

- A. Seal flush systems for process pump mechanical seals shall be as recommended by the pump and seal manufacturers, and installed as shown on the Drawings. Seal flush water flow shall be solenoid controlled, to activate anytime pumps run, either in "auto" or "hand" control mode.
- B. Seal flush lines shall be thoroughly flushed after installation and then flow tested by the Contractor using a time-to-fill container method to demonstrate delivery of the required water flow. Flush line control solenoid interlocks to pump starting circuits shall be demonstrated and verified as operable before proceeding with process pump testing or startup.
- C. Seal water flush lines flow and pressure regulators and appurtenances shall be wallmounted, or ceiling-mounted, as shown on the Drawings. Seal water tubing connections to pump units shall use flexible, braided stainless steel jacketed tubing for the length shown connecting to pumps.

3.08 TESTING

- A. Completed hot and cold water piping, including fixture connections shall be tested and demonstrated to be leak free by the Contractor by charging with water and maintaining 60 psi pressure, <u>using the house water system</u>, in the presence of the Engineer. Any leaks or defects shown shall be promptly remedied by the Contractor.
- B. Completed drain piping shall be tested and demonstrated to be leak free by the Contractor in the presence of the Engineer by filling with clean water to the elevation of the highest point in the system, and sustaining that water level for a period of 3 hours without loss.
- C. Other tests of completed piping as prescribed by the UPC shall also fully apply, and shall be conducted in the presence of the Engineer.
- D. Completed natural gas piping must be fully completed and tested by the Contractor in the presence of the Engineer <u>before</u> gas service is connected by the gas utility. The Contractor shall assure that all gas piping and appurtenances are suitable for connection and startup, and fully conform to the all code and utility's requirements.

END OF SECTION 22 00 00

SECTION 22 45 16 EYE WASH/SHOWER SAFETY EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This specification identifies a safety equipment product for emergency eyewash based on Guardian products or approved equal.
 - 1. Faucet Mounted Eyewash Station located in blower/UV building

PART 2 - PRODUCTS

2.01 EYESAFE-X FAUCET MOUNTED

- A. Application
 - 1. EyeSafe-X[™] faucet-mounted eyewashes converts a faucet into an emergency eyewash station without interfering with normal faucet operation. An EyeSafe-X[™] unit is ideal for use with gooseneck faucets, and can be installed at any sink, close to where accidents might occur. In an emergency, the unit is quickly located and activated, and provides an unlimited supply of potable water for rinsing the user's eyes.
- B. Outlet Heads
 - 1. Outlet heads are mounted 5" apart and deliver a soft, aerated flow of water. Heads angle forward and inward toward user. Angle of heads is adjustable to permit full coverage and avoid splashing. Furnished with float-off dust covers to protect outlet heads.
- C. Valve
 - 1. Forged brass diverter valve. Pull knob to activate eyewash; water pressure holds eyewash in operation, leaving user's hands free. Push knob or turn off faucet to return to normal faucet operation.
- D. Inlet
 - Body has 55/64"-27 female thread. Furnished with three adaptors (15/16"-27, 13/16"-27 and 3/8" NPS) for installing on most commonly used faucets, including laboratory-type faucets.
- E. Outlet
 - 1. Furnished with removable aerator on bottom.
- F. Fixture
 - 1. Guardian Equipment G1101 or approved equal.

- G. Quality Assurance
 - 1. Each unit is completely assembled and water tested prior to shipment.
 - 2. Unit shall be hydrostatically tested and come with a full 2-year warranty.
 - 3. Faucet-mounted eyewashes, whether manufactured by Guardian Equipment or other companies, require two motions to operate (turn on water, pull knob to activate eyewash flow).
 - 4. Guardian Equipment does not believe that the faucet-mounted eyewash meets the provisions of ANSI Z358.1-2014 as eyewash units. This equipment is intended solely as supplemental units to an approved station or in locations where ANSI approved equipment is not specifically required. Faucet-mounted eyewashes should be used with cold or warm water only. Use of hot water might cause scalding.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Safety equipment shall be installed in accordance with manufacturer's installation requirements.

END OF SECTION 22 45 16

DIVISION 23

HVAC

SECTION 23 01 00 HVAC

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section covers heating and ventilating systems for the Screening Building and the Blower/UV Building, including natural gas-fired heaters, electric unit heaters, supply and exhaust fans, ceiling fans, motorized dampers/louvers, and ductwork.
- B. Electrical systems to support HVAC equipment are detailed in the Section 26 Electrical.
- C. Natural gas piping and vent/flue systems to support HVAC equipment are specified in Section 22 00 00 Plumbing.
- D. Building automation and controls are specified in Section 23 09 23

1.02 SUBMITTALS

- A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.
 - 1. Manufacturer's catalog cuts and specification sheets.
 - 2. Performance data for airflow and electrical draw.
 - 3. Detailed dimensional drawings.
 - 4. Installation instructions, including wiring diagrams.
 - 5. Heating efficiencies and energy consumption.
 - 6. Operation and maintenance manuals.

1.03 COORDINATION OF WORK

A. Heating and ventilation work shall be carefully coordinated with all other work to assure proper support, clearance, electrical service, and final performance.

1.04 GENERAL REQUIREMENTS

- A. Standard Products. Equipment furnished under this section shall be the standard product of the manufacturer. Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of each system need not be the product of one manufacturer unless specified herein.
- B. Accuracy of Data. The Drawings show the work contemplated, but the Contractor shall be solely responsible for making his own measurements and installing his work to fit the conditions encountered. Before beginning any work, the Contractor shall examine all Drawings and report to the Engineer any apparent discrepancies or interferences.
- C. Metal Gauge. The gauge of sheet metal specified herein refers to U.S. Standard gauge and is the minimum permissible thickness.

- D. Balancing of Fans and Blowers. All fans and blowers shall be statically and dynamically balanced by the manufacturer before shipment. Whenever possible, the balancing shall be done with the fan wheels mounted on the shaft on which they will operate. Fan shafts shall not pass through their first critical speed as the unit comes up to the rated rpm. Any fan or blower determined to be out of balance by the Engineer shall be field-balanced by a certified balancing contractor. Equipment vibration shall not exceed 3 mils peak-to-peak at bearings of equipment in the vertical, horizontal or axial directions.
- E. Equipment Guards. All rotating equipment shall be provided with adequate guards which conform to OSHA requirements.
- F. Lubrication and Tools. Equipment requiring lubrication prior to startup shall be lubricated. Any special tools required for the operation or adjustment of equipment shall be furnished.
- G. UL Listing. All electrically operated ventilation equipment shall be UL listed.

1.05 QUALITY ASSURANCE

- A. Governing Standards and Codes. All work covered by this section shall be performed in accordance with all applicable codes, laws, and regulations. In case of conflict between these Specifications and any code, law, or regulations, the latter shall govern. All work shall comply with UL safety requirements.
- B. Materials and Equipment. All major items of mechanical equipment shall be of the best quality normally used for the purpose in good commercial practice and shall be the product of reputable manufacturers. Each major component of equipment shall have the manufacturer's name, address, and catalog number on a nameplate securely affixed in a conspicuous place. The nameplate of a distributing agent only will not be acceptable.
- C. Prevention of Rust. Unless otherwise specified, all ferrous sheet metal surfaces other than ductwork shall be shop-painted using a rust-inhibiting treatment consisting of galvanizing or bonderizing, followed by a rust-inhibiting primer and finish paint. Field painting, if required, shall be in accordance with the painting section. Surface finish damaged during installation shall be repaired in accordance with the painting section.
- D. Operation and Maintenance Instructions. Copies of all instruction books, parts lists, and wiring diagrams covering all equipment items furnished shall be provided in accordance with the submittals section. The copies shall be bound and delivered.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. Refer to the HVAC Schedules in the Construction Drawings for specific manufacturer model numbers and capacities for all HVAC equipment required for the project. "Or equal" alternatives to manufacturers and models listed will be considered, subject to equivalency in performance, functionality and quality, and based on the requirements for Submittal review.
 - B. Dampers and wall-mounted fans shall be suitable for insertion in appropriately sized

block-outs in 10" nominal depth, precast building walls. Unit frames shall span full masonry depth, or flashing matching frame material shall be installed to span the difference between the frame and wall depths.

C. Louver and damper performance data shall be licensed under the AMCA Certified Ratings Program and shall bear the AMCA Certified Ratings Seal. This certified performance data shall include airflow, pressure loss, and water penetration. Power ventilators shall be AMCA licensed for air and sound performance data.

2.02 INDUSTRIAL SUSPENDED GAS UNIT HEATER

- A. Construction
 - 1. Minimum 20-gauge galvanized steel cabinet;
 - 2. Factory-applied, high-gloss, powdercoat finish RAL1001 white color;
 - 3. Adjustable louvres to direct air flow;
 - 4. Full-opening, fully gasketed service access panel with captive screw closure attachment, safety interlock switch and lifting handle;
 - 5. All gas train components, electrical controls and power venter shall be within the sealed service compartment;
 - 6. Roll-formed, spring-held, adjustable horizontal louvers with powercoat finish;
 - 7. High-limit temperature control with automatic reset
- B. Standard Features/Performance Characteristics
 - 1. Minimum 82% overall efficiency;
 - 2. Minimum 99,600 BTUH output heating capacity (calibrated to 4,800' elevation);
 - 3. Power vented construction;
 - 4. 50°F-60°F temperature rise;
 - 5. 115VAC, 1Ø, 60 Hz supply voltage;
 - 6. $\frac{1}{2}$ " gas connection; 4" diameter vent connection;
 - 7. Single-stage, field-adjustable natural gas valve;
 - 8. External terminal strip;
 - 9. Factory-installed power venter to draw combustion air through an inlet in the rear of the cabinet;
- C. Heat Exchanger
 - 1. TCORE[™] titanium stabilized, aluminized steel heat exchanger;
 - 2. Multi-cell, 4 pass serpentine style;
 - 3. Heat exchanger tubes shall be press fabricated with no welding or brazing with only tool-pressed mechanical joints;

4. Cells shall be designed with an aerodynamic cross section for maximum airflow

D. Burner

- 1. Single burner combustion system with one-piece burner assembly;
- 2. Single venturi tube and orifice;
- 3. Continuous-wound, close pressed stainless steel ribbon separating flame from the burner interior;
- 4. Each heat exchanger cell shall use balanced draft induction to maintain optimum flame control
- E. Fan
 - 1. Minimum 1537 cfm airflow;
 - 2. Fan diameter 16" maximum;
 - 3. Thermally-protected motor;
 - 4. 115 VAC standard open fan motor with internal overload protection;
 - 5. Vibration and noise isolated fan motor;
 - 6. 55 dB maximum sound production
- F. Control
 - 1. Single stage gas valve;
 - 2. Multi-try direct spark ignition with timed lockout;
 - 3. Integrated circuit board with diagnostic indicator lights and DIP switches for fan overrun settings;
 - 4. Fan relay (included on circuit board) for fan-only operation;
 - 5. All controls enclosed within unit housing.
- G. Manufacturer/Model
 - 1. Manufacturer shall have a minimum of 50 years experience in the manufacture of gas-fired unit heaters;
 - 2. The gas unit heater shall be:
 - a. Reznor V3 Series Model UDAP 125
 - b. Pre-approved equals
- H. Installation
 - 1. Horizontal wall or ceiling mounting using one of two supplied brackets which allow 360° rotation.
- I. Warranty
 - 1. 1-year warranty against defects

2.03 INDUSTRIAL SUSPENDED ELECTRIC UNIT HEATER

- A. General
 - 1. Color Standard Almond
 - 2. Finish Standard epoxy/polyester powder paint
- B. Construction
 - 1. 18 and 20-gauge steel
 - 2. Adjustable louvres to direct air flow
 - 3. High-limit temperature control with automatic reset

C. Voltage

- 1. 208V, 240V, 277V, 347V, 480V, 600V, 1 or 3-phase
- 2. Some units may be field converted from 3 to 1-phase

D. Fan

- 1. Minimum 510 cfm airflow;
- 2. Motor mounted in cold compartment
- 3. Thermally-protected motor
- 4. Totally enclosed and factory-lubricated ball bearing motor (except for 15 to 25kW at 208/240V)
- 5. 58dBA fan (2 to 10kW) and 67 dBA fan (15 to 30kW)
- 6. Fan delay purges heater of residual heat
- E. Heating Element
 - 1. Durable tubular heating elements; stainless steel (2 to 10kW); finned (15-60kW)
 - 2. Concentric disposition of heating elements
 - 3. Factory sealed element upon request
 - 4. Minimum 25°F temperature rise
- F. Control
 - 1. All models have a factory-installed contactor
 - 2. 240/208V control circuit standard (with transformer if necessary)
 - 3. 24V relay, with or without transformer available
 - 4. Built-in thermostat
 - 5. 120V control circuit
- G. Manufacturer/Model
 - 1. The electric unit heaters shall be:

- a. Reznor/EGHB-4AK7E (4KW)
- b. Pre-approved equals
- H. Installation
 - 1. Horizontal wall or ceiling mounting using one of two supplied brackets which allow 360° rotation.
 - 2. Vertical mounting using 4 threaded rods 1/2 in. X 13 UNC.
 - 3. Diffuser cones provided
 - 4. Large and easily accessible control compartment.
 - 5. Maximum recommended height (horizontal): 2 to 10kW: 8 ft.; 15 to 30kW: 10 ft.; 40 to 60kW: 15 ft.
 - 6. Protective screen allows lower mounting height.
 - 7. 85 °F maximum operating ambient temperature.
- I. Warranty
 - 1. 1-year warranty against defects

2.04 EXPLOSION-RESISTANT ELECTRIC UNIT HEATER

- A. General
 - $1. \quad Color-Standard-Red$
 - 2. Finish Standard epoxy/polyester powder paint
- B. Construction
 - 1. 14-gauge steel cabinet.
 - 2. Adjustable anodized aluminum louvers.
 - 3. Cast aluminum control and element enclosure lids NEMA Type 7 and 9 with O-ring.
 - 4. Fan Guard: multiple horizontal stiffening wires
- C. Voltage
 - 1. 208V, 240V, 480V, 600V, 1 or 3-phase
- D. Fan
 - 1. Minimum 1200 cfm airflow;
 - 2. Explosion-resistant, thermally protected, permanently lubricated ball bearing motor.
 - 3. 3 to 20kW: 1/4 HP, 1725 rpm.
 - 4. 25 to 35kW: 1/2 HP, 1725 rpm.
- E. Protection
 - 1. High temperature pressure relief device.

- 2. Two high-limit temperature controls: one with automatic reset and one with manual reset.
- F. Temperature Code
 - 1. Division System: 5 30kW: T3B 165 °C (329 °F).

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3/35kW: T3A 180 °C (356 °F).
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- 2. Zone System: T3 200 °C (392 °F).
- G. Heat Exchanger
 - 1. Minimum 39°F temperature rise;
 - 2. High grade metal-sheathed elements fins with ethylene glycol/water solution.
 - 3. Long-life, low watt density.
 - 4. Evacuated and sealed, carbon steel tube core with 10 aluminum fins per inch.

H. Control

- 1. 120V control (standard).
- 2. 24V control.
- 3. Built-in or wall thermostat.
- 4. Disconnect switch.
- I. Manufacturer/Model
 - 1. The explosion resistant electric unit heaters shall be:
 - a. Reznor/EXUB-15AK7E (15KW)
 - b. Pre-approved equals
- J. Installation
 - 1. Horizontal wall or ceiling mounting using one of two supplied brackets which allow 360° rotation.
 - 2. Vertical mounting using 4 threaded rods 1/2 in. X 13 UNC
 - 3. Diffuser cones provided;
 - 4. Large and easily accessible control compartment.
 - 5. Maximum recommended height (horizontal): 2 to 10kW: 8 ft.; 15 to 30kW: 10 ft.
 - 6. Protective screen allows lower mounting height
 - 7. 30 °C (85 °F) maximum operating ambient temperature.
- K. Warranty
 - 1. 3-year warrant against defects
- 2.05 FIXED LOUVERS

A. General

- 1. Color Standard White
- 2. Finish Standard 70% Kynar/100% Fluoropolymer

B. Construction

- 1. 4" x 0.081 thick aluminum channel frame;
- 2. 0.081" blade thickness;
- 3. 0.75" x 0.05" flat expanded aluminum internal bird screen;
- 4. Greenheck Model ESD-435 L1 and L-2 or approved equals

2.06 MOTORIZED CONTROL DAMPERS

- A. General
 - 1. Color Standard White
 - 2. Finish Standard epoxy/polyester powder paint

B. Construction

- 1. 16-gauge galvanized steel channel frame;
- 2. Adjustable opposed action, stainless steel blades with TPE seals;
- 3. Steel axles and linkage with synthetic bearings;
- 4. Stainless steel jamb material;
- 5. Rated to a minimum of 180°F;
- 6. 120 VAC, 1Ø external, two-position actuator with spring return (fail closed)
- 7. NEMA 7 enclosure suitable for installation in Class I, Division I, Groups C & D;
- 8. Greenheck Model VCD-23 L1 and L2 or approved equals
- C. Damper Actuator
 - 1. 120 VAC, 60 Hz;
 - 2. 22 in·lb (for 14"x14" damper) and 30 in·lb (all other dampers) minimum torque motor capacity;
 - 3. Reversible motor and spring-return rotation with CW/CCW mounting;
 - 4. Visual position indicator 0° to 95°;
 - 5. 32°F to 122°F operating temperature;
 - 6. IP30, NEMA 1 for non-explosion proof installation; NEMA 7 enclosure for Class I, Division I Group C & D installation;
 - 7. 15 second opening and closing time;
 - 8. Belimo FSLF120-FC US (for 24"x24" and larger dampers) and Belimo TFB120 (for

14"x14" damper) or approved equal.

2.07 VERTICAL MOUNT EXHAUST DAMPER

- A. Construction
 - 1. 24-gauge galvanized steel frame;
 - 2. 0.016" roll-formed aluminum damper blades with vinyl seals on closing edge
 - 3. Fiberglass-reinforced nylon axle/bearing;
 - 4. 12" wide x 12" height x 1.675" frame depth
- B. Manufacturer/Model
 - 1. Greenheck Vertical Mount Exhaust Damper Model BD-330

2.08 CENTRIFUGAL WALL EXHAUST FANS

- A. General
 - 1. Color Standard Gray-RAL 7023
 - 2. Finish Standard Hi-Pro Polyester
- B. Construction
 - 1. 16-gauge galvanized steel wall bracket;
 - 2. Spark B Construction, UL 705 listed;
 - 3. Backward inclined aluminum wheel;
 - 4. Aluminum curb cap;
 - 5. Drain trough;
 - 6. Ball bearing motor mounted on shock mounts with corrosion-resistant fasteners;
 - 7. Aluminum bird screen nominal 86% free area;
 - 8. Aluminum rub ring;
 - 9. Solid state speed control 6 Amp, mounted and wired;
- C. Greenheck Model CUE-121-A, CUE-070-D and CUE-099-B or approved equals.
 - 1. CUE-121-A shall have a minimum performance of 1,500 CFM
 - 2. CUE-070-D shall have a minimum performance of 200 CFM
 - 3. CUE-099-B Shall be explosion proof and have a minimum performance of 550 CFM

2.09 DUCTWORK

A. Ductwork shall be sized and routed as shown on the Drawings, providing adapters and transitions as necessary to fit nominal dimensions and penetrations as shown. Where called on the Drawings, double-wall insulated duct shall be used. Duct routings shall be laid out to clear all existing obstacles, including those not shown on the Drawings. The Contractor shall provide transitions and adjustments to nominal duct dimensions shown

shall be made as necessary to avoid spatial conflicts.

- B. Ductwork shall be supported on adjacent wall and ceiling surfaces with steel straps and suitable fasteners. Steel straps shall be 12-gage, galvanized or stainless steel to match duct material being supported. Ductwork installation shall include adequate supports to provide a stable, secure finished installation.
- C. Manufactured Galvanized Round Duct:
 - 1. Single-wall Round Duct: Unless otherwise shown on the Drawings, round duct shall be spiral lockseam, single-wall duct constructed with an interlocking helical seam running the length of the duct. Duct shall be manufactured from 18-gauge, galvanized (both sides) sheet steel.
 - 2. Fittings for round duct shall be of the same manufacturer as, and fully compatible the duct. Fittings shall be of the same type of construction as the duct to which they're attached single-wall or double-wall insulated
 - 3. Single-wall round duct and fittings shall be McGill AirFlow Corporation UNI-SEAL duct, or equal.
 - 4. Grilles for round duct shall be framed galvanized steel units of the sizes and orientations shown on the Drawings, and shall be from the same manufacturer as duct. Grilles shall include closed cell foam gasketing around their full perimeter. Grilles shall be McGill AirFlow Corporation model DDF-G Series, or equal.
- D. Round PVC Duct:
 - 1. PVC duct and fittings shall meet requirements of ASTMD-1784. Fittings and duct shall be gray in color.
 - 2. All duct piping, sizes 6" through 24", shall be PVC seamless extruded type, This duct pipe shall be extruded from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784, trade name H707 PVC. All extruded PVC duct shall have a maximum flame spread rating of 25 or less per ULC S102.2. Material shall carry a maximum temperature rating of 140°F. All extruded PVC duct pipe shall be marked with the manufacturer's name or identifying symbol.
 - 3. Joints to be solvent welded or hot air welded per manufacturer recommendation. Provide flanges as shown in the Drawings.
 - 4. PVC duct and fittings shall be Harvel, Harrison Plastics, Spears, or equal.
- E. Rectangular duct shall be fabricated of shall be 16-gauge, galvanized (both sides) sheet steel. Duct joints shall be flanged or crimped. Crimped insertion type joints shall be riveted with self-expanding aluminum rivets spaced at a maximum of 6" O.C. The interior of finished ductwork sheet metal shall be trimmed of protrusions and obstructions.
- F. Elastomeric bellows or flexible duct sections, compatible with adjacent rigid ducting, shall be provided at outlet connections of rotating HVAC equipment to attenuate

resonance and vibration.

- G. Outdoor Duct Insulation
 - 1. Outdoor Duct Insulation shall consist of two outer layers of aluminum foil that reflect 97% of radiant heat. The outside layer of foil is made of heavier foil. Each layer of foil is bonded to a tough layer of polyethylene for strength. Two inner layers of insulating bubbles resist conductive heat flow while a center layer of polyethylene. Insulation shall be Reflectix or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Installation of heating and ventilating equipment shall be performed by qualified and experienced workmen in strict conformance with the Drawings and approved manufacturer's installation submittals.

3.02 EQUIPMENT MOUNTING

- A. Wall openings to install HVAC equipment in buildings shall be made as part of the Work. Openings shall be true and clean, taking care to maintain the integrity of interior and exterior surfaces, insulation, and framing members. Provide temporary closures during installation to prevent moisture, rodents, and insects from entering wall cavities.
- B. Contractor shall provide mounting members, wall openings, and closures as necessary to adapt equipment to building walls and structures. Supplemental wood or metal structural support members shall be added as required for a secure and finished installation. No exposed insulation or openings to the core of building walls will be permitted in the finished installation; provide adequate closures as part of the Work.
- C. Equipment mounting shall utilize the manufacturer's flanging or self-framing accessories where available.
- D. Installations shall be completed to isolate vibration and prevent excessive noise.

3.03 WIRING AND CONTROLS

- A. Wiring and controls for ventilation equipment shall be provided and installed as shown on the Drawings, and specified in Section 26, ELECTRICAL.
- B. Ventilation equipment shall be wired on dedicated circuits, not in combination with lighting or other electrical equipment, unless specifically shown otherwise on the Drawings.

3.04 SYSTEM DEMONSTRATION

A. Once installation is complete, equipment and controls shall be demonstrated by the Contractor in the presence of the Engineer and the Owner. Any modifications or adjustments needed to equipment operation shall be made by the Contractor, following the demonstration, and the system(s) demonstrated once again.

END OF SECTION 23 01 00

DIVISION 26

ELECTRICAL

SECTION 26 00 00 ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 ELECTRICAL REQUIREMENTS

- A. The electrical requirements are supplemental to the General and Supplementary Conditions and the General Requirements of these Specifications. The Electrical Sections shall apply to phases of the work specified, shown on the Drawings, or required to provide for the complete installation of Electrical Systems for this project.
- B. The work shall include all items, articles, materials, operations and methods listed, mentioned or scheduled in these specifications and the accompanying drawings. All material, equipment and labor shall be furnished together with all incidental items required by good practice to provide the complete systems described.
- C. Examine and refer to all Architectural, Structural, Utility, Landscape and Mechanical drawings and specifications for construction conditions which may affect the electrical work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.
- D. See general requirements for listed Alternate Bids. Note alternates listed and include any changes in work and price required to meet the requirements of the respective alternate.

1.02 CODES AND STANDARDS

A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following organizations:

American National Standards Institute (ANSI) Americans with Disabilities Act (ADA) Certified Ballast Manufacturers (CBM) Electrical Testing Laboratories (ETL) Independent Testing Laboratories (ITL) National Electrical Code (NEC) Latest Edition National Electrical Manufacturers Association (NEMA) National Fire Protection Association (NFPA) Occupational Safety & Health Act (OSHA) Underwriters Laboratories (UL) Uniform Building Code (UBC) Rules and Regulations of the State Fire Marshal Requirements of the Serving Utility Company Local and State Codes and Ordinances

1.03 FEES AND PERMITS

A. The electrical contractor shall pay all fees and arrange for all permits required for work done under his contract and under his supervision by subcontract.

1.04 MATERIALS AND EQUIPMENT

- A. Manufacturer's trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed must have prior approval. Written prior approval must be obtained from the Architect/Engineer ten (10) days prior to bid opening. Requests are to be submitted sufficiently ahead of the deadline to give ample time for examination. The items approved will be listed in an addendum and only this list of equipment will be accepted in lieu of specified products. Submittals must indicate the specific item or items to be furnished in lieu of those specified, together with complete technical and comparative data on specified items and proposed items.
- B. Electrical equipment may be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of architect approved enamel.
- C. This contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.
- D. Manufactured material and equipment applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.
- E. This contractor shall make the required arrangement with General Contractor for the introduction into the building of equipment too large to pass through finished openings.
- F. Store materials and equipment indoors at the job site or, if these are not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin
- G. Lighting fixtures proposed, as substitutes to those specified must have prior approval by Architect/Engineer as noted above. Approval will not be considered unless the request has all of the following information:
 - 1. Manufacturers data showing catalog number.
 - 2. Construction details.
 - 3. Photometrics.

1.05 INTENT OF DRAWINGS

A. The drawings are partly diagrammatic and do not necessarily show exact location of conduit unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining quantities or lineal runs of conduit.

- B. The Contractor shall visit the site prior to the bid and examine all existing conditions. Discrepancies shown on different plans or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution prior to the bid.
- C. The plans and specifications go hand in hand. What is required in one is to be considered as required by both contract documents. If a conflict exists between the plans and the specifications the most stringent requirement of the two shall be interpreted as the intent of the documents.

1.06 RESPONSIBILITY

- A. Be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- B. The drawings do not attempt to show complete details of the building construction which affect the electrical installation; and reference is therefore required to the Architectural, Structural, Landscape and Mechanical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.
- C. Location of electrical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. Components shall be mounted in such a manner to allow safe and adequate access to all switches, knobs, handles, and any other components necessary to operate such equipment. In the event of any conflicts, the Architect/Engineer shall be consulted and his decision shall govern. Necessary changes shall be made at no additional expense to the Architect/Engineer or Owner.
- D. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves and other openings in the construction required for the work, and obtain this information well in advance of the construction progress so work will not be delayed. Roughing-in fixtures, etc. must be laid out accurately. Connections to equipment of the same class shall be equal heights, plumb, and at right angles to the wall, unless otherwise directed.
- E. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- F. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- G. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury of loss. Make good any damage injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by

law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.

- H. Circuiting and switching shall be exactly as shown on drawings. Combining of home runs is acceptable but no more than three different phase, one neutral, one equipment ground and associated light switch conductors shall be installed in any single raceway except where specifically noted otherwise on the plans. Three phase branch circuits shall each be individually home run a separate raceway. Contractor shall refer to NEC Article 310.8 and adjust accordingly. Combining of wiring of various systems in conduit runs is not acceptable unless otherwise specified herein or noted on drawings.
- 1.07 INSPECTION
 - A. All work and material is subject to inspection at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform with these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at no additional expense to the Owner.

1.08 WORKMANSHIP

A. GENERAL

1. Work under this contract shall be performed by workmen skilled in the particular trade including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.

B. CUTTING, PATCHING AND FRAMING

- 1. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by this Contractor shall be the responsibility of this Contractor and shall be repaired by skilled craftsmen of the trades involved at no additional expense to the Owner.
- 2. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by this contractor for his work. Whether chases, etc., are provided by this contractor or others, this contractor is responsible for correct size and locations.

1.09 COORDINATION

A. This contractor shall plan his work to proceed with a minimum interference with other trades and it shall be his responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.

1.10 CLEAN UP

A. Keep the premises free from accumulation of waste material or rubbish caused by his work or employees.

B. Upon completion of work, remove materials, scraps and debris relative to his work and leave the premises, including tunnels, crawl spaces, and pipe chases in clean and orderly condition. Remove all dirt and debris from the interior and exterior of all devices and equipment. After construction is completed, wash all light fixtures and lamps, remove all labels from fixture lenses.

1.11 DUST PROTECTION

A. Contractor will provide suitable dust protection for all existing areas prior to beginning of cutting or demolition. Contractor will obtain approval of partition from Owner before proceeding with work involved in these rooms.

1.12 TEMPORARY FACILITIES

A. OFFICES

1. Contractor shall provide temporary offices for himself including lights, heat and telephone, if required.

B. REMOVAL

1. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

1. The contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the contractor.

D. PROTECTION DEVICES

 The contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc. required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the contractor. The contractor shall assume all responsibility for which the owner may be held responsible because of lack of above items.

E. TEMPORARY WATER

1. The contractor shall provide all water required by his trade for construction. Temporary drinking water shall be provided by contractor from a proven safe source dispensed by single service containers, until such time as the construction water outlet has been install, disinfected and approved for drinking purposes.

F. TEMPORARY FIRE PROTECTION

1. The contractor shall provide all necessary first-aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority. The contractor shall provide general area fire extinguishers only.

1.13 TEMPORARY ELECTRICAL FACILITIES

ELECTRICAL GENERAL REQUIREMENTS

A. DESCRIPTION OF SYSTEM

- 1. Provide temporary electric power for items listed, throughout the construction period, so that power can be secured at any desired point from temporary service panel within building proper.
 - a. Power centers for miscellaneous tools and equipment used in the construction period, so that power can be secured at any desired point from temporary service panel within building proper.
 - b. Lighting for safe and adequate working conditions throughout the buildings, stairways, and crawl spaces. Provide at least 1/2 watt of incandescent lighting per square foot of floor area. Maintain a socket voltage of at least 110 volts. Use a minimum of 100-watt bulbs.
 - c. Power for construction site offices and for other temporary storage and construction buildings.
 - d. Power to maintain continuous construction during changeover of electrical equipment.
 - e. Power for testing and checking equipment.
- B. CAPACITY
 - 1. Provide and maintain adequate electrical power for construction use by all trades during the construction period at the locations necessary.
- C. POWER COSTS
 - 1. The contractor shall pay all cost of setting and removing temporary service.
- D. USE OF PERMANENT SYSTEM
 - 1. Regulate any part of the permanent electrical system which is used for construction purposes to prevent interference with safety and orderly progress of the work.
 - 2. Leave permanent electrical services in a condition as good as new.
 - 3. The permanent heating system is to be connected to the permanent power supply as soon as possible to provide heat to complete construction at no additional cost to Owner or Architect/Engineer.
 - 4. The contractor will NOT be required to separately meter electrical power consumption used for construction purposes when using the building's permanent electrical system.

1.14 ALTERATIONS

A. In alteration, extension, and remodeling projects, existing conduits shall be extended, altered or reconnected as shown or as directed. Where existing conduits which are indicated to be revised, or which will be essential to the functioning of the particular system, are cut or exposed due to construction changes, new connections shall be made in the most expeditious manner as directed or indicated. Where wiring is involved, new

wires shall be pulled in between the nearest available, accessible, reused outlets. In all cases where new wires are required, indicated or specified to be installed in existing conduits, if same cannot be installed, new conduits shall be provided. Attention is called to the fact that all new conduit; wiring and apparatus shown on drawings or specified shall be connected to the existing systems so as to function as complete units. All conduits and electrical apparatus, etc., in place and not shown or specified to be reused or which will not be essential to the functioning of the various systems when the work is complete, shall be removed and stored where directed. No old material shall be reinstalled or reused unless otherwise indicated on drawings or herein specified. Concealed conduits which are not indicated or specified to be reused and become exposed due to construction changes shall be removed to the nearest available, accessible, reused outlets.

1.15 SHOP DRAWINGS

- A. Provide electronic (pdf) copies of manufacturer's literature and/or certified prints as soon as possible but within thirty (30) days after awarding of Contract, for items of materials, equipment, or systems where called for in specifications. Shop drawings and literature complete showing item used, size, dimensions, capacity, rough in, etc., as required for complete check and installation. Manufacturers literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
- B. Each copy of each item submitted must be clearly marked as follows for purposes of identification and record. Submittals not marked (typewritten only) as described below will be rejected and returned without review.

Date: Name of Project: Branch of Work: Submitted by: Specification or Plan Reference:

- C. Prior to their submission, each submittal shall be thoroughly checked by the contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the contractor evidencing such checking will be rejected and returned without review.
- D. All submittals will be examined when submitted in proper form for compliance. Such review shall not relieve the contractor of responsibility for errors, for deviation from the contract Documents, nor for violation of sound safety practices.
- E. The contractor shall keep in the field office one print of each submittal, which has been reviewed and stamped by the Architect or Engineer.

- F. Submittals will be required for each item of material and equipment furnished as noted in specifications.
- G. Submittals which are incomplete relative to quality requirements, capacity, engineering data, dimensional data or detailed list of specialty or control equipment will be rejected. Lists shall include descriptive coding as specified or shown on drawings.

ITEM	MFG LIT	SHOP DWG	WIRING DIAG.	O&M BOOK
RACEWAYS AND FITTINGS	X			
WIRE AND CABLE	X			
OUTLET BOXES	X			
CONTROLLERS	X	Х	Х	Х
WIRING DEVICES	X			
SUPPORTING DEVICES	X			
FUSES	X			
DISCONNECT SWITCHES	X			
PANELBOARDS	X	Х		
SWITCHGEAR	X	Х		
LIGHTING & LIGHTING CONTROL	X	Х		

H. Schedule of Shop Drawings.

1.16 OPERATION AND MAINTENANCE MANUALS

A. At the time orders are placed for any item of equipment requiring service or operating maintenance, the contractor shall request the manufacturer furnish three (3) copies of OPERATION AND MAINTENANCE INSTRUCTIONS for each piece of equipment. These shall be included in the brochure of equipment.

1.17 BROCHURE OF EQUIPMENT

A. Upon completion of work, prepare a "Brochure of Equipment" containing data pertinent to equipment and systems on job. Binders containing materials shall be one or more three ring binders of sufficient number to hold all literature. Contained in binders shall be: Installation, maintenance, and operating instructions for each piece of equipment; parts lists; wiring diagrams; one copy of each shop drawing and literature submittal; record drawings, etc.

- B. All literature shall be clean, unused and filed under divider headings corresponding to the specifications.
- C. These brochures shall be submitted to the Architect/Engineer and approved by him before authorization of final payment.

1.18 "AS-BUILT" DRAWINGS

A. The contractor shall furnish to the Owner and Architect/Engineer a red line marked print set of drawings, each sheet stamped as the "As-Built" drawing and bearing the contractor's name, date and signature. The As-Built drawing shall show the location of all concealed or underground conduit runs and other equipment, devices, outlets, etc., installed other than as shown on the drawings. Dimension underground lines from established building lines. As-Built drawings to be developed from a job site record drawing set and shall be clean, neat and all changes legible and shown in the same format and symbols used on the contract drawings. The As-Built drawing set shall be submitted to the architect/engineer for approval, and any deficiencies noted by the architect/engineer at no cost to architect/engineer or owner.

1.19 PLACING SYSTEMS IN OPERATION

A. At the completion of the work and at such time as the Owner shall direct, prior to final acceptance, the contractor performing this work shall put into satisfactory operation the various systems installed under the specifications. At no additional cost to the Owner, furnish the services of a person completely familiar with the installations performed under this specification, to instruct the Owners operating personnel in the proper operation and servicing of the equipment and systems. These services shall be available for a period of no less than one (1) day.

1.20 GUARANTEE-WARRANTY

A. This contractor shall and hereby does warrant and guarantee that all work executed under this Division will be free from defects of materials and workmanship for a period of one year from the date of final acceptance of this work and that he will, at his own expense, repair and/or replace all such defective materials and work and all other work damaged thereby which becomes defective during the term of warranty, except that lamps and tubes shall be his responsibility only for normal lamp life or one year, whichever occurs first.

END OF SECTION 26 00 00

SECTION 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.

1.02 REFERENCES

- A. NECA (National Electrical Contractors Association) Standard of Installation.
- B. Division 07 Thermal and Moisture Protection
- C. Division 26 Electrical
- D. Section 26 05 26 Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- E. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 21 00 Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- G. Division 31 Earthwork

1.03 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 18 AWG for control circuits.
 - 5. 10 AWG conductors for 20 ampere, 120 volt, branch circuit homeruns longer than 75 FEET.
 - 6. 8 AWG conductors for 20 ampere, 120 volt, branch circuit homeruns longer than 150 FEET.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Interior Locations: Use only Type THHN/THWN in raceway.
 - 2. Exterior Locations: Use only THW or direct burial cable in raceway.
 - 3. Underground Locations: Use only Type THW, THHN/THWN or direct burial cable in raceway.

- 4. Increase raceway size where required to comply NEC raceway maximum fill requirement.
- 1.04 DESIGN REQUIREMENTS
 - A. Conductor sizes are based on copper. Aluminum conductors are not acceptable unless noted otherwise.
- 1.05 SUBMITTALS
 - A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
 - B. Product Data: Submit for building wire.
 - C. Test Reports: Indicate procedures and values obtained.
- 1.06 CLOSEOUT SUBMITTALS
 - A. Section 01 70 00 Execution Requirements: Requirements for submittals.
 - B. Project Record Documents: Record actual locations of components and circuits.
- 1.07 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- 1.08 FIELD MEASUREMENTS
 - A. Verify field measurements as indicated on Drawings.
- 1.09 COORDINATION
 - A. Division 1 General Requirements.
 - B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
 - C. Wire and cable routing indicated is approximate unless dimensioned.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co. Model.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Southwire
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.

- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 75 degrees C.
- F. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- G. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
 - 1. Exceptions:
 - a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
 - b. Use power and control tray cable or metal-clad cable for installation in cable tray.
- H. Nonmetallic-sheathed cable is not permitted unless noted otherwise.
 - 1. In addition to other applicable restrictions, may not be used:
 - a. Where exposed to view.
 - b. Where exposed to damage.
 - c. For damp, wet, or corrosive locations.
 - d. Underground locations.
- I. Service entrance cables are permitted only as follows.
 - 1. For underground service entrance, installed in raceway.
 - 2. In addition to other applicable restrictions, may not be used:
 - a. Where exposed to damage.
- J. Armored cable is not permitted.
 - 1. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where not approved for use by the authority having jurisdiction.
 - c. Where exposed to view.
 - d. Where exposed to damage.
 - e. For damp, wet, or corrosive locations.
 - f. For isolated ground circuits.
- K. Metal-clad cable is not permitted.
 - 1. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where not approved for use by the authority having jurisdiction.

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- c. Where exposed to view.
- d. Where exposed to damage.
- e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
- f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.
- L. Manufactured wiring systems are permitted only as follows:
 - 1. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where not approved for use by the authority having jurisdiction.
 - c. Where exposed to view.
 - d. Where exposed to damage.
 - e. For damp, wet, or corrosive locations.
 - f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

2.02 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
 - c. Substitutions: See Section 01 60 00 Product Requirements.
 - 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 - 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 - 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 - 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.

- 6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
- 7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
 - 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Burndy LLC: www.burndy.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 Product Requirements.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. Ilsco: www.ilsco.com.
 - d. Substitutions: See Section 01 60 00 Product Requirements.
- D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 - 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. American Polywater Corporation: www.polywater.com.
 - c. Ideal Industries, Inc: www.idealindustries.com.
 - d. Substitutions: See Section 01 60 00 Product Requirements.
- E. Cable Ties: Material and tensile strength rating suitable for application.
 - 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com.
 - b. Substitutions: See Section 01 60 00 Product Requirements.

PART 3 - EXECUTION

- 3.01 EXAMINATION
 - A. Verify interior of building has been protected from weather.
 - B. Verify mechanical work likely to damage wire and cable has been completed.
 - C. Verify raceway installation is complete and supported.
- 3.02 PREPARATION
 - A. Completely and thoroughly swab raceway before installing wire.
- 3.03 INSTALLATION
 - A. Route wire and cable to meet Project conditions.
 - B. Install wire and cable in accordance with NECA "Standard of Installation."
 - C. Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - D. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - E. Special Techniques Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
 - F. Special Techniques Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
 - G. Special Techniques Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - 7. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

8. Install stranded conductors for branch circuits 8 AWG and larger. However, when stranded conductors are used in lieu of solid, then install crimp-on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

3.04 WIRE COLOR

- A. General
 - Color-code 208/120-V, 240/120-V system secondary, feeder, and branch-circuit conductors throughout the secondary electrical system as follows. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:

Description	120/240V	120/208V	277/480V	Control
Phase A (Left)	Black	Black	Brown	
Phase B (Center)	Red	Red	Orange	
Phase C (Right)		Blue	Yellow	
Neutral	White	White	Gray	White
Ground	Green	Green	Green	Green
120 VAC				Red
Control				
120 VAC		Neutral		White
Control				
DC Control (+)				Blue
DC Control (-)				Gray
External Source				Yellow

- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.05 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Testing and inspection services;
- B. Section 01 70 00 Execution Requirements: Testing, adjusting, and balancing.
- C. Inspect and test system in accordance with manufacturer's recommendations and industry standards. System shall be free of all unnecessary shorts and insulation or conductor damage.

END OF SECTION 26 05 19

SECTION 26 05 26 GROUNDING AND BONDING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- 1.03 SUBMITTALS
 - A. Product Data: For each type of product indicated.
- 1.04 QUALITY ASSURANCE
 - A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 1. Comply with UL 467.

PART 2 - PRODUCTS

2.01 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 05 19 Section Conductors and Cable.
- B. Material: Copper only.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

2.02 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In raceways, use insulated copper equipment grounding conductors.

3.02 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.
- C. Signal and Communication Systems: For telephone, television, alarm, voice and data, and other communication systems, provide insulated grounding conductor in raceway with all equipment branch circuits. Verify existing equipment ground back to grounding electrode system is present and functional. Notify Engineer if any problem with equipment branch circuits or grounding system is observed.
- 3.03 CONNECTIONS
 - A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - B. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values.

END OF SECTION 26 05 26

SECTION 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
 - 1. Raceways include the following:
 - a. RMC Rigid Metal Conduit.
 - b. IMC Intermediate Metal Conduit.
 - c. PVC externally coated, rigid steel conduits.
 - d. PVC externally coated, IMC.
 - e. EMT Electrical Metallic Tubing.
 - f. FMC Flexible Metal Conduit.
 - g. LFMC Liquidtight Flexible Metal Conduit.
 - h. RNC Rigid Non-Metallic Conduit.
 - i. Wireways.
 - j. Surface raceways.
 - 2. Boxes, enclosures, and cabinets include the following:
 - a. Device boxes.
 - b. Outlet boxes.
 - c. Pull and junction boxes.
 - d. Cabinets and hinged-cover enclosures.
- B. Related Sections include the following:
 - 1. Division 07 Thermal and Moisture Protection
 - 2. Division 26 Electrical
 - 3. Section 26 27 26 Wiring Devices, for devices installed in boxes and for floor-box service fittings.
- 1.03 DEFINITIONS
 - A. EMT: Electrical metallic tubing.

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- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RMC: Rigid metal conduit.
- F. RNC: Rigid nonmetallic conduit.
- 1.04 SUBMITTALS
 - A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- 1.05 QUALITY ASSURANCE
 - A. Comply with NFPA 70.
- 1.06 COORDINATION
 - A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

- 2.01 METAL CONDUIT AND TUBING
 - A. Rigid Steel Conduit: ANSI C80.1.
 - B. IMC: ANSI C80.6.
 - C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.
 - D. Plastic-Coated IMC and Fittings: NEMA RN 1.
 - E. EMT and Fittings: ANSI C80.3.
 - 1. Fittings: Set-screw or compression type steel. Cast fittings are not acceptable.
 - F. LFMC: Liquid-tight flexible steel conduit with PVC jacket.
 - G. Fittings: NEMA FB 1; compatible with conduit/tubing materials.
- 2.02 NONMETALLIC CONDUIT
 - A. RNC: NEMA TC 2, Schedule 40 or 80 PVC.
 - B. RNC Fittings: NEMA TC 3; match to conduit type and material.
- 2.03 METAL WIREWAYS
 - A. Material: Sheet metal sized and shaped as indicated.
 - B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
 - C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.
- 2.04 OUTLET AND DEVICE BOXES
 - A. Sheet Metal Boxes: NEMA OS 1.
 - B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box with gasketed cover.
 - C. Non-metallic Floor Boxes: Carlon E971FB
- 2.05 PULL AND JUNCTION BOXES
 - A. Small Sheet Metal Boxes: NEMA OS 1.
 - B. Cast-Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- 2.06 ENCLOSURES AND CABINETS
 - A. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 - B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.07 SURFACE RACEWAYS

- A. Types, sizes, and channels as indicated on the floor plans, with fittings that match and mate with raceways.
- B. Manufacturer
 - 1. The surface metal raceway specified herein shall be either G4000 gray or V4000 ivory finish as stated on approval drawings and manufactured by The Wiremold Company. Systems of other manufacturers may be considered if equal, by written approval of the specifying engineer and shall meet all the performance standards specified herein.
- C. Materials
 - The raceway and all the system components must be UL Listed. Steel shall be galvanized. Finish may be either gray or ivory ScuffCoat[™] (a polyester topcoat over ivory base) and shall be suitable for field repainting to match surroundings.
 - 2. Raceway
 - a. The raceway shall be of a two-piece design with a metal base and snap-on metal cover. Base shall be a minimum of 0.050" wall thickness and cover shall be a minimum of 0.040" wall thickness. Assembled base and cover shall be 4.750" wide by 1.750" high with a cross-section area of 7.50 square inches. Base shall be dividable by means of a removable barrier section into two equal

compartments. A cutting tool shall be available for the base and cover to ensure clean, square cuts.

- b. A full line of fittings must be available including but not limited to flat, internal and external elbows, couplings for joining raceway sections, wire clips, blank end fitting and a full compliment of device mounting brackets and plates. The fittings shall be colored to match the raceway.
- 3. Fiber Optic/UTP/STP Radius Full Capacity Fittings And Inserts
 - a. A complete line of full capacity corner elbows and tee fittings must be available to maintain a controlled 2" cable bend radius which meets the specifications for Fiber Optic and UTP/STP cabling and exceeds the TIA 569 requirements for communications pathways.
 - b. A series of inserts shall also be available for retrofit applications that provide a controlled 2" cable bend radius which meets the specifications for Fiber optic and UTP/STP cabling and exceeds the TIA 569 requirements for communications pathways.
- 4. Device Brackets and Plates
 - a. Device brackets shall be available to install single or two-gang devices either horizontal or vertical within the raceway. Horizontal device brackets to be provided with a single two-gang or a single four-gang cover plate. Horizontal device mounting brackets are to be a single piece with two integral auxiliary grounding points provided. Horizontal device brackets to have option to be provided with receptacles pre-mounted from the factory with wire leads. Devices both power and data/communication shall have the capacity of mounting flush or in conjunction with faceplates. Faceplates to conceal seam between raceway cover and installed faceplate. Device brackets and plates shall be colored to match the raceway and available with any combination of multiple device opening options.
- 5. Plastic Overlapping Cover Bracket and Faceplates
 - A plastic device mounting bracket and trim plate shall be available to install devices horizontally. Trim plate shall overlap cover-eliminating seam.
 Faceplates shall be available to accept a variety of power and data/communication devices. Plastic must be compatible with UL 94 for Plastic Materials.
- 6. Communication Devices and Accessories
 - a. The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP, STP (150 ohm), fiber optic, coaxial, and other cabling types with faceplates and bezels to facilitate mounting. A complete line of preprinted station and port identification labels, snap-in icon buttons as well as write-on station identification labels shall be available.

D. FITTINGS

- 1. A full complement of fittings must be available including, but not limited to flat, internal and external elbows, tees, entrance fittings, wire clips, cover clips, couplings, support clips, c-hangers and end caps. The fittings shall be ivory, gray or custom colors to match the raceway. All fittings shall be supplied with a base where applicable to eliminate mitering.
- 2. Take-off fitting shall be available to adapt to existing flush wall boxes and to other series raceways manufactured by The Wiremold Company.

E. EXPLOSION-PROOF COUPLINGS

- 1. Couplings in explosion-proof environments shall be watertight, dust-ignition proof, and rated for hazardous locations where threaded metal conduit is used.
- 2. O-Z/Gedney ECGJH series, or equivalent.
- 3. O-Z/Gedney Type EYF conduit sealing fitting, or equivalent.
- 4. O-Z/Gedney Type UNF conduit unions, or equivalent.

F. EXPLOSION-PROOF OUTLET BOXES

- 1. Outlet boxes in explosion-proof environments shall be dust-ignition proof and rated for hazardous locations.
- 2. O-Z/Gedney Type GUA, Form 1 series conduit outlet boxes and covers, or equivalent.
- 3. O-Z/Gedney Type OELB conduit outlet bodies, or equivalent.

PART 3 - EXECUTION

- 3.01 EXAMINATION
 - A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRING METHODS

- A. Outdoors: Use the following wiring methods:
 - 1. Exposed: Rigid steel or IMC. (Only where use and location approved by architect prior to installation.)
 - 2. Concealed: Rigid steel or IMC. (All finished areas)
 - 3. Underground, Single Run: RNC.
 - 4. Underground, Grouped: RNC.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

- 6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Indoors: Use the following wiring methods:
 - 1. Exposed: EMT or IMC. (All finished areas)
 - 2. Concealed: None. All raceway shall be exposed on the surface of the walls.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): use LFMC.
 - 4. Damp or Wet Locations: Rigid steel conduit.
 - 5. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
 - a. Damp or Wet Locations: NEMA 250, Type 4, nonmetallic.

3.03 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Minimum Raceway Size: 3/4-inch trade size.
 - 1. 1/2-inch trade size is acceptable for control wiring conduit.
- C. Expose conduit and EMT, unless otherwise indicated, on finished walls, ceilings, and floors.
- D. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- E. Install raceways level and square and at proper elevations. Provide adequate headroom.
- F. Complete raceway installation before starting conductor installation.
- G. Use temporary closures to prevent foreign matter from entering raceways.
- H. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- I. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- J. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- K. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- L. Raceways Embedded in Slabs: Install in middle third of slab thickness where practical, and leave at least 1-inch concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

- 2. Space raceways laterally to prevent voids in concrete.
- 3. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
- 4. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.
- M. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- N. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 - 2. Use insulating bushings to protect conductors.
- O. Tighten set screws of threadless fittings with suitable tools.
- P. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with 1 locknut, use 2 locknuts: 1 inside and 1 outside the box.
- Q. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- R. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.
- S. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to the above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- T. Install raceway sealing fittings according to manufacturer's written instructions. Locate fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as the boundaries of refrigerated spaces.

- 2. Where otherwise required by NFPA 70.
- U. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- V. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- W. Install nonferrous conduit or tubing for circuits operating above 60 Hz.
- X. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.
- Y. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying the raceways to receptacle or fixture ground terminals.
 - 1. Select each surface raceway outlet box, to which a lighting fixture is attached, of sufficient diameter to provide a seat for the fixture canopy.
 - 2. Where a surface raceway is used to supply a fluorescent lighting fixture having central-stem suspension with a backplate and a canopy (with or without extension ring), no separate outlet box is required.
 - 3. Provide surface metal raceway outlet box, and the backplate and canopy, at the feedin location of each fluorescent lighting fixture having end-stem suspension.
 - 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed, no additional surface-mounted outlet box is required. Provide a backplate slightly smaller than the fixture canopy.
- Z. Set floor boxes level and adjust to finished floor surface.

AA. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.04 **PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.05 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 26 05 33

SECTION 26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.
- 1.02 SUBMITTALS
 - A. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
 - B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- 1.03 CLOSEOUT SUBMITTALS
 - A. See Requirements for submittals in General Requirements section.
 - B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.
- 1.04 QUALITY ASSURANCE
 - A. Perform Work in accordance with State.
- 1.05 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years experience.
 - B. Installer: Company specializing in performing Work of this section.
- 1.06 DELIVERY, STORAGE, AND HANDLING
 - A. Refer to General Specification Product Requirements for requirements for transporting, handling, storing, and protecting products.

- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.
- 1.07 ENVIRONMENTAL REQUIREMENTS
 - A. Refer to General Requirements Section for environmental conditions affecting products on site.
 - B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.01 NAMEPLATES

- A. Manufacturers:
 - 1. Brady
 - 2. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Laminated three-layer plastic with engraved black letters on contrasting background color.
- C. Letter Size:
 - 1. 1/8 inch high letters for identifying individual equipment and loads.
 - 2. 1/4 inch high letters for identifying grouped equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.

2.02 LABELS

- A. Manufacturers:
 - 1. Brady
 - 2. Substitutions: Section 01 60 00 Product Requirements
- B. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.
- 2.03 WIRE MARKERS
 - A. Manufacturers:
 - 1. Brady
 - 2. Substitutions: Section 01 60 00 Product Requirements.
 - B. Description: Split sleeve or tubing type wire markers.
 - C. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number.

IDENTIFICATION FOR ELECT. SYSTEMS

- 2. Control Circuits: Control wire number as indicated on Drawings. Description: Nameplate fastened with adhesive.
- D. Color:
 - 1. 208 Volt System: Black lettering on white background.
 - 2. 240 Volt System: Black lettering on white background.
 - 3. Fire Alarm System: Red lettering on white background.
 - 4. Telephone System: Blue lettering on white background.
 - 5. Security System: Yellow lettering on white background.
- E. Legend:
 - 1. 480 Volt System: 480 VOLTS.
 - 2. Fire Alarm System: FIRE ALARM.
- 2.04 UNDERGROUND WARNING TAPE
 - A. Description: 4" wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Degrease and clean surfaces to receive adhesive for identification materials.
 - B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.
- 3.02 EXISTING WORK
 - A. Install identification on existing equipment to remain in accordance with this section as noted on Drawings.
 - B. Replace lost nameplates, labels, or markers.

3.03 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

- 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Service Disconnects.
 - d. Motor Starters.
- C. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations.
 - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
 - 1. Install wire marker for each conductor at panelboard gutters and each load connection.
 - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 - 3. Install labels at data outlets identifying patch panel and port designation.
- E. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION 26 05 53

SECTION 26 24 16 PANELBOARDS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Power distribution panelboards.
 - B. Lighting and appliance panelboards.
 - C. Load centers.
 - D. Overcurrent protective devices for panelboards.
- 1.02 RELATED REQUIREMENTS
 - A. Division 26 Electrical
 - B. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - C. Section 26 05 53 Identification for Electrical Systems: Identification products and requirements.
 - D. Section 26 28 13 Fuses: Fuses for fusible switches and spare fuse cabinets.
- 1.03 REFERENCE STANDARDS
 - A. FS W-C-375 Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
 - B. NECA 1 Standard for Good Workmanship in Electrical Construction; 2010.
 - C. NECA 407 Standard for Installing and Maintaining Panelboards; 2009.
 - D. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
 - E. NEMA ICS 2 Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
 - F. NEMA KS 1 Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
 - G. NEMA PB 1 Panelboards; 2011.
 - H. NEMA PB 1.1 General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
 - I. NETA ATS Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
 - J. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - K. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

- L. UL 50E Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- M. UL 67 Panelboards; Current Edition, Including All Revisions.
- N. UL 98 Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- O. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- P. UL 869A Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- Q. UL 943 Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- R. UL 1053 Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- S. UL 1699 Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 33 00 Submittal Procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

- 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
- 2. Include wiring diagrams showing all factory and field connections.
- 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- 4. Include documentation of listed series ratings upon request.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 60 00 Product Requirements, for additional provisions.
 - 2. Panelboard Keys: Two of each different key.
 - 3. See Section 26 28 13 for requirements for spare fuses and spare fuse cabinets.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.
- 1.08 FIELD CONDITIONS
 - A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
 - 2. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.

PART 2 - PRODUCTS

- 2.01 MANUFACTURERS
 - A. Eaton Corporation
 - B. Schneider Electric; Square D Products
 - C. Siemens Industry, Inc
 - D. Substitutions: See Section 01 60 00 Product Requirements.
 - E. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.
- 2.02 PANELBOARDS GENERAL REQUIREMENTS
 - A. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
 - b. Panelboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
 - C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 26 05 73.
 - 3. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.

- 4. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
 - 3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 - 4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide removable end walls for NEMA Type 1 enclosures.
 - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

- c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
- 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 43 00, list and label panelboards as a complete assembly including surge protective device.
- L. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
 - 1. Ampere Rating: Not less than ampere rating of panelboard bus.
 - 2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
 - 3. Coil Voltage: As required for connection to control system indicated.
- M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- N. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- O. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- P. Load centers are not acceptable.
- Q. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Feed-through lugs.
 - 2. Sub-feed lugs.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
 - 1. Phase and Neutral Bus Material: Aluminum.
 - 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
 - 1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
 - 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
 - 1. Provide surface-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
 - 3. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 4. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 5. Provide clear plastic circuit directory holder mounted on inside of door.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:

- 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
- 2. Phase and Neutral Bus Material: Aluminum.
- 3. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 4. Provide clear plastic circuit directory holder mounted on inside of door.
- F. Provide column-width panelboards with accessory column-width cable trough and pullbox where indicated.
- 2.05 LOAD CENTERS
 - A. Description: Circuit breaker type load centers listed and labeled as complying with UL 67; ratings, configurations, and features as indicated on the drawings.
 - B. Products:
 - 1. NOTE: Load Centers are only acceptable by written permission from the engineer.
 - 2. Substitutions: See Section 01 60 00 Product Requirements.
 - C. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Bus Material: Aluminum or copper.
 - D. Circuit Breakers: Thermal magnetic plug-in type.
 - E. Enclosures:
 - 1. Provide flush-mounted enclosures unless otherwise indicated.
 - 2. Fronts: Provide cover without door to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
 - 3. Fronts: Provide hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 4. Provide circuit directory label on inside of door or individual circuit labels adjacent to circuit breakers.

2.06 OVERCURRENT PROTECTIVE DEVICES

- A. Fusible Switches:
 - 1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
 - 2. Fuse Clips: As required to accept indicated fuses.
 - a. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
 - 3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
 - 4. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- B. Molded Case Circuit Breakers:
 - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - i. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - ii. 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
 - 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.

- c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - b. Provide interchangeable trip units where indicated.
- 5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - i. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - ii. Long time delay.

iii. Short time pickup and delay.

iv. Instantaneous pickup.

- v. Ground fault pickup and delay where ground fault protection is indicated.
- b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
- c. Provide communication capability where indicated: Compatible with system indicated.
- 6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- 7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
 - c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
 - d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
 - e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle

wave of the symmetrical prospective current when operating within its current limiting range.

- 8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- 9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
- 10. Do not use tandem circuit breakers.
- 11. Do not use handle ties in lieu of multi-pole circuit breakers.
- 12. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
- 13. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - d. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - e. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.07 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.
- 3.02 INSTALLATION
 - A. Perform work in accordance with NECA 1 (general workmanship).
 - B. Install products in accordance with manufacturer's instructions.

- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required supports in accordance with Section 26 05 29.
- F. Install panelboards plumb.
- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
- J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- K. Provide grounding and bonding in accordance with Section 26 05 26.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- L. Install all field-installed branch devices, components, and accessories.
- M. Provide fuses complying with Section 26 28 13 for fusible switches as indicated.
- N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- P. Set field-adjustable circuit breaker tripping function settings as indicated.
- Q. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 05 73.
- R. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- S. Provide filler plates to cover unused spaces in panelboards.
- T. Provide circuit breaker lock-on devices to prevent unauthorized personnel from deenergizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.
 - 3. Communications equipment circuits.

- 4. Intrusion detection and access control system circuits.
- 5. Video surveillance system circuits.
- U. Identify panelboards in accordance with Section 26 05 53.
- 3.03 FIELD QUALITY CONTROL
 - A. See Section 01 40 00 Quality Requirements, for additional requirements.
 - B. Inspect and test in accordance with NETA ATS, except Section 4.
 - C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
 - D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 100 amperes. Tests listed as optional are not required.
 - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
 - 2. Test functions of the trip unit by means of secondary injection.
 - E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
 - F. Test GFCI circuit breakers to verify proper operation.
 - G. Test AFCI circuit breakers to verify proper operation.
 - H. Test shunt trips to verify proper operation.
 - I. Correct deficiencies and replace damaged or defective panelboards or associated components.
- 3.04 ADJUSTING
 - A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
 - B. Adjust alignment of panelboard fronts.
 - C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.
- 3.05 CLEANING
 - A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
 - B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 24 16

SECTION 26 27 13 ELECTRICAL UTILITY SERVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes coordination with Montana State Hospital for installation of overhead/underground electric primary lines. The service drops to the screen building and to the UV/blower building are owned and maintained by the Montana State Hospital, not the local utility company.
- 1.02 SYSTEM DESCRIPTION
 - A. Primary Service Owner: MONTANA STATE HOSPITAL
 - B. System Characteristics: three-phase, primary, overhead or underground, electrical line.
 - C. Scope:
 - 1. Provide a new electrical service line from the Montana State Hospital sub-station to the new facilities. Refer to site civil and electrical plans. All service costs, both temporary and permanent, shall be included in the Contractor's bid pricing.
- 1.03 SUBMITTALS
 - A. Section 01 33 00 Submittal Procedures.
 - B. Submit Utility-Company-prepared drawings.
- 1.04 QUALITY ASSURANCE
 - A. Perform Work in accordance with Montana State Hospital written requirements.
 - B. Maintain one copy of each document on site.
- 1.05 FIELD MEASUREMENTS
 - A. Verify field measurements are as indicated on Drawings.
- 1.06 COORDINATION
 - A. Coordinate with the Montana State Hospital the installation of a new electrical service line from their existing electrical sub-station.
 - B. The Contractor shall pay for all costs that will be associated with work performed to provide the new electrical service; such costs are part of this contract.

PART 2 - PRODUCTS

- 2.01 UTILITY METERS
 - A. Furnished by Electrical Contractor per Montana State Hospital standards.
- 2.02 UTILITY METER BASE & CT CANS
 - A. Furnished by Electrical Contractor per Montana State Hospital standards.

ELECTRICAL UTILITY SERVICES

PART 3 - EXECUTION

- 3.01 EXAMINATION
 - A. Verify service equipment is ready to be connected and energized.
- 3.02 INSTALLATION
 - A. Install service entrance conductors to building service entrance equipment. Electrical contractor shall connect service entrance conductors from the substation to the building disconnects via primary junction cans and the pad mounted transformer. Coordinate all electrical outages with the Montana State Hospital.

END OF SECTION 26 27 13

SECTION 26 27 26 WIRING DEVICES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This Section includes receptacles, connectors, switches, and finish plates.
- 1.03 DEFINITIONS
 - A. GFCI: Ground-fault circuit interrupter.
- 1.04 SUBMITTALS
 - A. Product Data: For each product specified.
 - B. Shop Drawings: Legends for receptacles and switch plates; floor box cut-sheets.
 - C. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 1.
- 1.05 QUALITY ASSURANCE
 - A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
 - B. Comply with NEMA WD 1.
 - C. Comply with NFPA 70.
- 1.06 COORDINATION
 - A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2.02 RECEPTACLES
 - A. Straight-Blade Receptacles: Specification grade, Heavy-Duty, 5-20R duplex receptacle, 120VAC, 20 amp. Hubbell #HBL 5362, Leviton #5362 or equal. Construction grade not acceptable. CR Series not acceptable.

- B. GFCI Receptacles: Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch deep outlet box without an adapter. Hubbell #HBL GF5362, Leviton #7899, or equal.
- C. GFCI Receptacles (Exterior): Feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle arranged to protect connected downstream receptacles on same circuit. Design units for installation in a 2-3/4-inch deep outlet box without an adapter. Heavy duty, commercial grade, tamper and weather resistant, 20 Amp, 125VAC. Leviton or equivalent.

2.03 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.04 SWITCHES

- A. General A/C Switches: Specification grade, Heavy-duty, quiet type, toggle type, 120-277 VAC, 20 amp. Leviton CSB series or equal.
- B. Occupancy Sensor Switches: Refer to Occupancy Sensor Schedule on the drawings for description, manufacturer, and part number.
- 2.05 WALL PLATES
 - A. Single and combination types match corresponding wiring devices.
 - 1. Material: Stainless Steel. Configuration to match devices and device ganging. Leviton or equal.
- 2.06 FINISHES
 - A. Color: Gray
- 2.07 EXPLOSION PROOF DEVICES
 - A. Devices in explosion-proof environments shall be factory sealed, dust-ignition proof, and rated for hazardous locations where used.
 - B. Appleton EFD/EFDC series control stations, or equivalent.
 - C. Appleton U-Line Contender series, Type ENR receptacle, 20 Amp, 125Vac, or equivalent.
 - D. Appleton U-Line Interchanger series, Type ECP plug, 20 Amp, 125 Vac, or equivalent.

PART 3 - EXECUTION

WIRING DEVICES

3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- D. Protect devices and assemblies during painting.
- 3.02 CONNECTIONS
 - A. Connect wiring device grounding terminal to outlet box with bonding jumper.
 - B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
 - C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.
- 3.03 FIELD QUALITY CONTROL
 - A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.
 - B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
 - C. Replace damaged or defective components.
- 3.04 CLEANING
 - A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 26 27 26

SECTION 26 28 13 FUSES

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02 SUMMARY
 - A. This Section includes cartridge fuses, rated 600 V and less, for use in switches, panelboards, switchboards, controllers, and spare fuses.
- 1.03 SUBMITTALS
 - A. Product Data: Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings for each fuse type indicated.
- 1.04 QUALITY ASSURANCE
 - A. Source Limitations: Provide fuses from a single manufacturer.
 - B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - C. Comply with NEMA FU 1.
 - D. Comply with NFPA 70.
- 1.05 COORDINATION
 - A. Coordinate fuse ratings with HVAC and refrigeration equipment nameplate limitations of maximum fuse size.
 - B. Fuse shall be approved for use for the application's actual voltage, ampere, and short circuit characteristics. Verify all fuse size indications on the drawings with actual nameplate ratings and install the appropriate fuse size for the application according to the NEC.

PART 2 - PRODUCTS

- 2.01 CARTRIDGE FUSES
 - A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.02 FUSE APPLICATIONS
 - A. Motor Branch Circuits: Class RK5, time delay.
 - B. Other Branch Circuits: Class RK5, time delay.
- 3.03 INSTALLATION
 - A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- 3.04 IDENTIFICATION
 - A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 26 28 13

SECTION 26 28 16 ENCLOSED SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes fusible and non-fusible switches.
- B. Related Sections:
 - 1. Section 26 28 13 Fuses.

1.02 REFERENCES

- A. NECA (National Electrical Contractors Association) Standard of Installation.
- B. NEMA FU 1 (National Electrical Contractors Association). Low Voltage Cartridge Fuses.
- C. NEMA KS 1 (National Electrical Contractors Association). Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- 1.03 SUBMITTALS
 - A. Section 01 33 00 Submittal Procedures: Submittal procedures.
 - B. Product Data: Submit switch ratings and enclosure dimensions.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCH ASSEMBLIES

- A. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle shall be lockable in the ON and OFF position.
- B. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
- D. Furnish switches with entirely copper current carrying parts.

2.02 NONFUSIBLE SWITCH ASSEMBLIES

- A. Product Description: NEMA KS 1, Type HD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle shall be lockable in the ON and OFF position.
- B. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray.

- 1. Interior Dry Locations: Type 1.
- 2. Exterior Locations: Type 3R.
- 3. Corrosive environments: Type 4X.
- C. Furnish switches with entirely copper current carrying parts.
- 2.03 SWITCH RATINGS
 - A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
 - B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 33.
- C. Height: 42" or as scheduled.
- D. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates in accordance with Section 26 05 33.
- F. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.
- G. Ensure that all handles, switches, knobs, buttons, etc. are easily accessible and operational.
- 3.02 FIELD QUALITY CONTROL
 - A. Inspect and test for proper installation and operation.

END OF SECTION 26 28 16

SECTION 26 29 23 BLOWER CONTROL PANEL

PART 1 - GENERAL

1.01 SUMMARY

- A. Work under this section shall include the furnishing of all labor, materials, tools, equipment, and other items necessary for the supply and installation of the control panel for the blowers as specified herein.
- B. The control panel manufacturer shall provide an enclosure that can be mounted to a post and beam structure or a wall without field modifications to the enclosure that would compromise the rating of the enclosure.
- C. The control panel installer shall provide the mounting hardware and fittings necessary to ensure that the enclosure is mounted securely, and that such openings made to the enclosure for conduit or any other entry are of the same NEMA rating as the enclosure so as not to compromise such rating.

1.02 SUBMITTALS

- A. The Control Panel Supplier shall furnish a submittal package to the Engineer for approval prior to fabrication. Submittals shall include proposed layout drawing(s) detailing appurtenances and escutcheon plates, a one-line diagram of panels and interconnecting wiring and a circuit diagram of each panel and shall include a bill of materials with catalog cuts.
- B. Upon engineer's approval of shop drawings, the contractor shall submit equipment "Installation, Operation, and Maintenance Manuals" (I.O.M). The I.O.M. manuals shall detail all components and include installation instructions, start-up procedures, and normal operation and maintenance procedures.

PART 2 - PRODUCTS

- 2.01 CONTROL SYSTEM
 - A. The control system shall consist of a lockable NEMA 4 enclosure suitable for outdoor use. The enclosure shall be carbon steel with one coat of phosphatized primer and one coat of enamel finish coat. For indoor applications the cabinet shall be passively vented.
 - B. The enclosure shall be as manufactured by English Electric (Vynckier), Hammond Manufacturing, Hoffman Engineering, Stahlin (Robroy Industries) Wiegmann Manufacturing, Tanco, Inc., Eurobex, or equivalent.
 - C. Refer to the Technical Data Sheet for number of motors, horsepower of each motor, and electrical information.
 - D. The enclosure assembly shall comply with UL 508 standards for safety and shall be assembled in such a manner that if required it could be UL inspected and listed as such without any modifications.

- E. Control voltage shall be 120 volts AC, and shall be derived from a primary and secondary fused isolating control power transformer (CPT). The CPT shall have a minimum excess capacity of 15% and shall have a grounded secondary. Glass or ceramic tube fuses are unacceptable. Control power transformers shall be as manufactured by Fern Electric (Cincinnati) Types A-D and N, G.E. Type IP, Hammond Types MH or MT, Sola Hevi-Duty Type E or Type Y, and Westinghouse types MTA or MTC or equal.
- F. Selector switches, pilots, and push buttons (if applicable) shall be of modular design, with field replaceable contact sets and lamps. These devices shall be AEG Type D22/D30, Allen-Bradley Bulletin 800-H or 800-F or 800-T, Cutler-Hammer File 10250T, GE Type CR104, Idec Type TWTD, Square-D Class 9001 Types K or T, Telemechanique Type XB3 or equal. Any type used must be UL listed. Component recognized units shall not be acceptable.
- G. Fuse blocks/holders and fuses shall not be sized to carry in excess of 80% of their rating and shall be as manufactured by Bussman Division, Cooper Industries; Power Fuse Division, Littel Fuse; Ferraz-Shawmut, Marathon Special Products or equal.
- H. All internal components shall be legibly and permanently marked and coincide with the drawings and bill of materials. All external devices shall have engraved escutcheon plates affixed above the device with high quality 2-sided tape or stainless-steel screws.
- I. All control wiring shall be 18 awg (min.) type MTW. All neutral or grounded conductors shall have white insulation. In a case where white is not available for a particular use, the wire shall be coded at each end by wrapping with white electrical tape. All such coded non-white neutral conductors shall also be coded every 610mm (24 inches), when applicable, with white tape wrap. All control wires shall be numbered at both ends with a suitable, high quality, permanent wire numbering product. Control wires 100mm (4 inches) or less may be numbered at one end only. Individual wire numbering tapes or other products, which unravel or easily fall off are not acceptable. Wire marking shall be as manufactured by Thomas & Betts (T&B) Shur-Code, the 3M company Scotch Code wire marking systems, or Brady Datab, Laser Tab, Omni-grip, Brady, Panduit, or Sleeve wire marking systems.
- J. Enclosure interconnect control and power wiring shall terminate in permanently marked terminals or blocks, with one (1) wire per terminal, unless the device is designed for multiple terminations. Barrier strips are acceptable only if covers are also provided and wires are terminated in a SEMS self-lifting type pressure pad or listed crimp terminal. There shall be at least 10% extra unmarked terminals provided in each enclosure. Jumpering of adjacent terminals shall be accomplished with terminal manufacturer supplied jumpers intended specifically for use with that product.
- K. Acceptable terminal blocks are Entrelec Series 5000, Buchanan 300 and 600-volt medium to heavy-duty sectionals, Marathon Special Products 3/8" and 7/16" 600 volt sectionals, Schlegal Elektrokontakt IK, and WAGO Cage-Clamp 2xx series, Allen Bradley 1492-J Series, or equal. The acceptable barrier type strips are Kulka 601 or larger series, or Marathon 200HB, 300, 400 series.

- L. Disconnect equipment shall be Allen-Bradley Bulletin 194R or 1494R, Cutler-Hammer File C362, Selzer Series H or S switches, Square-D Class 9422, Westinghouse Type DS and Visi-Flex, or Allen-Bradley OS Series or OES Series.
- M. Main breakers, if used in lieu of a listed fused switch, shall be UL listed F, J, or K frame units with minimum 22k AIC symmetrical interrupt rating at operating voltage. Supplementary breakers, such as control and motor branch circuit protection devices, if used in lieu of listed fuses, shall be any UL listed unit with minimum interrupt rating of 5k AIC symmetrical at the operating voltage.
- N. Motor controllers (starters) shall be IEC rated magnetic, rated with a minimum of 1 size hp higher. Acceptable units are Allen-Bradley 100-C Series and Allen-Bradley 100-D Series.
- O. Plug-in (standard 8- or 11-pin octal) or can-type timing/relay/logic devices shall be as manufactured by Diversified, Eagle Signal, Idec, Infitec, NCC, SSAC, R&K, Allen-Bradley, or Motor Saver.
- P. Enclosure shall contain the power distribution and logic components, and any indicating devices. It shall be door-in-door type, with the outer door pad-lockable. Inner door shall be interlocked by the disconnecting means. No devices shall be mounted on the outer door. All indicating devices shall be visible without shutting off power.
- Q. The indoor swing-out door shall have mounted on and include but not be limited to:
 - 1. Thru-door operated fusible main disconnect switch or main circuit breaker operator handle, clearly indicating and pad-lockable in the "off" position with inner-door interlock.
 - 2. A 4-digit plus 10ths, non-resettable hour meter for each motor. Battery operated types not acceptable.
 - 3. A circuit wiring print pocket on the inside of outer door.
- R. Mounted on the side of the main enclosure shall be (but not limited to) the following NEMA 4 devices installed such that the wiring for the devices is behind the closed inner door:
 - 1. There should be a green pilot light to indicate which motor is running.
 - 2. There should be a red pilot light for each motor to indicate overload (OL) relay trip. Pilot to remain lit until OL Reset button pressed.
 - 3. There should be a one push button to test all pilot lights.
- S. Enclosure internal to include but not be limited to the following:
 - 1. Main fused disconnect switch or breaker as mentioned above, with operating mechanism. If fused, switch fuses shall be included and be the rejection type.
 - 2. Full-voltage magnetic starter(s) with overload relay. Starters may be of the IEC design but shall be sized and rated to NEMA standards. Overload elements (heaters) in each ungrounded phase, to be direct-heated bi-metal design and must be

sensitive/reactive to single phasing condition (running loss of phase). Overload relay must be field adjustable for manual or automatic reset. The contactors shall have field-replaceable power pole contacts.

- 3. Individual motor branch circuit, short-circuit, and over-current protective devices shall be provided in accordance with NEC section 430. Such devices may consist of listed rejection type fuses, inverse-time thermal magnetic, or instantaneous-trip circuit breakers sized in accordance with NEC tables 430-150 and 430-152.
- 4. Also acceptable would be UL type 508 combination starters consisting of a combination short-circuit/over-current/running overload protection device, and a magnetic contactor of suitable capacity. Such combinations shall have been evaluated and listed by UL for this purpose.
- T. The main breaker or fuse arrangement may serve as the backup SC/OC protection for motor grouping.
- U. Control Power Transformer (CPT).
 - Plug-in (octal) style logic devices required for function as outlined in this document. Include as standard a phase-monitor (PM) wired after the main fuses or breaker to sense loss of phase, improper phase sequence, and low line voltage or imbalance. The PM should be of the automatic reset type with adjustable dropout voltage. PM sensed condition to lock out all motor function and automatically restart when condition returned to normal.
- V. Terminals with adequate current rating for line and field connections as required.
- W. Motor starting and stopping operators and the individual motor safety/service disconnect switches.
- X. Individual motor safety/service disconnect switch operators, clearly indicating, padlockable in the "off" position.
- Y. Hand Off Auto selector switches for each motor. System must re-start automatically subsequent to loss and restoration of power.
- Z. Individual motor safety/service switches, on/off, horsepower rated, 3-pole, UL listed.
- AA. Terminals are required for 120V AC control circuitry.
- BB. Heavy-duty terminals for motor power/disconnect if the switches are not a feed-thru top accessible type. Connections shall be able to be made without removing the switch.
- CC. Timer control for each motor is required.

2.02 SPARE PARTS

- A. The panel builder shall include at least one complete set of spare fuses for each fuseholder in the control. At least one spare lamp shall be included for each pilot, and 2 spare SS/PB contacts of each unique block combination shall be provided.
- B. If the contactors DO NOT have field replaceable contact sets, one spare contact shall be included for every four starters in the enclosure.

C. If the contactors DO have replaceable contacts, one complete spare set of power pole contacts and one spare operating coil shall be provided for every four starters in the enclosure.

PART 3 - EXECUTION (GENERAL)

- 3.01 The control panel shall be protected during fabrication and installation from ingress of metal chips, debris or other foreign material from entering the components whereby such ingress would degrade or otherwise cause failure.
- 3.02 All internal wiring shall be neatly bundled or routed in wire duct or channels.
- 3.03 The contractor shall provide a method of protecting the panel until start-up and any marks shall be refinished to the approval of the engineer.

Control Panel Data

Application Type: Wastewater Treatment

Enclosure Type: NEMA 4

List of Motors:

		Motor				
Equipment	Quantity	Capacity of	Voltage		Cycle	Service Factor
		Each (HP)	(Volts)	Phase	(Hz)	
Blowers	2	60	480	3	60	1.15

Features:

- A. Main Disconnect.
- B. ON (RUN)-OFF AUTO Switch.
- C. Non-resettable hour meter.
- D. Timer control.
- E. One push button to test all pilot lights.
- F. Lightning Protection.

END OF SECTION 26 29 23

SECTION 26 32 13 STANDBY POWER SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF SYSTEM & SITE

- A. Provide a 130 kW standby power system to supply electrical power at 480 Volts, 60 Hertz, three phase for two locations: the UV/Blower Building and the Screen/Lift Station building. The single generator shall consist of a liquid cooled, industrial, diesel fueled engine, a synchronous AC alternator, and system controls with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.
- B. The generator site is an NEC ordinary location with no specific harsh environment requirements.
- C. The genset shall be applied at the listed ambient temperature and elevation. Bidders shall submit the generator's rated power output at 104 ambient (°F) and 4,813 elevation (Ft).
- D. Bidders are to submit the genset's sound level no greater than 78 in dBA at 23 ft based on the configuration specified.
- E. The Engine-Generator Set (Genset) shall be capable of starting the following loads for the Lift Station and Screen building:
 - 1. Two 5 HP, 480 V, 3-phase motors (code G)
 - 2. 36 kW of heating load
 - 3. 1 HP Screen room grinder pump
 - 4. 8 kW instantaneous hot water heater
 - 5. 8.7 kW of miscellaneous load for lighting, receptacles, and other equipment.
 - 6. Voltage dip shall not exceed 20%.
- F. The Engine-Generator Set (Genset) shall be capable of starting the following loads for the UV & Blower Building:
 - 1. One 3 kVA UV light bank
 - 2. Two 5 HP non-potable water pumps
 - 3. One 10 HP air compressor
 - 4. 600W of heating load
 - 5. 8 kW instantaneous water heater
 - 6. 6.6 kW of miscellaneous load for lighting, receptacles, and other equipment.
 - 7. Voltage dip shall not exceed 20%.

1.02 REQUIREMENTS FOR REGULATORY AGENCIES

- A. An electric generating system, consisting of a prime mover, generator, governor, coupling and all controls, must have been tested, as a complete unit, on a representative engineering prototype model of the equipment to be sold.
- B. The generator set must conform to applicable NFPA requirements.
- C. The generator set must be available with the Underwriters Laboratories listing (UL2200) for a stationary engine generator assembly.
- D. The generator set must meet EPA federal emission guidelines for stationary standby power generation.

1.03 MANUFACTURER QUALIFICATIONS

- A. This system shall be manufactured by Kohler, Detroit Diesel, or an approved equal.
- B. The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.
- C. Manufacturer's authorized service representative shall meet the following criteria:
 - 1. Certified, factory trained, industrial generator technicians
 - 2. Service support 24 hours a day, 7 days a week.
 - 3. Service location within 125 miles.
 - 4. Response time of 2 hours.
 - 5. Service & repair parts in-stock at performance level of 95%.
 - 6. Offer optional remote monitoring and diagnostic capabilities.
- D. SUBMITTALS Engine Generator specification sheet
- E. Controls specification sheet(s)
- F. Installation / Layout dimensional drawing
- G. Wiring schematic
- H. Sound data
- I. Emission certification
- J. Warranty statement

PART 2 - PRODUCTS

- 2.01 GENSET ENGINE RATING AND PERFORMANCE
 - A. The prime mover shall be a liquid cooled, diesel fueled, turbocharged after-cooled engine of 4-cycle design. It will have adequate horsepower to achieve a rated output of 130 kW, with an operating speed of 1800 RPM.
 - B. The engine shall support a 100% load step.

STANDBY POWER SYSTEM

- C. The generator system shall support generator start-up and load transfer within 10 seconds.
- D. The generator shall accept a load step of 60 kW with a maximum frequency dip of 5 Hz.
- E. ENGINE OIL SYSTEM
 Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter(s) with internal bypass and replaceable element(s).
- F. The engine shall operate on mineral based oil. Synthetic oils shall not be required.
- G. The oil shall be cooled by an oil cooler which is integrated into the engine system.
- H. The engine oil pan will contain a 120vac thermostatically controlled crankcase oil heater.
- 2.02 ENGINE COOLING SYSTEM
 - A. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system. The coolant system shall include a coolant fill box which will provide visual means to determine if the system has adequate coolant level. The radiator shall be designed for operation in 122 degrees F, ambient temperature.
 - B. The engine shall have (a) unit mounted, thermostatically controlled water jacket heater(s) to aid in quick starting. The wattage shall be as recommended by the manufacturer. [The wattage shall be upsized to support very cold environments.]
 - C. Engine coolant and oil drain extensions, equipped with pipe plugs and shut-off valves, must be provided to the outside of the mounting base for cleaner and more convenient engine servicing.
 - D. A radiator fan guard must be installed for personnel safety that meets UL and OSHA safety requirements.
- 2.03 ENGINE STARTING SYSTEM
 - A. Starting shall be by a solenoid shift, DC starting system.
 - B. The engine's cranking batteries shall be lead acid. The batteries shall be sized per the manufacturer's recommendations. [The batteries shall be the largest available by the manufacturer for this generator size.] The batteries supplied shall meet NFPA 110 cranking requirements of 90 seconds of total crank time. Battery specifications (type, amp-hour rating, cold cranking amps) to be provided in the submittal.
 - C. The genset shall have an engine driven, battery charging alternator with integrated voltage regulation.
 - D. The genset shall have an automatic dual rate, float equalize, 10 amp battery charger. The charger must be protected against a reverse polarity connection. The chargers charging current shall be monitored within the generator controller to support remote monitoring and diagnostics. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

- E. Thermostatically controlled battery blanket heaters are to be provided to maximize the batteries cold cranking capabilities.
- 2.04 ENGINE FUEL SYSTEM
 - A. The engine fuel system shall be designed for operation on diesel fuel.
 - B. The genset shall include a secondary duplex fuel filter assembly capable of switching filters without shutting down the engine. The filter shall remove contaminants of 10 microns or larger.
 - C. The genset shall include a secondary fuel filter with an electric fuel heating element sized to increase the fuel temperature 40 degrees F with the engine at 75% load.
- 2.05 ENGINE CONTROLS
 - A. Engines that are equipped with an electronic engine control module (ECM), shall monitor and control engine functionality and seamlessly integrate with the genset controller through digital communications. ECM monitored parameters shall be integrated into the genset controllers NFPA 110 alarm and warning requirements. All ECM fault codes shall be displayed at the genset controller in standard language fault code numbers are not acceptable.
 - B. For engines without ECM functionality or for any additional genset controller monitoring, sensors are to be conditioned to a 4-20ma signal level to enhance noise immunity and all sensor connections shall be sealed to prevent corrosion.
 - C. Engine speed shall be controlled with an integrated isochronous governor function with no change in alternator frequency from no load to full load. Steady state regulation is to be 0.25%.
- 2.06 ENGINE EXHAUST INTAKE
 - A. The engine exhaust emissions shall meet the EPA emission requirements for standby power generation.
 - B. The manufacturer shall supply its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system. A rain cap will terminate the exhaust pipe after the silencer. All components must be properly sized to assure operation without excessive back pressure when installed.
 - C. The manufacturer shall supply a critical grade exhaust silencer as standard. For applications with site specific sound requirements (reference section 1.1), the silencer shall be selected to achieve site sound levels.
 - D. For gensets in a weather or sound attenuated enclosure, all exhaust piping from the turbocharger discharge to the silencer shall be thermally wrapped to minimize heat dissipation inside the enclosure.
 - E. The engine intake air is to be filtered with engine mounted, replaceable, dry element filters.
- 2.07 ALTERNATOR

- A. The alternator shall be the voltage and phase configuration as specified in section 1.01.
- B. The alternator shall be a 4 pole, revolving field, stationary armature, synchronous machine. The excitation system shall utilize a brushless exciter with a three phase full wave rectifier assembly protected against abnormal transient conditions by a surge protector. Photo-sensitive components will not be permitted in the rotating exciter.
- C. The alternator shall include a permanent magnet generator (PMG) for excitation support. The system shall supply a minimum short circuit support current of 300% of the rating for 10 seconds.
- D. For proper motor starting for this specific project, the alternator shall be up sized and shall support minimum 232 skVA with a maximum voltage dip of 20%. Documentation shall be submitted to verify this rating.
- E. Three phase alternators shall be 12 lead, broad range capable of supporting voltage reconnection. All leads must be extended into a NEMA 1 connection box for easy termination. A fully rated, isolated neutral connection must be included by the generator set manufacturer.
- F. The alternator shall use a single, sealed bearing design. The rotor shall be connected to the engine flywheel using flexible drive disks. The stator shall be direct connected to the engine to ensure permanent alignment.
- G. The alternator shall meet temperature rise standards of UL2200 (120 degrees C). The insulation system material shall be class "H" capable of withstanding 150 degrees C temperature rise.
- H. The alternator shall be protected against overloads and short circuit conditions by advanced control panel protective functions. The control panel is to provide a time current algorithm that protects the alternator against short circuits. To ensure precision protection and repeatable trip characteristics, these functions must be implemented electronically in the generator control panel -- thermal magnetic breaker implementation are not acceptable.

2.08 CONTROLS

- A. The generator control system shall be a fully integrated microprocessor based control system for standby emergency engine generators meeting all requirements of NFPA 110 level 1.
- B. The generator control system shall be a fully integrated control system enabling remote diagnostics and easy building management integration of all generator functions. The generator controller shall provide integrated and digital control over all generator functions including: engine protection, alternator protection, speed governing, voltage regulation and all related generator operations. The generator controller must also provide seamless digital integration with the engine's electronic engine control module (ECM) if so equipped. Generator controller's that utilize separate voltage regulators and speed governors or do not provide seamless integration with the engine management system are considered less desirable.

- C. Communications shall be supported with building automation via the Modbus protocol without network cards. Optional internet and intranet connectivity shall be available.
- D. The control system shall provide an environmentally sealed design including encapsulated circuit boards and sealed automotive style plugs for all sensors and circuit board connections. The use of non-encapsulated boards, edge cards, and pc ribbon cable connections are considered unacceptable.
- E. Circuit boards shall utilize surface mount technology to provide vibration durability. Circuit boards that utilize large capacitors or heat sinks must utilize encapsulation methods to securely support these components.
- F. A predictive maintenance algorithm that alarms when maintenance is required. The controller shall have the capability to call out to the local servicing dealer when maintenance is required.
- G. Diagnostic capabilities should include time-stamped event and alarm logs, ability to capture operational parameters during events, simultaneous monitoring of all input or output parameters, callout capabilities, support for multi-channel digital strip chart functionality and .2 msec data logging capabilities.
- H. In addition to standard NFPA 110 alarms, the application loads should also be protected through instantaneous and steady state protective settings on system voltage, frequency, and power levels.
- I. The control system shall provide pre-wired customer use I/O: 4 relay outputs (user definable functions), communications support via RS232, RS485, or an optional modem. Additional I/O must be an available option.
- J. Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. In addition, custom ladder logic functionality inside the generator controller shall be supported to provide application support flexibility. The ladder logic function shall have access to all the controller inputs and customer assignable outputs.
- K. The control panel will display all user pertinent unit parameters including: engine and alternator operating conditions; oil pressure and optional oil temperature; coolant temperature and level alarm; fuel level (where applicable); engine speed; DC battery voltage; run time hours; generator voltages, amps, frequency, kilowatts, and power factor; alarm status and current alarm(s) condition per NFPA 110 level 1.
- L. The control panel shall display all pertinent unit parameters including:
 - 1. Generator Status
 - 2. Current unit status in real time
 - 3. Engine operating conditions
 - 4. Real time readouts of the engine and alternator values
 - a. Oil pressure and optional oil temperature

- b. Coolant temperature and level
- c. Fuel level (where applicable)
- d. Engine speed
- e. DC battery voltage
- f. Run time hours
- g. Generator voltages, amps, frequency
- h. Power factor
- 5. Generator Commands
 - a. Current engine start/stop status
- 6. Alarm Status
 - a. Current alarm(s) condition
 - b. Low or high AC voltage
 - c. Low or high battery voltage
 - d. Low or high frequency
 - e. Pre-low or low oil pressure
 - f. Pre-high or high oil temperature (optional)
 - g. Low water level and temperature
 - h. Pre-high or high engine temperature
 - i. High, low and critical low fuel levels (where applicable)
 - j. Overcrank
 - k. Over and under speed
 - 1. Unit not in "Automatic Mode"
- 7. Alarm Log
 - a. Memory of last twenty alarm events (date and time stamped)

2.09 ENGINE/ALTERNATOR PACKAGE

- A. The engine/alternator shall be isolated from the generator frame with rubber isolators. The packaging shall not require the addition of external spring isolators.
- B. Two mainline thermal magnetic [electronic LSI] circuit breakers carrying the UL mark shall be factory installed. The breakers shall be rated at 125 Amps. The line side connections are to be made at the factory. Output lugs shall be provided for load side connections.
- C. The generator shall include a unit mounted 120 volt convenience outlet.

2.10 ENCLOSURE

- A. The genset shall be packaged with a sound attenuating, weatherproof, [weather protective] enclosure.
- B. The enclosure shall be completely lined with sound deadening material. This material must be of a self-extinguishing design.
- C. The enclosure shall be made of steel with a minimum thickness of 14 gauge. The enclosure is to have hinged, removable doors to allow access to the engine, alternator and control panel. The hinges shall allow for door fit adjustment. Hinges and all exposed fasteners will be stainless steel or JS5000. The use of pop-rivets weakens the paint system and not allowed on external painted surfaces. Each door will have lockable hardware with identical keys.
- D. The enclosure shall be coated with electrostatic applied powder paint, baked and finished to manufacturer's specifications. The color will be manufacturer's tan standard.
- E. The enclosure shall utilize an upward discharging radiator hood. Due to concerns relative to radiator damage, circulating exhaust, and prevailing winds, equipment without a radiator discharge hood will not be acceptable.
- F. The genset silencer shall be mounted on the discharge hood of the enclosure. Due to architectural concerns, silencers mounted on the top of the generator enclosure are not acceptable. Gensets with silencers mounted inside the main generator compartment are acceptable only if the silencer is thermally wrapped to minimize heat stress on the surrounding components.
- G. The enclosure shall include a thermostatically controlled space heater designed to maintain the enclosure at 40 degrees F.
- H. The fuel tank shall include a fuel spill box with spill sensor, automatic overflow fill valve, and the normal vent elevated 12 feet above grade.

2.11 SPARE PARTS

- A. Provide two spare filters for each air, fuel, and oil.
- 2.12 AUTOMATIC TRANSFER SWITCH
 - A. The automatic transfer switch shall be furnished by the manufacturer of the enginegenerator set so as to maintain system compatibility and local service responsibility for the complete emergency power system. It shall be listed by Underwriter's Laboratory, Standard 1008 with circuit breaker protection. Representative production samples of the transfer switch supplied shall have demonstrated through tests the ability to withstand at least 10,000 mechanical operation cycles. One operation cycle is the electrically operated transfer from normal to emergency and back to normal. Wiring must comply with NEC table 373-6(b). The manufacturer shall furnish schematic and wiring diagrams for the particular automatic transfer switch and a typical wiring diagram for the entire system.
 - B. The automatic transfer switch shall be a 3 pole design rated for 125 amps continuous operation in ambient temperatures of -20 degrees Fahrenheit to +140 degrees Fahrenheit.

Main power switch contacts shall be rated for 600 V AC minimum. The transfer switch supplied shall have a minimum withstand and closing rating when fuse protected of 200,000 amperes. Where the line side overcurrent protection is provided by circuit breakers, the short circuit withstand and closing ratings shall be 25,000 amperes RMS. These RMS symmetrical fault current ratings shall be the rating listed in the UL listing or component recognition procedures for the transfer switch. All withstand tests shall be performed with the overcurrent protective devices located external to the transfer switch.

- C. The transfer switch shall be double throw construction, positively electrically and mechanically interlocked to prevent simultaneous closing and mechanically held in both normal and emergency positions. Independent break before make action shall be used to positively prevent dangerous source to source connections. When switching the neutral, this action prevents the objectionable ground currents and nuisance ground fault tripping that can result from overlapping designs. The transfer switch shall be approved for manual operation. The electrical operating means shall be by electric solenoid. Every portion of the contactor is to be positively mechanically connected. No clutch or friction drive mechanism is allowed, and parts are to be kept to a minimum. This transfer switch shall not contain integral overcurrent devices in the main power circuit, including molded case circuit breakers or fuses.
- D. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching. Maximum electrical transfer time in either direction shall be 160 milliseconds, exclusive of time delays. Main switch contacts shall be high pressure silver alloy with arc chutes to resist burning and pitting for long life operation.
- E. All control equipment shall be mounted on the inside of the cabinet door in a metal lockable enclosure with transparent safety shield to protect all solid state circuit boards. This will allow for ease of service access when main cabinet lockable door is open, but to prevent access by unauthorized personnel. Control boards shall have installed cover plates to avoid shock hazard while making control adjustments. The solid state voltage sensors and time delay modules shall be plug-in circuit boards with silver or gold contacts for ease of service.
- F. A solid state undervoltage sensor shall monitor all phases of the normal source and provide adjustable ranges for field adjustments for specific application needs. Pick-up and drop-out settings shall be adjustable from a minimum of 70% to a maximum of 95% of nominal voltage. A utility sensing interface shall be used, stepping down system voltage of 277/480 VAC 3 phase to 24 VAC, helping to protect the printed circuit board from voltage spikes and increasing personnel safety when troubleshooting.
- G. Signal the engine-generator set to start in the event of a power interruption. A set of contacts shall close to start the engine and open for engine shutdown. A solid state time delay start, adjustable, .1 to 10 seconds, shall delay this signal to avoid nuisance start-ups on momentary voltage dips or power outages.
- H. Transfer the load to the engine-generator set after it reached proper voltage, adjustable from 70-90% of system voltage, and frequency, adjustable from 80-90% of system

frequency. A solid state time delay, adjustable from 5 seconds to 3 minutes, shall delay this transfer to allow the engine-generator to warm-up before application of load. There shall be a switch to bypass this warm-up timer when immediate transfer is required.

- I. Retransfer the load to the line after normal power restoration. A return to utility timer, adjustable from 1-30 minutes, shall delay this transfer to avoid short term normal power restoration.
- J. The operating power for transfer and retransfer shall be obtained from the source to which the load is being transferred. Controls shall provide an automatic retransfer of the load from emergency to normal if the emergency source fails with the normal source available.
- K. Signal the engine-generator to stop after the load retransfers to normal. A solid state engine cooldown timer, adjustable from 1-30 minutes, shall permit the engine to run unloaded to cooldown before shutdown. Should the utility power fail during this time, the switch will immediately transfer back to the generator.
- L. Provide an engine minimum run timer, adjustable from 5-30 minutes, to ensure an adequate engine run period.
- M. Provide a solid state plant exercise clock. It must allow selection of any combination of days of the week and the time of day for the generator set exercise period. Clock shall have a one week cycle and be powered by the load side of the transfer switch. A battery must be supplied to maintain the circuit board clock operation when the load side of the transfer switch is de-energized. Include a switch to select if the load will transfer to the engine-generator set during the exercise period.
- N. The transfer switch shall have a time delay neutral feature to provide a time delay, adjustable from .1-10 seconds, during the transfer in either direction, during which time the load is isolated from both power sources. This allows residual voltage components of motors or other inductive loads (such as transformers) to decay before completing the switching cycle. A switch will be provided to bypass all transition features when immediate transfer is required.
- O. The transfer switch shall have an in-phase monitor which allows the switch to transfer between live sources if their voltage waveforms become synchronous within 20 electrical degrees within 10 seconds of transfer initiation signal. A switch must be provided to bypass this feature if not required.
- P. If the inphase monitor will not allow such a transfer, the control must default to time delay neutral operation. Switches with inphase monitors which do not default to time delay neutral operation are not acceptable.
- Q. Front mounted controls shall include a selector switch to provide for a NORMAL TEST mode with full use of time delays, FAST TEST mode which bypasses all time delays to allow for testing the entire system in less than one minute, or AUTOMATIC mode to set the system for normal operation.

- R. Provide bright lamps to indicate the transfer switch position in either UTILITY (white) or EMERGENCY (red). A third lamp is needed to indicate STANDBY OPERATING (amber). These lights must be energized from utility or the engine-generator set.
- S. Provide manual operating handle to allow for manual transfer. This handle must be mounted inside the lockable enclosure so accessible only by authorized personnel.
- T. Provide a safety disconnect switch to prevent load transfer and automatic engine start while performing maintenance. This switch will also be used for manual transfer switch operation.
- U. Provide LED status lights to give a visual readout of the operating sequence. This shall include utility on, engine warm-up, standby ready, transfer to standby, in-phase monitor, time delay neutral, return to utility, engine cooldown and engine minimum run. A "signal before transfer" lamp shall be supplied to operate from optional circuitry.
- V. The transfer switch mechanism and controls are to be mounted in a NEMA 1 enclosure.
- W. Provide an NFPA 110/99 compliant alarm annunciator panel for remote indication. The panel shall have an ALARM switch that when moved to the OFF position silences the audible alarm. A TEST/RESET switch must be included to verify the lights are functional and reset any condition after it has cleared. The annunciator shall be controlled using RS485 communications from the generator controller. Annunciators requiring individual contacts and wires per indication point are not preferred.
- X. Provide a remote annunciator panel to be located in the fire control room that meets the monitoring requirements of the IBC and supports running the generator remotely.

PART 3 - ADDITIONAL PROJECT REQUIREMENTS

- 3.01 FACTORY TESTING
 - A. Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:
 - 1. Verify voltage & frequency stability.
 - 2. Verify transient voltage & frequency dip response.
 - 3. Load test the generator for 30 minutes.
 - B. Applications with NEC 700 emergency loads are generally required to comply with the installation and acceptance requirements of NFPA 110, section 7.13.
 - C. Load testing to be performed at rated power factor.
- 3.02 OWNER'S MANUALS
 - A. Three hard copy (3) sets and one (1) electronic set of owner's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

3.03 INSTALLATION

A. Contractor shall install the complete electrical generating system including all external fuel connections in accordance with requirements of NEC, NFPA, and the manufacturer's recommendations as reviewed by the Engineer.

3.04 SERVICE

A. Supplier of the genset and associated items shall have permanent service facilities within 125 miles of the installation site. These facilities shall comprise a permanent force of certified factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the owner maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

3.05 WARRANTY

- A. The standby electric generating system components, complete genset and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of five (5) years. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for parts, labor and travel. Warranty shall include both generator system and automatic transfer switch.
- B. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

3.06 STARTUP AND CHECKOUT

- A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:
 - 1. Ensuring the engine starts (both hot and cold) within the specified time.
 - 2. Verification of engine parameters within specification.
 - 3. Verify no load frequency and voltage, adjusting if required.
 - 4. Test all automatic shutdowns of the engine-generator.
 - 5. Perform a load test of the electric plant using a portable load bank sized for 100% of generator capacity. Load test shall include 1 hour at 25% load, 1 hour at 50% load and 2 hours at 100% load. Records shall be kept at 15 minute intervals, recording minimum engine generator parameters of coolant temperature, oil pressure, generator AC kw, AC amperes, AC voltage, AC frequency.

3.07 TRAINING

- A. Perform a load test for 1.5 hours using building load. In addition to the building load test, load the generator at 30% for 30 minutes, 50 % for 30 minutes, and 100% for 60 minutes.
- B. Training is to be supplied by the start-up technician for the end-user during commissioning. The training should cover basic generator operation and common generator issues that can be managed by the end-user.

END OF SECTION 26 32 13

SECTION 26 51 00 LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section covers furnishing and installation of all light fixtures and lamps indicated on the drawings or specified herein.

1.02 STANDARDS AND CODES

- A. All materials and equipment specified herein shall, within the scope of UL Examination Services, be approved by the Underwriter's Laboratories for the purpose for which they are used and shall bear the UL label.
- B. All materials and equipment specified herein shall conform with all applicable NEMA, ANSI, and IEEE standards.
- C. All materials and equipment specified herein and their installation methods shall conform to the latest published version of the National Electric Code.
- 1.03 SUBMITTALS
 - A. Submit catalog data showing material information and conformance with specifications. The intended use of each item shall be indicated.

PART 2 - PRODUCTS

2.01 LIGHT FIXTURES

- A. Fixture Schedule: Provide in accordance with the Lighting Fixture Schedule, as shown on the drawings.
- B. The fixture catalog numbers listed in the fixture schedule indicate manufacturer, fixture design, quality of design and manufacture, appearance, features, and options required. Lighting fixtures specified will be the basis for comparison in the consideration of fixtures of other manufacturers. Fixtures of lesser quality shall not be considered equivalent.
- C. Contractor shall investigate ceiling construction and supply fixtures designed for the application.
- D. All fixture component parts shall be manufactured and/or assembled at the manufacturing plant for shipment. The shipment from the fixture manufacturer shall include integrally mounted and/or remote mounted ballasts, where ballasts are required for the proper operation of the fixture lamps.

2.02 HARDWARE

A. The Contractor shall provide any necessary hardware for mounting fixtures. The mounting hardware shall be made of materials suitable for the environment installed.

Provide materials made from aluminum, non-metallic, or stainless steel in outdoor, damp, or corrosive areas. Enclosures for lighting contactors shall be NEMA rated for the environment in which they are installed. In general, devices installed indoors shall be in NEMA 1 enclosures, and devices installed outdoors shall be in NEMA 3R enclosures.

2.03 BALLASTS

- A. Ballasts shall be of the high power factor type. All ballasts shall be rated for a degree C operation and be equipped with automatic resetting protective devices in accordance with UL requirements.
- B. Ballasts for use in fluorescent fixtures shall be energy efficient GE Maxi-Miser II ballasts or equivalent. Ballasts must be electronic solid state. Magnetic ballasts are not acceptable. Ballasts must have less than 10% total harmonic distortion (THD).

2.04 LAMPS

- A. Provide all lamps as specified. Refer to the Lighting Fixture Schedule on the drawing for the ordering information of lamps. Fluorescent lamps shall be energy efficient GE Watt-Miser II or as otherwise indicated. Approved manufacturers are: WESTINGHOUSE, SYLVANIA and GE. Lamps shall be provided for all lighting fixtures.
- B. General Use Incandescent Lamps and Incandescent Reflector Lamps are prohibited. Use LED retrofit lamps or LED luminaires in lieu of incandescent or halogen luminaires. LED retrofit lamps shall be:
 - 1. Rated for the voltage of the incandescent lamp/luminaire they are replacing.
 - 2. Dimmable where required as indicated on the plans.
 - 3. Rated for the luminaire in which they are being installed. Verify whether the luminaire is enclosed and whether the LED retrofit lamp is rated for enclosed luminaires and the temperatures that will be encountered.
 - 4. LED lamps/luminaires shall provide delivered footcandles equal to or greater than the footcandles provided by an equivalent incandescent lamp/luminaire.
 - 5. LED retrofit lamps shall have an average rated life of 25,000 hours, minimum.
 - 6. Lamp color temperature shall be nearly equal to the incandescent lamp it is replacing.
 - 7. All lamps shall be new.

2.05 LED LUMINAIRES

- A. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category are:
 - 1. Minimum Light Output.

- 2. Zonal Lumen Requirements.
- 3. Minimum Luminaire Efficacy.
- 4. Minimum CRI.
- 5. L70 Lumen Maintenance.
- 6. Minimum Luminaire Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- B. LED Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).
- C. Glare Control: Exterior luminaires shall meet DesignLights Consortium's® criteria for Zonal Lumen Distribution requirements or Backlight-Uplight-Glare (BUG) standards for exterior luminaires.
- D. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- E. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- F. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
- G. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
- H. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- I. Luminaire and driver shall be furnished from a single manufacturer to ensure compatibility.
- J. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.
- K. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).
- L. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- M. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- N. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.
- O. All luminaires shall be provided with knockouts for conduit connections.
- P. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

- Q. Provide all of the following data on submittals:
 - 1. Delivered lumens
 - 2. Input watts
 - 3. Efficacy
 - 4. Color rendering index.
- R. LED Luminaires used for Emergency Egress Lighting: The failure of one LED shall not affect the operation of the remaining LEDs.
- S. Emergency LED Luminaire Compatibility with Inverters: Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

2.06 LED DRIVERS

- A. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated on the luminaire schedule on the drawings.
- B. Minimum Warranty of 5 years (not pro-rated) to include LED driver and all LED components.
- C. Driver shall have a rated life of 50,000 hours, minimum.
- D. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.
- E. Driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.
- F. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
- G. Driver shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.
- H. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
- I. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.
- J. Provide all of the following data on submittals:
 - 1. Input watts
 - 2. Power Factor (pf)
 - 3. Crest Factor (cf) at full input power
 - 4. Total Harmonic Distortion (THD).

2.07 LED DIMMING DRIVERS

- A. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.
- B. Step-Dimming Drivers: Easily switched from 0% to 50% to 100% output power. Both switch-leg inputs shall control 50% of the luminaire's light output equally.
- C. Continuous Dimming Drivers: LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or "popcorn effect". "Popcorn effect" is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire. Continuous Dimming Drivers shall use 0-10V control.
- 2.08 SPECIAL ACCESSORIES
 - A. Provide accessories such as junction boxes, plastic frames, stem, hangers, canopies, couplings, cords, toggle bolts, etc., necessary to mount the fixture in a proper and approved method.
- 2.09 OCCUPANCY SENSORS
 - A. Refer to the drawings for the occupancy sensor schedule and device locations. Devices shall be Watt Stopper, or approved equal.
- 2.10 EXPLOSION PROOF
 - A. Devices in explosion-proof environments shall be factory sealed, dust-ignition proof, and rated for hazardous locations where indicated on the Contract Drawings.

PART 3 - EXECUTION

3.01 FIXTURE MOUNTING

- A. The fixture supplier shall provide necessary hanging or mounting devices for all fixtures and shall be responsible for checking the type needed for various ceiling conditions.
- B. The Contractor shall see that all lighting fixtures designed to be installed throughout the project shall be of the correct size and design to properly suit the requirements of each area prior to ordering fixtures.
- C. Contractor shall install fixtures to avoid access hatches, sky-lights, rails, mechanical equipment, etc.
- D. The Contractor shall provide any additional hardware needed for installation of fixtures, including poles, clamps, brackets, screws, bolts, etc.
- E. Fixtures and other equipment installed in hazardous areas shall be rated for the environment. Provide fittings and seals per NEC.
- F. Pendant mounted lighting fixtures shall be supported by a flexible fixture hanger CROUSE-HINDS Type "AI" and shall have locking couplings, CROUSE-HINDS Type "COUP".

LIGHTING

- G. Properly support and align fixtures and provide all necessary steel shapes for support of the fixtures. Coordinate complete fixture installation with the facility construction. Clean and mount all lighting fixtures with new lamps immediately prior to final inspection.
- H. Square and rectangular fixtures shall be mounted with sides parallel to building lines and parallel with ceiling lines.
- I. Install fixtures as recommended by the manufacturer or as necessary to provide exact horizontal alignment, preventing horizontal or vertical deflection or angular jointing of fixtures installed in continuous rows.

3.02 CONTROL OF OUTDOOR FIXTURES

A. Outdoor light fixtures shall be controlled by means of a photocell and/or time clock, as specified in the written specifications above or in the drawings.

END OF SECTION 26 51 00

DIVISION 31 EARTHWORK

SECTION 31 00 00 EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This work is the excavation, trenching and backfilling for the placement of structures, utilities, equipment and appurtenances, handling and storing materials for fill and backfill, bracing, shoring, trench protection, subgrade preparation, final grading, site dressing and cleanup.
- B. To the extent possible, reuse existing topsoil and other materials excavated from the site.

1.02 REFERENCES

A. The most recent publication of all the following form a part of this specification:

AASHTO T99	Moisture-Density Relations fo Soils and Soil-Aggregate Mixtures Using 5-lb Rammer and 12" Drop
ASTM D698	Moisture-Density Relations fo Soils and Soil-Aggregate Mixtures Using 5-lb Rammer and 12" Drop
AASHTO T191 ASTM D1556	Density of soil in-place by the sand-cone method
AASHTO T310 ASTM D6938	In-Place density and water content of soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 ASTM C117	Materials finer than 0.075 mm (No. 200) sieve in mineral aggregates by washing
AASHTO T27 ASTM C136	Sieve analysis of fine and coarse aggregate
AASHTO T89	Determining the liquid limit of soils
AASHTO T90	Determining the plastic limit and plasticity index of soils
ASTM D4318	Test method for liquid limit, plastic limit and plasticity index of soils

1.03 RELATED DOCUMENTS

- A. The following documents and specification sections apply directly to this Section:
 - 1. Division 01 Section "Payment Procedures" for a schedule of unit prices;
 - 2. Division 01 Temporary Facilities and Controls;
 - 3. Division 02 Existing Conditions Site Clearing;

- 4. Division 02 Existing Conditions Dewatering;
- 5. Division 31 Site Clearing, Geotextiles;
- 6. Division 32 Exterior Improvements;
- 7. Division 33 Utilities;
- 8. Division 40 Process Interconnections

1.04 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Base Course: Layer placed between the subbase course and asphalt paving.
- C. Bedding Course: Layer placed over the excavated subgrade before installing structure.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Select Subgrade: Satisfactory soil imported from off-site for use between membrane liner and imported dike material.
- F. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, manholes, lagoon inlets, valve pits, lift stations, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Drainage fabric (if applicable);
 - 2. Separation fabric (if applicable);
 - 3. Stabilization fabric (if applicable).

- B. Samples: For the following:
 - 1. 30 lb samples, sealed in airtight containers, of each proposed soil material from onsite or borrow sources.
 - 2. 1 ft x 1ft samples of drainage fabric.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill;
 - 2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill;
 - 3. Liquid limit, plastic limit and plasticity of soils in accordance with AASHTO T89 and T90, respectively.

1.06 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

- 2.01 SOIL MATERIALS
 - A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
 - B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GM, GC, ML, SC, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, clayey soils, and other deleterious matter. <u>All liner subgrade and overlayment material shall consist of well-graded material free of organics, trash, clay-balls or other harmful matter. No sharp edged stones larger than three eights (¾) inch, nor any stones larger than three quarter (¾) inch diameter or hard objects shall be in contact with the liner material. The surface shall be compacted in accordance with project specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects.</u>
 - C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GP, MH, CL, CH, OL,

OH, and PT, or a combination of these group symbols.

- 1. Unsatisfactory soils also include satisfactory soils not maintained within 4 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed recycled concrete, and natural or crushed sand.
- F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed recycled concrete, and natural or crushed sand.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed recycled concrete, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1 ½ inch sieve and not more than 12 percent passing a #200 sieve.
- H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand having a maximum ³/₄ inch size and must be free draining and nonplastic.
- I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel having 100% passing the 1 ½ inch sieve and 0 to 10% passing the No. 10 sieve.
- J. Select Subgrade: Satisfactory soil materials, with no rocks larger than 2" in any dimension.

2.02 ACCESSORIES

A. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 - 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- 3.03 EXPLOSIVES
 - A. Blasting is not anticipated to be necessary for this project and will not be allowed.
- 3.04 EXCAVATION, GENERAL
 - A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.
 - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, notify geotechnical engineer and replace with satisfactory soil materials. No additional payment will be made for remedial action due to unsuitable soils.
 - 2. Meet OSHA requirements for excavations (including work performed in pre-existing excavated openings) and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

3.05 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 - 2. Pile Foundations: Stop excavations from 6 inches to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
 - 3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.

3.06 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.
- 3.07 APPROVAL OF SUBGRADE
 - A. Notify Engineer when excavations have reached required subgrade.

- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. No additional payment will be made for remedial action due to unsuitable soils.
- C. Proof roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.
- E. Subgrade and contact surface for membrane liners must be smooth and completely free of any protrusions that may penetrate the liner after installation. Subgrade must be approved by Engineer and Liner Manufacturer/Installer representative prior to installation of the liners.

3.08 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Engineer.
 - 1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.
- 3.09 STORAGE OF SOIL MATERIALS
 - A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
- 3.10 BACKFILL
 - A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 - 2. Inspecting and testing underground utilities.
 - 3. Removing concrete formwork.
 - 4. Removing trash and debris.
 - 5. Removing temporary shoring and bracing, and sheeting.
 - 6. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- 3.11 FILL
 - A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials,

obstructions, and deleterious materials from ground surface before placing fills.

- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under footings and foundations, use engineered fill.

3.12 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 4 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 4 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.14 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cutout soft spots, fill low spots, and trim high spots to comply with required surface

tolerances.

- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
- 3.15 FIELD QUALITY CONTROL
 - A. Testing: The Engineer will perform field quality-control testing. The Contractor may also engage the services of a qualified testing firm to perform field quality-control testing to verify the Engineer's testing results, at no additional cost to the OWNER.
 - B. Allow Engineer to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
 - C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Engineer.
 - D. Engineer and Contractor's independent firm (if applicable) will test compaction of soils in place according to ASTM D 2922. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 square feet or less of paved area or building slab, but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
 - 3. Utility Structures: At each compacted backfill layer, at least one test for every 100 square feet or less, but no fewer than one test per structure.
 - E. When Engineer's testing reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained. Contractor shall be responsible for the cost of repeat testing conducted by the Engineer.

3.16 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 31 00 00

SECTION 31 05 13 SOILS FOR EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.
- B. Related Sections include:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
- 1.02 SUBMITTALS FOR REVIEW
 - A. See Section 01 33 00 Submittals: Procedures for submittals.
 - B. Samples: In accordance with Section 01 40 00.
- 1.03 QUALITY ASSURANCE
 - A. Section 01 40 00 Quality Control: Field Samples.
 - B. Material Source: Provide materials from the same source throughout the Work. Change of source requires Engineer approval.

PART 2 - PRODUCTS

- 2.01 SUBSOIL MATERIALS
 - A. Subsoil: Uncontaminated excavated onsite material or imported borrow material. Graded free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
 - 1. Type A: See MPWSS, latest edition. Existing (Native) soil shall be considered a Type A.
 - 2. Type B: See MPWSS, latest edition.
 - 3. Type C: Non-used; All frozen material, vegetation, trash, rocks, and concrete and bituminous chunks having a dimension exceeding 3 inches.
- 2.02 TOPSOIL MATERIALS
 - A. Topsoil: Uncontaminated excavated onsite material or imported borrow material; Graded free of roots, rocks larger than ³/₄ inches, subsoil, debris, large weeds, and foreign matter.
 - 1. Imported or Re-used; Friable loam. Acidity range (pH) of 5.5 to 7.5 containing a minimum of 4 percent and a maximum of 25 percent organic matter. Conforming to

ASTM D2487 Group Symbol OL and OH.

- 2.03 SOURCE QUALITY CONTROL
 - A. Section 01 40 00 Quality Control: Testing and analysis of soil material.
 - B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698, ASTM D2922, and ASTM D3017.
 - C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D2487.
 - D. Provide materials of each type from same source throughout the Work.
 - E. Contractor to obtain and pay for services of soil classification technician from an independent geotechnical laboratory to monitor soils installed.

END OF SECTION 31 05 13

SECTION 31 10 00 SITE CLEARING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This work includes the identification, preparation, removal, stockpiling, salvage and disposal of existing surface materials at the project site which are impacted by or interfere with construction of the improvements.

1.02 RELATED DOCUMENTS

- A. The following documents and specification sections apply directly to this Section:
 - 1. Drawings and Special Provisions of the Contract;
 - 2. General and Supplementary Conditions;
 - 3. Division 01 General Requirements;
 - 4. Division 02 Existing Conditions;
 - 5. Division 31 Earthwork;
 - 6. Division 33 Utilities.

1.03 SUMMARY

- A. This Section includes, but not limited to, the following:
 - 1. Protecting existing trees and vegetation to remain.
 - 2. Removing trees and other vegetation as necessary.
 - 3. Clearing and grubbing.
 - 4. Topsoil stripping and stockpiling;
 - 5. Removing above-grade site improvements.
 - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 7. Disconnecting and removing site utilities.
- 1.04 DEFINITIONS
 - A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.05 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.
- 1.06 PROJECT CONDITIONS

SITE CLEARING

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 00 00 Earthwork; and 31 05 13 Soils for Earthwork.
 - 1. Obtain approved borrow soils materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TREE PROTECTION

- A. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
- B. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- C. Do not excavate within drip line of trees, unless otherwise indicated.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.
 - 1. Replace trees that cannot be repaired and restored to full-growth status, as determined by a qualified arborist.

3.03 UTILITIES

SITE CLEARING

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Owner will arrange to shut off any publicly-owned utilities indicated to be removed.
 - 2. Contractor shall arrange to shut off any privately-owned utilities with utility companies.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- 3.04 CLEARING AND GRUBBING
 - 1. Perform Clearing and Grubbing in accordance with 31 11 00.
- 3.05 TOPSOIL STRIPPING
 - Topsoil stripping and stockpiling shall be conducted in accordance with Section 31 14 13.
- 3.06 SITE GRADING
 - A. Rough-grade the site to provide positive drainage away from all construction elements and away from the site in such a manner that no damage to adjacent property will result from runoff.
 - 1. Project site shall be graded sufficiently smooth to provide access to all elements of construction.
- 3.07 SITE IMPROVEMENTS
 - A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
 - B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
- 3.08 DISPOSAL
 - A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property unless Contractor has made arrangements for onsite disposal.

END OF SECTION 31 10 00

SECTION 31 11 00 CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Protection of features not designated for removal.
 - 2. Site removals.
 - 3. Disposal of waste materials.
- B. Related Sections include:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 General Requirement Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.

1.02 REGULATORY REQUIREMENTS

- A. Conform to applicable codes and regulations for proper disposal of debris.
- B. Conform to applicable codes for worker safety.

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. Construction Fencing: Construction fencing shall be orange plastic mesh, heavy duty, snow fencing fastened to metal or wood posts.

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Verify that existing plant life designated to remain is tagged or identified.
 - B. Beginning work of this Section means acceptance of existing conditions.
 - C. Identify and furnish an area for storing or placing removed material prior to the commencement of Work in this Section.

3.02 PROTECTION

- A. Locate, identify, and protect utilities that remain from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Protect bench marks, survey control points, and existing structures from damage.
- D. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades and from flooding site and surrounding area.

- E. Contractor shall repair or replace, to original condition or better, existing structures and improvements, flora, and landscaping damaged or injured during construction operations. Contractor shall understand the sensitive nature of working on or near developed property and shall endeavor to limit injury or damage both inside the limits of construction and outside the limits of construction.
- F. Protect existing trees and other vegetation indicated to remain from unnecessary cutting, breaking, skinning of roots, skinning and bruising of bark, smothering of trees, by stockpiling construction materials or excavated materials within the drip line, excess foot of vehicular traffic, or parking of vehicles within drip line.
- G. Protect wetlands, rivers, streams, and other waters of the state from all construction activities and contamination by erosion and runoff.
- H. Protect areas that have been finish graded from subsequent construction operations, traffic, and erosion. Remove, provide new, and compact as required, material contaminated by erosion and runoff
- 3.03 WORK BY OTHERS
 - A. Sod in areas to be disturbed will be removed by others prior to commencement of earthwork activities.

3.04 CLEARING

- A. Clear areas required for access to site and execution of Work.
- 3.05 GRUBBING
 - A. Shall conform to Montana Department of Transportation (MDT) Standard Specifications for Road and Bridge Construction (2014 edition). Section 201.03.1 shall be followed except as specified below and absolutely no burning will be allowed.
 - 1. Grubbing operations may be completed by removal of stump section or by grinding
 - 2. Remove stumps, logs, roots, and other organic matter located within proposed pavements and structures to the depth indicated:
 - a. Gravel or paved surface: 48" below surface grade.
 - b. Grass areas: 12" below surface grade
 - c. Other structures or utilities: 36" below existing ground or finish grade, whichever is lower.
 - B. Depressions resulting from grubbing operations shall be backfilled in accordance with other sections in Division 31.

3.06 DISPOSAL OF WASTE MATERIALS

A. Remove all clearing and grubbing debris from the site in accordance with the Contract Documents and all permits and regulations. Burning shall not be allowed on Owner's property.

END OF SECTION 31 11 00

CLEARING AND GRUBBING

SECTION 31 11 10 REMOVAL OF EXISTING PAVEMENT, CONCRETE CURB, SIDEWALK, DRIVEWAY, AND/OR STRUCTURES (Reference MPWSS Section 02112)

All applicable portions of MPW Standard Specification Section 02112 shall apply with the following additions, deletions, and/or modifications.

PART 3 - EXECUTION

Delete the last sentence of 3.1.C and add the following:

Edges on all concrete and asphalt shall be straight lines and vertical cuts made with a saw. Concrete shall be cut with a saw to a depth of 4 inches minimum. Section deeper than 4 inches may be broken after cutting. Resulting face shall not be flatter than a 1:1 from vertical. Construction methods will not disturb the remaining concrete slabs.

All slabs to remain shall be replaced, if disturbed, at no cost to the owner.

Exercise care in removal of existing tree roots that conflict with the work. Tree roots shall be removed by saw-cutting the roots to a neat line at the extent of the excavation. Remove only the minimum amount of roots necessary in order to complete the work.

PART 4 - MEASUREMENT AND PAYMENT

DELETE: Entire Section and refer to Section 01 29 00

END OF SECTION 31 11 10

SECTION 31 14 13 SOIL STRIPPING AND STOCKPILING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Protection of features not designated for removal.
 - 2. Topsoil Removal.
 - 3. Stockpiling of Materials.
 - 4. Stockpile Cleanup.
 - 5. Estimated Excess Material Volumes.
- B. Related Sections include:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 General Requirement Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.

1.02 DESCRIPTION

- A. Limits of construction are shown on the Drawings. Excavation shall not be allowed outside of the limits of construction where shown on the Drawings.
- B. Materials may be temporarily stockpiled on the site within the limits of construction or where shown on the Drawings.
- C. Protect benchmarks and existing structures that are to remain from damage or displacement.
- 1.03 FIELD MEASUREMENTS
 - A. Verify that survey benchmark and intended elevations for the Work are as indicated.
- 1.04 DEFINITIONS
 - A. Soil Testing Laboratory: Refers to a professional soils engineering firm with soil sampling and testing services that is independent from the Contractor.
 - B. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.
- 1.05 SITE CONDITIONS
 - A. Soil borings were taken for this project by Pioneer Technical Services, Inc. The Geotechnical Investigation Report and associated Addenda are included in Appendix C of this Project Manual.

- B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.
- D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- F. Do not commence construction of structure foundation until soil test results are confirmed.
- 1.06 ADDITIONAL PAYMENT
 - A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.
 - B. No claim for additional payment will be accepted for excavation and fill for all or improvements required for removal of unsuitable material up to three (3) feet below bottom of proposed foundation or one (1) foot below bottom of noted geosynthetically reinforced structural fill or one (1) foot below minimum excavation limit or as noted on the Drawings, whichever results in the greater excavation and fill.
 - C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.
 - D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

- 3.01 INSPECTION
 - A. Contractor shall verify which native materials are suitable for reuse at the site. Provide testing data as required and keep materials separated.

- B. Notify Engineer of any unsuitable materials.
- 3.02 PROTECTION
 - A. Protect all existing structures, trees, plantings, turf, and other facilities which are not scheduled for removal.
- 3.03 TOPSOIL REMOVAL
 - A. All topsoil shall be stripped to full depth and stockpiled separately to be placed on top of finished grading and all disturbed areas not covered by structures or pavement. Remove all heavy growths of grass prior to stripping topsoil.
 - B. Separate all debris, large roots, and rocks greater than one (1) inch from the topsoil and remove from the site in accordance with all applicable Federal, State, and Local regulations to Contractor furnished site.
 - C. Where trees are to be left standing, stop topsoil stripping a sufficient distance (at least the drip line) from a tree to prevent damage to main root system.

3.04 STOCKPILING OF MATERIALS

- A. Contractor may temporarily stockpile acceptable materials including topsoil, excess excavated, and delivered materials within the limits of construction where shown on the Drawings. Contractor shall obtain approval from Engineer before stockpiling excess materials.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Apply appropriate erosion control measures to stockpile areas.
- F. Avoid stockpiling in location of future levee or berm around the site.
- G. Contractor shall remove all excess stockpiles from the site prior to substantial completion of the project.
- 3.05 STOCKPILE CLEANUP
 - A. Remove stockpile; leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.
 - B. Restore stockpile area in accordance with Section 32 90 00.
 - C. Temporary Stockpile Area:
 - 1. Contractor shall place material from excavations onsite in the area designated on the plans.

END OF SECTION 31 14 13

SOIL STRIPPING & STOCKPILING

SECTION 31 22 00 GRADING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements and procedures for site grading including, but not limited to, the following:
 - 1. Rough Grading
 - 2. Finish Grading
 - 3. Topsoil Placement
- B. Related Sections include:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 General Requirement Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.

1.02 DESCRIPTION

- A. Contractor shall grade the site as shown on the Drawings. Contours and spot elevations indicate finished surface grades.
- B. Construct uniform slopes between contours and spot elevations.
- C. Limits of construction are shown on the Drawings as indicated by the fencing boundary. Excavation, placement of fill, or general grading shall not be allowed outside of the limits of construction where shown on the Drawings.
- D. Materials may be temporarily stockpiled on the site within the limits of construction or where shown on the Drawings.
- E. Topsoil removal and rough grading of the site shall be completed prior to structure erection.
- F. Perform finish grading and topsoil placement after structure erection.
- G. Protect benchmarks and existing structures that are to remain from damage or displacement.
- H. All earthwork shall be performed in a manner and sequence that will provide drainage and proper erosion control at all times.
- 1.03 FIELD MEASUREMENTS
 - A. Verify that survey benchmark and intended elevations for the Work are as indicated.
 - B. Contractor shall utilize a licensed surveyor to provide grading layout, elevations, staking

and all necessary offsets.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil: Type S4 as specified in Section 31 05 13.
- B. Subsoil Fill: Type S1 or S2 as specified in Section 31 05 13.
- C. Engineered Fill: Type A4 as specified in Section 32 05 16.
- D. Aggregate Base and Surface Course: Type A3 and A2 respectively as specified in Section 32 05 16 and shown on drawings.
- E. Provide source testing data in accordance with Section 01 40 00.
- 2.02 SOURCE QUALITY CONTROL
 - A. Conduct the following tests on each material proposed for use prior to start of soils work. Refer to Section 01 40 00 for source test requirements.

PART 3 - EXECUTION

- 3.01 INSPECTION
 - A. Verify structure and trench backfilling have been inspected.
 - B. Verify subgrade base has been contoured and compacted.
- 3.02 PROTECTION
 - A. Contractor shall conduct all grading operations within the limits of construction where shown on the Drawings, and within the designated grading limits as shown from contours and spot elevations.
 - B. Protect all existing structures, trees, plantings, turf, and other facilities which are not scheduled for removal
 - C. Provide proper erosion and sediment control for all grading operation.
 - D. Repair disturbed areas and compact to required density prior to further work.
 - E. Remove material contaminated by erosion and runoff, provide new material and compact.

3.03 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, and stones in excess of 2 inches in size. Remove subsoil contaminated with petroleum products.
- C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.
- 3.04 ROUGH GRADING
 - A. Uniformly grade areas within limits of grading under this Section, including adjacent

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transition areas. Smooth finish surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

- B. Grade surface of fill under structures and slabs to required density, free of voids, and to required elevations.
- C. Rough grade areas adjacent to structure lines to drain away from structures and to prevent ponding or increase in soil lateral pressure on the structure.

3.05 FINISH GRADING

A. Contractor shall provide the degree of finish grading that will be normally obtainable through the use of suitable equipment operated under favorable conditions and by an experienced operator. Deviations from the required tolerance shall be corrected by the Contractor at no additional cost to the Owner.

3.06 TOPSOIL PLACEMENT

- A. Place topsoil in areas where seeding and restoration is required to a nominal depth of 6 inches. Place topsoil during dry weather.
- B. Use imported topsoil as a supplement to stockpiled topsoil only when a 6 inch depth is unable to be maintained.
- C. Drag topsoiled areas to remove wheel tracks and provide a uniform texture and appearance.
- D. Place fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade. Finish grades shall allow for proper drainage without ponding.
- E. Remove roots, weeds, rocks, and foreign material while spreading.
- F. Manually spread topsoil close to plant life and buildings to prevent damage.
- G. Lightly compact placed topsoil.
- H. Remove surplus subsoil and topsoil from site. Contractor shall pay for loading, hauling, and spreading of all excess topsoil materials removed from the site or placed and spread on-site by direction of Owner or Engineer.
- I. Contractor shall pay for additional topsoil that is required at the site, including providing transporting and placing topsoil.
- J. Leave stockpile area and site clean and raked, ready to receive landscaping.
- 3.07 TOLERANCES
 - A. Surface of Topsoil: Plus or minus 1 inch.

END OF SECTION 31 22 00

SECTION 31 22 10 GRAVEL ROADWAY AND SHOULDERS

PART 1 - GENERAL

The work covered by this section of the specifications shall consist of furnishing, placing, watering, shaping and compacting gravel to provide a firm and stable roadway and parking lots or driveway. Existing gravel roadways, driveways and parking lots disturbed during construction shall be replaced with gravel as noted on the drawings. The typical section for gravel shall be as shown on Sheet GC-21 of the project drawings. Minor surface repairs shall be made with crushed gravel surface course only at no cost to the Owner.

END OF SECTION 31 22 10

SECTION 31 23 13 SUBGRADE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Scarifying, compacting and shaping the earth subgrade.
 - 2. Perform subgrade preparation on all areas to receive concrete pavement, bituminous pavement, aggregate base course, and/or aggregate surface course.
- B. Related Sections:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections

PART 2 - PRODUCTS

2.01 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to approval of the Engineer.
- B. Suitable Soil Materials: On-Site excavated material or imported material meeting subsoil classification S1, S2, or S3 as defined in Section 31 05 13, free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. The contractor shall follow the recommendations as provided in the September 2019 Montana State Hospital WWTP Geotechnical Report by Pioneer Technical Services, Inc. The Geotechnical Investigation Report and associated Addenda are included in Appendix C of this Project Manual.
 - B. Subgrade Preparation shall consist of producing a firm and stable subgrade prior to placement of the surface or base course.
- 3.02 SUBGRADE PREPARATION
 - A. The Contractor shall compact and shape the subgrade for its full width as may be necessary to produce, at the time the base course is placed, the required density in the upper 12-inches of the base and the required grade and cross-section.
 - B. If areas are encountered that cannot be compacted, sub-excavate unstable materials and

SUBGRADE PREPARATION

replace with materials that can be compacted.

- C. Contractor shall be responsible for drying the subgrade soil or applying water as may be necessary to obtain the required density. Contractor shall also be responsible for grading the Work area and providing drainage so that accumulating water will drain away from the subgrade.
- D. The finished subgrade surface shall be smooth and uniform and shall not rut, shove, flex, or displace when any construction equipment is placed on it.
- E. The required grade and cross-section for subgrades shall consist of a smooth subgrade surface that conforms to the prescribed elevations for the particular subgrade being prepared, prior to constructing an additional course thereon. The required grade and cross-section for rough graded surfaces shall consist of a smooth graded surface that conforms to the prescribed elevations for that particular rough grade being prepared. The prescribed elevation for any point on the subgrade or rough graded surfaces shall be as determined from the grades staked by the Engineer.
- F. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations, vehicular traffic, or weather conditions.
- G. Subgrade preparation shall apply to all mat foundations, pipe trenches, concrete slabs, paved and graveled areas, including roads, driveways, parking areas, and sidewalks.
- H. Testing requirements for subgrade preparation shall be as follows:
 - 1. Shall conform to requirements of Section 01 40 00.

3.03 SPECIAL REQUIREMENTS

- A. Only hand-operated compaction equipment should be used within 5 feet of walls.
- B. Final subgrade elevation improvements for mat foundations should be smoothed using a vibratory plate, care shall be taken to prevent pumping of subgrade.

3.04 TOLERANCES

A. Finish subgrade or rough graded surfaces shall not deviate by more than 1 inch from the required section and grade.

END OF SECTION 31 23 13

SECTION 31 23 16 EXCAVATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for Excavation.
 - 2. Subgrade Preparation.
 - 3. Common Excavation.
 - 4. Structural Excavation.
 - 5. Estimated Excavation Quantities.
 - 6. Disposal.
- B. Related Sections:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. Montana Public Works Standard Specifications (MPWSS), latest edition.
- 1.03 SUBMITTALS
 - A. Submit the following in accordance with Section 01 33 00:
 - 1. Test Results: Prior to start of work, submit written reports for each material sampled and tested. Include project identification, date of report, name of contractor, name of testing laboratory, source of material, manufacturer and brand name for manufactured products, specification requirements for each material, and corresponding test results.
 - a. Tests must have been taken no more than 180 calendar days before Notice to Proceed.
 - 2. Product Data: Information on manufactured products indicating compliance with requirements of this Section.

1.04 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Structures: Existing and new construction, including slabs, buildings, tanks, and

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structural elements and systems.

- C. Acceptable Materials: Material that will provide for the indicated soil bearing capacity, soil densities, material requirements and that, in the opinion of soil testing laboratory, will not be subject to future decomposition, settlement, subsidence, expansion and are otherwise of the required soil type.
- D. Unsuitable Materials: Material that will not provide for the indicated soil bearing capacity and soil densities and that in the opinion of the soil testing laboratory will be subject to future decomposition, settlement, subsidence, expansion, and are otherwise not of the required soil type.
- E. Soil Testing Laboratory: Refers to professional soils engineering firm with soil sampling and testing services and that is independent from the Contractor. The soil testing laboratory's engineer shall be licensed in the State of Montana.
- F. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, topsoil removal, excavation to grade, and scarification and compaction of subgrade.

1.05 SITE CONDITIONS

- A. Soils data were collected for this project by Pioneer Technical Services and are reflected in the September 2019 Geotechnical Investigation Report included in Appendix C of these project documents.
- B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.
- D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- F. Do not commence construction of structure foundation until soil test results are confirmed.
- G. See Geotechnical Excavation Report by Pioneer Technical Services, Inc. for recommended soil bearing capacities for footings and structures.
- 1.06 CONVENTIONAL QUALITY ASSURANCE
 - A. Source Quality Control Testing: Retain the services of an independent soil testing

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laboratory for Source Quality Control sampling and testing.

- B. Materials and installed work may require testing and retesting, as required by Engineer, at any time during progress of work.
- C. Allow free access of testing laboratory to material stockpiles and facilities at all times.
- D. Tests including retesting of rejected materials and installed work shall be at Contractor's own expense unless otherwise indicated.
- E. See Section 01 40 00 for additional requirements.
- 1.07 SEQUENCING AND SCHEDULING
 - A. Additional excess material shall be stockpiled in accordance with Section 31 14 13.
- 1.08 DELIVERY, STORAGE, AND HANDLING
 - A. Stockpile delivered materials and excavated materials at locations approved by Owner until required for backfill or fill. Place, grade, and shape stockpiles for drainage.
 - B. Store materials in manner that will not impose additional loading and soil pressure on excavation limits and structures.
- 1.09 PAYMENT
 - A. All earth rock, peat, muck and all other excavation, removal and disposal required; erosion control, sheeting, shoring and bracing; fill and backfill; placement compaction, grading, source quality control testing, and all other work required under this Section shall be considered incidental to the Project and no claim for compensation or extra work will be accepted.
 - B. No claim for additional payment will be accepted for excavation and fill for all structures required for removal of unsuitable material of up to three (3) feet below bottom of foundation or one (1) feet below noted structural fill or backfill or one foot below minimum excavation limit as noted on Drawings, whichever results in the greater excavation and fill.
 - C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.
 - D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related problems.
- 1.10 FIELD MEASUREMENTS
 - A. Survey benchmarks, control points, and intended elevations for the Work are as shown on the Drawings or will be provided by the Engineer.
- 1.11 COORDINATION
 - A. Coordinate work under provisions of Section 01 31 13.

- B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.
- C. Contractor shall excavate for structures, pipe, and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 - PRODUCTS

- 2.01 EXCAVATION MATERIALS
 - A. See Sections 31 00 00 and 31 05 13 for materials specifications.
- 2.02 SOURCE QUALITY CONTROL
 - A. See Section 31 23 23 and Section 01 45 00 for material quality testing requirements.

PART 3 - EXECUTION

- 3.01 INSPECTION
 - A. Examine project site and conditions under which work of this Section is to be performed.
 - B. Contractor shall verify which native materials are suitable for reuse at the site. Provide testing data as required and keep materials separated.
 - C. Notify Engineer of any unsuitable materials.
 - D. Do not over excavate without authorization from Engineer.

3.02 PREPARATION

- A. An OSHA approved competent person shall review the above mentioned soil classification in the field. Excavations shall comply with the requirements of OSHA 29 CFR, Part 2926, Subpart P, "Excavations and Trenches." Excavation safety is the responsibility of the Contractor. All excavations greater than 20 feet in depth shall be designed by a registered Professional Engineer.
- B. Protection
 - 1. Locate existing utilities in areas of work. Protect utilities that are to remain.
 - 2. Protect structures from damage and from damage caused by groundwater, surface water, flood or floatation forces, lateral movement, settlement, undermining, washout, and other undesirable conditions created by the work.
 - a. Maintain drainage when drainage ways are obstructed by earthwork and related operations.
 - 3. Protect areas beyond construction zone with erosion control system.
 - 4. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when allowed by utility owner and then only after acceptable

temporary utility services have been provided.

- a. Provide temporary services, complying with Federal, State and local laws and regulations, and as acceptable to Owner, during any interruptions.
- 5. Maintain full access to structure exits and entrances, fire hydrants, street crossings, sidewalks, and other points as designated by Owner to prevent significant interruption of accessibility.
- 6. Do not bring explosives on site or use in work.
- 7. Maintain excavations and stockpiles to prevent caving, heaving, slides, and increased soil pressures on adjacent and underlying structures.
- 8. Maintain existing site drainage ways or provide new paths of drainage for site as required to perform earthwork.
- C. Dry subgrade: Add water, then mix to make moisture content uniform throughout.
- D. Wet subgrade: Aerate material by blading, discing, harrowing, or other methods to hasten drying process.
- E. Excavation support: Install and maintain, as specified in Section 31 41 00, Shoring, as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

3.03 PROTECTION

- A. Locate existing utilities in areas of work. Protect utilities that are to remain.
- B. Protect structures from damage and from damage caused by groundwater, surface water, flood or floatation forces, lateral movement, settlement, undermining, washout, and other undesirable conditions created by the work.
 - 1. Maintain drainage when drainage ways are obstructed by earthwork and related operations.
- C. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when allowed by utility owner and then only after acceptable temporary utility services have been provided.
 - 1. Provide temporary services, complying with Federal, State and local laws and regulations, and as acceptable to Owner, during any interruptions.
- D. Protect areas that have been finish graded from subsequent construction operations, traffic, and erosion.
 - 1. Install erosion control protection along perimeter of unfinished areas.
- E. Maintain full access to structure exits and entrances, fire hydrants, street crossings, sidewalks, and other points designated by Owner to prevent significant interruption of accessibility.
- F. Do not bring explosives on site or use in work.

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- G. Maintain excavations and stockpiles to prevent caving, heaving, slides, and increased soil pressures on adjacent and underlying structures.
- H. Repair disturbed areas and compact to required density prior to further work.
- I. Remove material contaminated by erosion and runoff, provide new material and compact.
- 3.04 COMMON EXCAVATION
 - A. Excavate designated areas to the proposed subgrade elevations indicated on the Drawings.
 - B. Contractor shall advise Engineer immediately if any unsuitable materials are encountered during excavation. Unsuitable materials shall be reasonably separated form unsuitable materials and shall be considered surplus material at no additional cost to the Owner.
 - C. If Contractor encounters excess excavation materials which meet the requirements of common fill as specified herein, Contractor may use those materials as common fill. Contractor shall verify with soils testing laboratory suitability of the use of on-site material.
 - D. Trench excavating shall be done in accordance with Section 31 23 33.

3.05 STRUCTURAL EXCAVATION

- A. Remove unsuitable materials in accordance to the depth recommended by soils testing laboratory beneath structures to obtain the design bearing capacity.
 - 1. Do not bear any structure partially on bedrock and partially on more compressible soils. Remove bedrock materials and replace them with clean compacted sand or gravel in accordance to the Geotechnical Report. The minimum depth of compacted sand or gravel is 6-inches.
 - 2. Do not bear any structure on wet sandy, clay or elastic silt material. Over-excavate unsuitable native materials below the: Screen Building; lift station; valve vault; Blower Building and Polishing Reactor including footings to a minimum 1H:2V projection from perimeter of these structures and replace with compacted granular fill (As Indicated on the Construction Drawings) compacted to the requirements in Section 01 40 00.
 - 3. Dewater as warranted in accordance with Contractor's approved dewatering plan, prior to initiating construction within any excavation.
 - 4. Provide an opportunity for the Engineer to properly inspect the bottom of any excavation and remove any soft spots or unsatisfactory soils that are observed.
 - 5. When bottoms of excavations are approved by soils testing laboratory, but are slightly unstable only in relation to Contractor operations or convenience, Contractor may provide a compacted gravel course utilizing materials acceptable to the soil testing laboratory. Such work shall be considered for the Contractor's convenience and at Contractor's own expense.
- B. Slope sides of excavations as required to provide stability and to comply with Federal,

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State and local laws and regulations. Shore and brace excavation when required by project conditions.

- 1. Utilize cofferdams, steel sheet piling, shoring, underpinning, and other systems required to prevent damage to existing structures, settlement, slope stability problems, and undermining.
- 2. Remove construction related protection systems after their need is complete, in a manner that will not loosen or damage soils, create slope stability problems, and otherwise damage existing and new structures.
 - a. Leave construction-related protection systems in place when their removal would create potential for damage to the soil conditions or to structures.
- C. Excavate to required elevations and dimensions within a tolerance of plus or minus 1 inch, and extending a sufficient distance as required to provide for the work, completion of the structures, observation, and testing.
 - 1. When excavating for footings and foundations, do not disturb soil materials at and below excavation limits. Excavate by hand when necessary to prevent damage to soil materials that will remain.
 - 2. Trim bottoms to required lines and grades to leave solid dense base of required bearing capacity.
 - 3. Final removal limits shall be approved by soil testing laboratory prior to concrete placement.
- D. Removal of materials beyond required subgrade elevations or dimensions without specific approval of soils testing laboratory as well as backfilling, compaction and remedial work recommended by soils testing laboratory at the over-excavated area shall be at Contractor's own expense.
 - 1. Under structures and their components fill unauthorized excavation utilizing one of the following systems:
 - a. Extend indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
 - b. Install lean concrete fill to bring elevations to required position.
 - c. Fill and compact unauthorized excavations with soil materials and to required density.
 - 2. Elsewhere, backfill and compact unauthorized excavations as indicated for authorized excavations of same classification
- E. Protect excavation bottoms from freezing. Remove frozen materials and provide unfrozen compacted materials prior to placement of materials on them.
- F. Excavations of structures shall be widened a minimum of one foot horizontally beyond the outer edges of the building perimeter footings for each foot the excavations extend below bottom-of-footing elevations.

- G. It is anticipated the excavation bottom for each structure will consist of sand soils, lean clay or a combination of both. These soils shall be maintained within the prescribed moisture content range until successive layers are placed over them. Thus, if the placement of backfill and fill is slowed or delayed during dry or wet weather, reconditioning of the placed backfill, fill and natural soils may be necessary.
- H. Prior to the placement of engineered fill or construction of structures, any loosened granular materials shall be surface compacted using a vibratory plate compactor. In areas where groundwater is within 3 feet of the subgrade this requirement may be waived in the field by the Engineer if it is found the compaction is pumping up water or creating a temporary "quick" condition and the soils are otherwise suitable for support of the foundations. Areas that yield or pump during surface compaction may require additional subcutting.

3.06 DISPOSAL

A. Excess soil, if any exists, shall be stockpiled on the site. Contractor shall remove unsuitable material such as muck, organic matter, trash, and refuse from the site and dispose of said material according to applicable Federal, State, and local regulations. No additional payment will be provided for off-site disposal.

END OF SECTION 31 23 16

SECTION 31 23 21 FILL AND BACKFILL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements and procedures for site grading including, but not limited to, the following:
 - 1. Filling, Backfilling, and Compacting.
- B. Related Sections include, but are not limited to:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
- 1.02 REFERENCES
 - A. Montana Public Works Standard Specifications (MPWSS) specifications are referenced for material requirements and specific construction requirements only.
- 1.03 DESCRIPTION
 - A. Limits of construction are shown on the Drawings. Placement of fill shall not be allowed outside the fence boundary where shown on the Drawings unless location is authorized by the Owner.
 - B. Materials may be temporarily stockpiled on the site within the limits of construction, or where shown on the Drawings.
 - C. Excess materials shall be stockpiled on site at locations authorized by Owner.
 - D. Protect benchmarks and existing structures that are to remain from damage or displacement.

1.04 DEFINITIONS

- A. Suitable Material: Material that will provide the indicated required soil bearing capacity, soil densities, material requirements or, in the opinion of the soils testing laboratory, will not be subject to future decomposition, subsidence, settlement, or expansion.
- B. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.
- C. Relative Compaction:
 - 1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D1557.
 - 2. Apply corrections for oversize material to either as-compacted field dry density or

maximum dry density, as determined by the Engineer.

- D. Optimum Moisture Content:
 - 1. Determined in accordance with ASTM standard specified to determine maximum dry density for relative compaction.
 - 2. Determine field moisture content on basis of fraction passing ³/₄-inch sieve.
- E. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.
- F. Complete Course: A course or layer that is ready for next layer or next phase of Work.
- G. Lift: Loose (uncompacted) layer of material.
- H. Well-Graded:
 - 1. A mixture of particle sizes with not specific concentration or lack thereof of one or more sizes.
 - 2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
 - 3. Use to define material type that, when compacted, produces a strong and relative incompressible soil mass free of detrimental voids.
- I. Influence Area: Are within planes sloped downward and outward at 60-degree angle from horizontal measured from:
 - 1. 1 foot outside outermost edge at base of foundations or slabs.
 - 2. 1 foot outside outermost edge at surface of roadways or shoulder.
 - 3. 0.5 foot outside exterior of spring line of pipes.
- J. Borrow material: Material from required excavations or from designated borrow areas on or near Site.
- K. Select Backfill Material: Materials available on-site that Engineer determines suitable for specific use.
- L. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- 1.05 SITE CONDITIONS
 - A. Soil borings were taken for this project by Pioneer Technical Services, Inc. The Geotechnical Investigation Report and associated Addenda are included in Appendix C of this Project Manual.
 - B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form

considered a part of this Contract.

- C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.
- D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- F. Do not commence construction of structure foundation until soil test results are confirmed.
- 1.06 SEQUENCING AND SCHEDULING
 - A. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 00, Cast-In-Place Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.
 - B. Backfill around water holding structures only after completion of satisfactory leakage tests as specified in Section 31 35 26.
 - C. Construction of grade-supported slabs shall not occur immediately after below- grade walls are backfilled, so that post-compaction consolidation of the compacted backfills can be monitored to estimate how much the slabs could settle. Monitoring shall include the placement of grade stakes around the structure that shall be monitored weekly after construction. Results shall be reviewed by the Engineer to evaluate the rate at which post-construction settlements will occur. Settlement is estimated to be complete in less than 90 days.
- 1.07 PAYMENT
 - A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.
 - B. No claim for additional payment will be accepted for excavation and fill for all structures and improvements required for removal of unsuitable material up to two (2) feet below bottom of proposed piping invert elevation or two (2) feet below bottom of noted structural fill or 6" below minimum excavation limit for earthwork as noted on the Drawings, whichever results in the greater excavation and fill.
 - C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.

- D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.
- 1.08 FIELD MEASUREMENTS
 - A. Verify that survey benchmark, control point, and intended elevations for the Work are as shown on Drawings or will be provided by the Engineer.
- 1.09 FIELD QUALITY CONTROL
 - A. Section 01 40 00 Quality Control: Field inspection and testing.
 - B. Compaction testing will be performed in accordance with ASTM D698, and ASTM D2922.
 - C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to Owner.
- 1.10 COORDINATION
 - A. Coordinate work under provisions of Section 01 31 00.
 - B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.
 - C. Contractor shall excavate for piping and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Backfill around Structures: Backfill shall be as indicated on the Construction Drawings.

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Identify required lines, levels, contours, and datum locations.
 - B. Notify utility company to locate utilities.
 - C. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
 - D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
 - E. Maintain and protect above and below grade utilities that are to remain.
 - F. Contractor shall verify which native materials are suitable for reuse as granular foundation, bedding, encasement, and backfill material at the site. Provide testing data as required and keep materials separated.
 - G. Notify Engineer of any unsuitable materials or poor subgrade conditions.

- H. Notify Engineer when structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
- I. Dewater excavations during backfilling at no cost to Owner.
- J. Dewater and dry saturated materials suitable for backfill at no cost to Owner.
- K. Compact subgrade to density requirements for subsequent backfill materials.
- L. Cut out soft areas of subgrade not capable of compaction in-place. Backfill with Type A or Type B fill and compact to density equal to or greater than requirements for subsequent fill material.
- M. Identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
- 3.02 STOCKPILING OF MATERIALS
 - A. Stockpile according to Section 31 14 13.
- 3.03 FILLING, BACKFILLING, AND COMPACTING
 - A. The contractor shall follow the recommendations as provided in the Geotechnical Report by Pioneer Technical, Inc.
 - B. Surface compact excavations prior to installing fill material.
 - C. Proof roll subgrade areas, where noted with, as a minimum, a tandem axle dump truck loaded to at least 25 ton weight. Truck shall traverse the structure footprint to detect areas of loose or soft soils. Loose or soft soils shall be defined as soils exhibiting "excessive rutting" from the truck tires (approximately one (1) inch wheel rut depth.
 - D. Do not place material on muddy surfaces, frozen ground or on materials containing frost or ice.
 - E. Do not place fill required below structures until soil conditions encountered have been approved by special inspector.
 - F. Slope grade away from structures minimum 2 inches in 10 feet, unless noted otherwise.
 - G. Do not place material on or in water.
 - H. Do not proceed with backfilling of excavations until completion of the following:
 - 1. Observation, testing, approval, and recording of locations of underground utilities.
 - 2. Removal of concrete formwork.
 - 3. Removal of shoring, bracing, other protection systems, and backfilling and compaction of voids left by their removals.
 - 4. Removal of unsuitable materials, construction related debris, and excess materials.
 - 5. Walls, including interior walls that brace exterior walls and intermediate floors and roof construction is installed, cured, and obtained required 28- day compressive strength.

- 6. When existing in-place soil materials are of density less than that specified, but the soil material is acceptable, perform removal, filling, discing of ground surface, moisture-conditioning to within acceptable limits of the optimum moisture content, and compact to provide specified density and bearing capacity as recommended by soils testing laboratory.
- I. Placement and Compaction
 - 1. Place materials in compacted layers of thickness required to obtain specified soil densities. Layers shall not exceed 8 inches in loose depth for cohesive and cohesionless soil material, respectively, compacted by heavy compaction equipment and not more than 8 inches in loose depth for cohesive and cohesionless soil materials, respectively, compacted by hand operated tampers unless soil density tests substantiate specified densities will be obtained when material is placed in thicker lifts.
 - 2. Place material in lifts uniformly to the same approximate elevation, not exceeding the final grade height, in manner required to prevent creation of unbalanced soil lateral pressures, wedging action of materials and soil pressures that exceed the design lateral soil conditions and to prevent damage to the structure.
 - 3. Moisten or aerate each layer to the extent required to obtain the optimum moisture content required for the indicated compaction density. Prevent free water from appearing on surface during or subsequent to compaction operations.
 - 4. Remove and replace with acceptable material, or scarify and air dry otherwise acceptable soil material that is too wet to obtain specified soil density. Assist drying by discing, harrowing, or pulverizing, until moisture content is reduced to value required for compaction.
 - 5. Compact each layer to the required density specified for each area classification. Hand tamp or utilize hand operated vibratory equipment when required to compact material placed immediately adjacent to walls within 5 feet.
 - 6. Do not place additional layers until density of each layer in place complies with compaction requirements. Perform corrective work as required to obtain required density. Cost associated with correction work and retesting at failed test locations shall be at Contractor's expense.
 - 7. At door stoops place sand cushion to cross-section indicated on Drawings.

3.04 EMBANKMENTS

- A. The contractor shall follow the recommendations as provided in the Geotechnical Report by Pioneer Technical, Inc.
- B. Strip all topsoil, roots, and organic vegetation from embankment footprint. Excavate to design grade.
- C. Dewater as warranted.
- D. Subgrade soils should be moisture conditioned to plus or minus 3 percentage points from

the optimum moisture content and compacted to a standard relative compaction of at least 95% as per ASTM D698.

- E. Engineer shall approve subgrade prior to constructing embankments. Excavate or recondition and compact soft spots or unsatisfactory materials that are observed.
- F. Where excavations are made in or to construct dikes, the backfill shall be placed in uniform lifts not exceeding 12" (twelve inches) **maximum** loose thickness, watered/dried to achieve optimum moisture content, and compacted to a minimum of 95% of the dry density as determined by ASTM D698 Standard Proctor Method.
- G. All areas of the embankments that are not covered by a road or liner shall have 4" (four inches) of topsoil and be seeded to prevent erosion.
- H. Uniformity of Backfill and Embankment
 - 1. All backfill and embankment material shall be selectively placed to provide a uniform consistency of material throughout the fill.
 - 2. A uniform moisture content shall be maintained at or near optimum throughout the fill to achieve maximum and uniform compaction.
 - 3. All soft, spongy areas shall be excavated and the unstable material shall be replaced with suitable material and compacted as required.
- I. Testing
 - 1. All backfill, fill and embankments shall be tested by the Contractor and will be subject to inspection and testing by the Engineer. No further work shall proceed until all tests and inspections have been satisfactorily completed. Access to the work shall be given when requested.
 - a. The Contractor is required to perform the compaction testing.
 - b. The Engineer will spot check compaction only to determine the level of effort required to meet the compaction requirements. These tests will not constitute proof that the Contractor is meeting the compaction level required.
 - 2. The following spot checks and inspections will be performed:
 - a. Compaction of structural backfill, leveling course, fill and embankments.
 - b. Materials quality.
 - c. Grade and surface smoothness.

3.05 REPLACING OVEREXCAVATED MATERIAL

- A. Replace excavation carried below grade lines shown or established by the Engineer as follows:
 - 1. Beneath Existing Footings: Concrete of strength equal to respective footing.
 - 2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
 - 3. Beneath Slabs on Grade: Aggregate fill.

- 4. Permanent Cut Slopes (Where overlying area is not to receive fill or backfill):
 - a. Flat to Moderate Steep Slopes (3:1 or flatter): Common fill.
 - b. Steep Slopes:
 - i. Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, providing such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities or competed Work.
 - ii. Backfilling overexcavated areas is prohibited, unless in Engineer's opinion, backfill will remain stable, and overexcavated material is replaced as compacted common fill.

3.06 PLACING FILL OVER GEOSYNTHETICS

- A. General:
 - 1. Place fill over geosynthetics with sufficient care so there is no damage.
 - 2. Place fill only by back dumping and spreading only.
 - 3. Dump fill only on previously placed fill.
 - 4. While operating equipment, avoid sharp turns, sudden starts and stops that could damage geosynthetics.
- B. Hauling: Operate hauling equipment with a minimum 3 feet of covering.
- C. Spreading:
 - 1. Spreading equipment shall be track mounted low ground pressure, D-3 or lighter.
 - 2. Operate spreading equipment on minimum of 12-inches of fill.
 - 3. Spread fill in same direction as unseamed overlaps to avoid separation.
 - 4. Limit distance material falls to maximum of 2 feet.
 - 5. Flatten wrinkles in direction of spreading.
 - 6. Maintain proper overlap of unseamed.
 - 7. Avoid overstressing material and seams.
- D. Geosynthetics Damage:
 - 1. Mark punctures, tears, or other damage, so repairs can be made.
 - 2. Clear overlying fill as necessary to repair damage.

3.07 COMPACTION REQUIREMENTS

- A. Compact materials as required in Section 01 40 00.
- B. Contractor shall re-compact all areas represented by failed density tests at their own expense.
- 3.08 TOLERANCES

- A. Finished Grade:
 - 1. Plus or minus 1 inch, upon completion of settlement in ditches, berms, and lawn areas.
 - 2. Plus or minus 1 inch upon completion of settlement in roadways and driveways.
- B. All areas that receive fill or backfill shall be kept within settlement tolerances through the warranty period.
- 3.09 PROTECTION OF FINISHED WORK
 - A. Protect finished Work under provisions of Section 01 50 00.
 - B. Reshape and re-compact fills subjected to vehicular traffic during construction.
- 3.10 SETTLEMENT
 - A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the Supplementary Conditions.
 - B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the Engineer or Owner, or sooner if required by Engineer or Owner, depending on the critical nature of the settlement.

3.11 SCHEDULE

- A. Beneath Landscaped Areas:
 - 1. Type A or B, to a minimum of 6 inches and a maximum of 18 inches below finish grade, compacted as specified in Section 01 40 00.
- B. Beneath Grit Channel, Lift Station, Polishing Reactor and Generator slab:
 - 1. Material: As indicated on the Construction Drawings and in Division 31.
 - 2. Compacted Thickness: Equal, continuous layers not exceeding 8 inches compacted thickness. In the upper 12 inches of soil below the structures place compacted lifts no greater than 8 inches.
 - 3. Place Geogrid and Goetextile fabric as shown in the Drawings.
 - 4. Compaction: As specified in Section 01 40 00.
- C. Beneath Concrete Slabs on Grade and Adjacent to Concrete Structures and for all pipe installations:
 - Material: As indicated on the Construction Drawings, Type A or B material per Section 31 05 13 unless otherwise indicated as granular material per Section 32 05 16 placed in compliance with the Drawings.
 - 2. Compacted Thickness: Equal, continuous layers not exceeding 8 inches compacted thickness. In the upper 12 inches of soil below the pavement place compacted lifts no greater than 8 inches.

- 3. Compaction: As specified in Section 01 40 00.
- D. Fill to Correct Over-excavation:
 - 1. Fill Type A, B as specified in Section 31 05 13, or granular material as specified in Section 32 05 16 as indicated on the Construction Drawings, flush to required elevation, compacted as specified in Section 01 40 00.
- E. Sub-base Preparation:
 - 1. As indicated on the Construction Drawings, Fill Type A or B as specified in Section 31 05 13, compacted in Section 01 40 00.
- F. Beneath Asphalt:
 - 1. Compact Subsoil as specified in Section 01 40 00.
 - 2. As indicated on the Construction Drawings, Fill Type A or B as indicated on the Construction Drawings, compacted as specified in Section 01 40 00.
- G. Topsoil Fill:
 - 1. See Section 31 05 13.

END OF SECTION 31 23 21

SECTION 31 23 33 TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Excavating trenches for utilities.
 - 2. Compacted bedding and fill of utilities to subgrade elevations.
 - 3. Backfilling and compaction requirements for trenches.
- B. Related Sections include, but are not limited to:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.

1.02 **DEFINITIONS**

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Soil Testing Laboratory: Refers to a professional soils engineering firm with soil sampling and testing services that is independent from the Contractor.
- C. Suitable Material: Material that will provide the indicated required soil bearing capacity, soil densities, material requirements or, in the opinion of the soils testing laboratory, will not be subject to future decomposition, subsidence, settlement, or expansion.
- D. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

1.03 SITE CONDITIONS

- A. Soil borings were taken for this project by Pioneer Technical Services, Inc. The Geotechnical Investigation Report and associated Addenda are included in Appendix C of this Project Manual.
- B. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- C. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.

- D. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- E. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- F. Do not commence construction of structure foundation until soil test results are confirmed.
- 1.04 ADDITIONAL PAYMENT
 - A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.
 - B. No claim for additional payment will be accepted for excavation of unsuitable material and fill for all structures and improvements to a depth of up to two (2) feet below bottom of proposed piping invert elevation or one (1) foot below bottom of noted structural fill or one (1) foot below minimum excavation limit as noted on the Drawings, whichever results in the greater volume of excavation and fill.
 - C. Excavation and fill required for removal of unsuitable material deeper than the above limits will be paid for on a time and materials basis if conditions found in the Geotechnical Report are found to differ from actual conditions experienced on site. No additional payment will be made for conditions reflected in the Geotechnical Report.
 - D. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.
- 1.05 FIELD MEASUREMENTS
 - A. Verify that survey benchmark, control point, and intended elevations for the Work are as shown on Drawings.
- 1.06 COORDINATION
 - A. Coordinate work under provisions of Section 01 31 13.
 - B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.
 - C. Contractor shall excavate for piping and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Granular materials provided for foundation, bedding, encasement, and backfill or other purposes shall consist of any natural or synthetic mineral aggregate such as sand, gravel, crushed rock, or slag that shall meet the gradation requirements specified herein for each specific use.
- B. Granular materials provided for foundation, bedding, encasement, or backfill use shall be classified by use in accordance with the following requirements.
- 2.02 GRANULAR FOUNDATION
 - A. Granular foundation (pipe bedding) shall be placed below the bottom of the pipe invert as replacement for unsuitable or unstable soils to provide better pipe support.
 - B. Granular foundation material shall be Type A5 aggregate material as specified in Section 32 05 16.

2.03 GRANULAR BEDDING

- A. Granular bedding shall be placed below the pipe midpoint, prior to pipe installation to facilitate proper shaping and achieve uniform pipe support. Minimum depth as indicated on the Construction Drawings. Place approved bedding material 4-inches under the pipe, around the pipe, and to a depth of 6- inches over the pipe.
- B. Granular bedding material shall meet the requirements of Part 2.1 of Section 02221 -Montana Public Works Standard Specifications – (April 2010 Edition) and as indicated on the Construction Drawings.

2.04 SELECT TYPE I BEDDING

- A. Select Type I Bedding may be placed from the springline of the pipe to 6" over the pipe for protection of the pipe.
- B. Select Type I Bedding material if utilized, shall meet the requirements of Part 2.1.B of Section 02221 - Montana Public Works Standard Specifications – (April 2010 Edition) and as indicated on the Construction Drawings.

2.05 TRENCH BACKFILL

A. Between the top of pipe bedding (6" over top of pipe) to subgrade elevation, the trench backfill material shall meet the requirements of Part 2.2 of Section 02221 and Standard Drawing 02221-1 of Montana Public Works Standard Specifications – (April 2010 Edition) and as indicated on the Construction Drawings. Native materials unsuitable for trench backfill include those that are highly plastic, saturated or contaminated.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, maintain, and protect utilities that remain from damage.
- C. Notify utility company to locate utilities.

- D. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- E. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Maintain and protect above and below grade utilities that are to remain.
- G. Contractor shall verify which native materials are suitable for reuse as granular foundation, bedding, encasement, and backfill material at the site. Provide testing data as required and keep materials separated.
- H. Notify Engineer of any unsuitable materials.
- I. Dewater trench and structure excavations at no cost to Owner.
- 3.02 EXCAVATING
 - A. Excavate topsoil in accordance with Section 31 14 13.
 - B. Excavate trench to alignment and grade as required to meet foundation and bedding requirements as specified. Trench shall be centered on pipe alignment and no more than 100 feet of trench should be excavated in advance of pipe laying operations.
 - C. The trench width may vary and depend on the depth of trench, the diameter of pipe to be laid, and the nature of the material to be excavated, but in any case shall be of ample width to allow the pipe to be laid and joined properly and the backfill to be placed and compacted properly. The minimum bottom width of unsheeted trench shall be 18 inches. The maximum clear width of trench at the top of the pipe shall be not more than 32 inches greater than the outside diameter of the pipe for pipes 30 inches diameter and larger, or 18 inches greater for pipe under 30 inches in diameter. Wider trench widths at the top of the pipe shall be subject to approval by Engineer. The width of the trench at the ground surface shall be kept to a minimum to prevent unnecessary disruption of service structures.
 - D. If the trench width at the pipe zone is excavated to a greater width than the maximum, the Engineer may require the Contractor to provide a higher class of bedding and/or higher strength pipe that that required by the Contract Documents in order to satisfy pipe design requirements. In such case, no additional compensation shall be made for the higher class bedding or higher strength pipe.
 - E. Trench excavation shall be made by open cut methods. Trench sides shall be as vertical as possible and the trench shall be braced, sheeted, and drained such that the work may be performed safely in accordance with OSHA requirements.
 - F. Sheeting, shoring, and bracing shall be put in place and maintained as required due to soil stability or site constraints. Shoring, sheeting, and bracing shall be provided to prevent disturbance or settlement of adjacent surfaces, structures, foundations, utilities and other properties. Any damage to the work under contract or to existing adjacent structures or other improvements caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to lack of appropriate sheeting, shoring, or bracing shall be repaired at the Contractor's expense at no delay.

- G. Trench sheeting, shoring, and bracing shall be kept in place until pipe has been laid, tested for defects, and repaired if necessary, and the earth around the pipe is compacted. The sheeting, shoring, and bracing shall be removed in such a manner as not to remove the constructed pipe or adjacent structures or other improvements.
- H. It shall be the Contractor's responsibility for proper and adequate placement of sheeting, shoring, and bracing in accordance with all applicable regulations and standards.
- I. Whenever unsuitable or unstable soil for properly supporting the pipe or structures is encountered, a further depth and/or width shall be excavated and replaced with the foundation material specified herewith or other suitable foundation material and thoroughly compacted to assure a firm foundation for the pipe.
- J. Stockpile excavated material in an orderly manner, at sufficient distance from the trench to avoid overloading, to prevent slides and cave-ins.
- K. Contractor shall advise Engineer immediately if any unsuitable materials are encountered during excavation. Unsuitable materials shall be reasonably separated form unsuitable materials and shall be considered surplus material at no additional cost to the Owner.
- L. If Contractor encounters excess excavation materials which meet the requirements of common fill, Contractor may use those materials as fill in common execution and fill areas. Excess surplus materials shall be stockpiled.
- M. Excavate to and over-depth of a minimum of 6 inches below pipe in areas of bedrock or other extensive rock formations by jack hammer, blasting, or other approved method. Trench width shall be 1.25 times the outside diameter of the pipe.
- N. Remove unsuitable materials in accordance to the depth recommended by the soils testing laboratory beneath structures to obtain desired soil bearing capacity. Contractor shall notify Engineer prior to any additional excavation that is needed. Additional excavation shall be subject to approval by the Engineer and subject to additional payment as noted above.
- O. Removal of materials beyond required subgrade elevations or dimensions without specific approval from soils testing laboratory and Engineer as well as backfilling, compaction, and other work at the over excavated area shall be at the Contractor's own expense.
- P. Excavating and backfilling shall not be conducted in water. All excavations shall be maintained in a well drained condition at all times. Contractor shall provide and maintain temporary drainage facilities as required, and as approved by the Engineer, at no additional cost to the Owner.
- Q. Do not interfere with 45 degree bearing splay of foundations. Underpin adjacent structures, as necessary, to prevent damage by excavation Work.
- R. Hand trim for bell and spigot pipe joints. Remove loose matter.
- S. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard, measured by volume.
- T. In the event of shrinkage of excavated soils, resulting in shrinkage of backfill along

TRENCHING AND BACKFILLING

trenches, Contractor shall provide, haul, place, and compact suitable soil type S1 or S2 from source at no cost to Owner.

U. Stockpile excavated material in an orderly manner, at sufficient distance from the trench to avoid overloading, to prevent slides and cave-ins. Remove excess material not being used from site.

3.03 PIPE FOUNDATION

- A. Whenever unsuitable or unstable soil for properly supporting the pipe or structures is encountered, a further depth and/or width shall be excavated and replaced with the foundation material specified herewith or other suitable foundation material and thoroughly compacted to assure a firm foundation for the pipe.
- B. Additional density testing may be required in unstable areas where unsuitable materials are found. Engineer shall determine stability of trench bottom.
- C. Trench bottom shall be cut true and even so that the barrel of the pipe will have a bearing over the full length. Bell holes shall be excavated to ensure the pipe is resting for its entire length on the bottom of the trench and required bedding.

3.04 BACKFILLING

- A. Pipe Zone
 - 1. Should the materials available within the trench section be unsuitable or insufficient for this portion of the granular bedding, encasement and backfill materials as defined in this Specification, Contractor shall provide an approved material that meets the appropriate specifications.
 - 2. Backfill materials shall be placed with care and deposited uniformly on both sides of pipe throughout the entire trench width in maximum 8-inch lifts. Mechanically compact material to required densities.
 - 3. Flexible pipe shall be bedded in accordance with ASTM Specification D2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." This shall include the placement of granular bedding and encasement materials from a point four (4) inches below the bottom of the pipe to a point six (6) inches above the top of the pipe compacted to required densities.
 - 4. Placement and compaction of bedding, encasement, and backfill materials shall be consider incidental to the installation of the pipe.
- B. Above Pipe Zone
 - 1. Use suitable excavated materials from the site prior to importing of select granular borrow material. Any additional suitable select onsite borrow material required to be imported shall be provided by the Contractor at no additional cost to the Owner. Contractor shall separate out all unsuitable materials from select onsite borrow prior to installation. Excess surplus materials shall be removed from the Site.
 - 2. If excavated materials are unsuitable for backfill (not as a consequence of being mis-

managed by the Contractor), Contractor shall provide replacement imported backfill as required to establish required subgrade elevation. Imported granular backfill shall meet the requirements outlined in Section 2.05 above.

- 3. Place backfill materials in uniform layers no more the 8 inches loose depth. Mechanically compact each layer of material to required densities.
- 4. Do not backfill unless approved compaction equipment is operating. The method of means of placement and type of compaction equipment used is at the discretion of the Contractor, however, all portions of the trench backfill must meet the compaction requirements. Tests to determine the compacted density of the backfill may be ordered by the Engineer if the compaction does not appear to be adequate.
- 5. The intent of this specification is to compact the backfill enough to prevent large settlements above the pipe, but to use as little effort as possible to avoid disturbing the pipe and bedding at the pipe zone.
- C. Backfill trenches to contours and elevations with unfrozen fill materials.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Aggregate Fill: Place and compact materials in equal continuous layers not exceeding 8 inches loose depth.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches loose depth.
- G. Employ a placement method that does not disturb or damage utilities in trench. Prevent floatation of pipe.
- H. Maintain optimum moisture content of fill materials to attain required compaction density. Use vibratory or special compaction equipment when required.
- I. Remove surplus fill materials from site.
- J. Leave fill material stockpile areas completely free of excess fill materials. Contractor shall have the responsibility to load, haul, and spread all excess fill off-site.

3.05 COMPACTION REQUIREMENTS

- A. Compact according to Section 01 40 00 and Part 3.6 of Section 02221 Montana Public Works Standard Specifications – (April 2010 Edition) and as indicated on the Construction Drawings.
- B. Contractor shall recompact all areas represented by failed density tests.

3.06 TOLERANCES

- A. Top Surface of Backfilling:
 - 1. Plus or minus 1 inch, upon completion of settlement in ditches, berms, and lawn areas.
 - 2. Plus or minus 1 inch upon completion of settlement in roadways and driveways.

TRENCHING AND BACKFILLING

- B. Trenches shall be kept within settlement tolerances through the warranty period.
- 3.07 FIELD QUALITY CONTROL
 - A. Section 01 40 00 Quality Control: Field inspection and testing.
 - B. Compaction testing will be performed in accordance with ASTM D698, and ASTM D2922.
 - C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to Owner.
- 3.08 PROTECTION OF FINISHED WORK
 - A. Protect finished Work under provisions of Section 01 50 00.
 - B. Reshape and re-compact fills subjected to vehicular traffic during construction.
- 3.09 SCHEDULE
 - A. As Shown on the Construction Drawings in conformance with Geotechnical Report recommendations.

END OF SECTION 31 23 33

SECTION 31 25 00 EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

- A. Prevention of sedimentation of waterways, wetlands, and storm and sanitary sewers due to construction activities.
- B. Restoration of areas eroded due to insufficient preventative measures.
- C. Related Sections include, but are not limited to:
 - 1. Division 02 Existing Conditions
 - 2. Division 31 Earthwork
 - 3. Division 32 Exterior Improvements
 - 4. Division 33 Utilities

1.02 REFERENCES

- A. Montana General Permit No. MTR100000 (or its successor), Effective Date October 12, 2009 and Expiration Date January 1, 2013 Authorization to Discharge under the National Pollutant Discharge Elimination System.
- B. Montana Department of Transportation (MDT) Erosion and Sediment Control Field Manual – Latest Edition
- C. Montana Department of Transportation (MDT) Standard Specifications for Road and Bridge Construction Latest Edition
- D. Montana General Permit No. MTG070000 (or its successor), Effective Date October 12, 2009 and Expiration Date January 1, 2013 General Permit for Construction Dewatering.
- E. ASTM D 4355 Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2005.
- F. ASTM D 4491 Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 1999a (Reapproved 2004).
- G. ASTM D 4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2004.
- H. ASTM D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 1991 (Reapproved 2003).
- I. ASTM D 4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2004.
- J. ASTM D 4873 Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples, 2002.

1.03 SUBMITTALS

- A. Provide product specification sheets for the following erosion control materials to demonstrate that the Contractor's proposed products meet the Contract Document requirements:
 - 1. Fabric proposed for silt fence
 - 2. Fiber Roll
 - 3. Gradation tests for Construction Entrance stone material

PART 2 - PRODUCTS

- 2.01 SILT FENCE
 - A. Silt fence shall be a medium-duty, woven or non-woven polypropylene or polyethylene fabric that lets fluids pass through while trapping soil particles and preventing soil loss. The material shall meet the minimum characteristics of TENAX® silt fence.
- 2.02 SEDIMENT CONTROL LOGS
 - A. Prefabricated sediment control logs (SCR's) Rolls As shown on Drawings. SCR's shall meet the minimum characteristic of the 12" Stenlog® as manufactured by Erosion Control Blanket/GSI.
- 2.03 CONSTRUCTION ENTRANCE
 - A. Materials as Shown on Drawings.
 - B. 3-6 inch Stone
 - 1. Stone shall be angular and shall be comprised of hard, durable mineral materials that have been mechanically processed.
 - 2. Stone shall not be from limestone/dolomite deposits that have thinly bedded strata or strata of a shale nature.
 - 3. Stone gradation shall conform to the following:

SIEVE	PERCENT PASSING (by weight)
6-inch	100
3 ¹ / ₂ -inch	50 - 100
3-inch	10 - 75
2-inch	0-10
3/8 inch	0 - 1

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.
- 3.02 PREPARATION

- A. The Contractor shall develop a Storm Water Pollution Prevention Plan as required by the Montana Department of Environmental Quality that meets both the State's requirements and the minimum practices shown on the Drawings.
- B. The Contractor shall complete and sign the Notice of Intent and submit to the Montana Department of Environmental Quality.

3.03 PERFORMANCE REQUIREMENTS

- A. Contractor shall comply with all requirements of the Montana Department of Environmental Quality along with all Federal, State, and Local permits and regulations for erosion and sediment control.
 - 1. If erosion or sedimentation occurs due to non-compliance with any of these permits, Contractor shall restore eroded areas at no cost to Owner.
 - 2. If sedimentation beyond permitted thresholds occurs in regulated waterways or wetlands, Contractor shall at no additional cost to the Owner:
 - a. Contact the authorities having jurisdiction;
 - b. Remove deposited sediments to the satisfaction of the Owner and the authorities having jurisdiction;
 - c. Install or correct preventive measures to the satisfaction of the authorities having jurisdiction; and
 - d. Pay any fines or other additional requirements of the authorities having jurisdiction; and
 - e. Meet the Contract schedule for project completion.
- B. Contractor shall not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
- C. Timing of erosion and sediment control practices: As Shown on the Drawings.
- D. Erosion Control: Contractor shall reduce wind, water, and vehicular erosion of soil on project site due to construction activities for this project, consistent with approved permits and following these requirements:
 - 1. Minimum erosion control measures as shown on the Drawings with additional practices implemented as required by the Contractor's SWPPP.
 - 2. Control movement of sediment and soil from temporary stockpiles of soil.
 - 3. Prevent development of ruts due to equipment and vehicular traffic.
 - 4. Provide good site housekeeping.
 - 5. Inspect, repair, maintain, and replace erosion control practices consistent with

approved permits and as shown on the Drawings.

- E. Sediment Control: Contractor shall reduce sediment transport off- site due to construction activities for this project, consistent with approved permits and following these requirements:
 - 1. Minimum sediment control measures as shown on the Drawings with additional practices implemented as required by the Contractor's SWPPP.
 - 2. Reduce windblown soil from leaving the project site.
 - 3. Reduce tracking of mud onto public roads outside of the site.
 - 4. Reduce mud and sediment from flowing onto sidewalks and pavements.
 - 5. Inspect, repair, maintain, and replace sediment control practices consistent with approved permits and as shown on the Drawings.

3.04 CLOSE-OUT

- A. Contractor shall file a Notice of Termination with the State following site stabilization that meets the requirements of the General Permit.
- B. Contractor shall remove and clean up all temporary erosion and sediment control practices as shown on the Drawings. Site disturbance caused by removal of these practices shall be restored consistent with the surface restoration requirements shown on the Drawings. Costs for restoration shall be at Contractor's expense.

END OF SECTION 31 25 00

SECTION 31 35 26.16 60 MIL HDPE FLEXIBLE GEOMEMBRANE LINER

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work shall consist of providing all materials, tools, equipment and labor necessary to install the geomembrane liner to the lines and grades shown in the drawings for all three lagoon cells. The work includes preparation of the surface to receive the geomembrane, excavation and backfilling of the anchor trenches, installation of the geomembrane material complete with seams, and other appurtenances. The work shall include field testing and sampling of seams and providing the necessary testing and sampling equipment. The cells will be lined with double-side textured 60 mil HDPE.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM)
 - 1. D 638 Standard Test Method for Tensile Properties of Plastic
 - 2. D 792 Standard Test Method for Specific Gravity and Density of Plastics by Displacement
 - 3. D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
 - 4. D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperatures
 - 5. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
 - 6. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
 - 7. D 1593 Specification for Nonrigid Vinyl Chloride Plastic Sheeting
 - 8. D 1603 Test Method for Carbon Black in Olefin Plastics
 - 9. D 1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
 - 10. D 3015 Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds
 - 11. D 4437 Practice for Determining Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
- B. Federal Test Method Standards 101 Puncture Resistance
- 1.03 SUBMITTALS
 - A. Furnish the following product data, in writing, to the Engineer prior to installation of the geomembrane material.
 - B. Resin Data shall include the following:

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- 1. Certification stating that the resin meets the specification requirements
- 2. Certifications stating all resin is from the same Manufacturer
- 3. Copy of Quality Assurance/Quality Control certificates issued by Geomembrane Manufacturer and resin supplier shall be submitted.
- C. Each Geomembrane Roll
 - 1. Certification and test results showing that the resin meets the specification requirements.
 - 2. Statement certifying no reclaimed polymer is added to resin.
 - 3. Copy of quality assurance certificates issued by Geomembrane Manufacturer shall be furnished.
 - 4. Submitted to Engineer upon delivery of each roll to site.
- D. Extrudate resins and/or rod shall be certified that all extrudate is from one Manufacturer, is the same resin type, and was obtained from the same resin supplier as the resin used to manufacture the geomembrane rolls.
- E. Furnish the following information to the Engineer prior to installation
 - 1. Installation layout drawings. Submit drawings showing proposed panel layout including field seams and details. These drawings shall be approved prior to installing the geomembrane. This approval will be for concept only and actual panel placement will be determined by site conditions.
 - 2. Statements of experience from the proposed HDPE supplier and installer
 - 3. Installer's geosynthetic Field Installation Quality Assurance Plan
 - 4. Samples of HDPE proposed for use on project
 - 5. Reference lists from both the HDPE supplier and installer
 - 6. Results of conformance testing specified within Paragraph 1.04. All costs associated with testing shall be covered by the Contractor.
- F. Submittals on a daily basis during installation
 - 1. Subgrade Acceptance Forms
 - 2. All QC documentation and field testing results (destructive and non-destructive test results)
- G. Submit the following to the Engineer upon completion of installation
 - 1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents
 - 2. Material and installation warranties
 - 3. As-built drawings showing actual geomembrane panel placement and seams including typical anchor trench

1.04 CONFORMANCE TESTING

- A. The Engineer will sample HDPE materials which have arrived on-site for conformance testing. The Contractor will be responsible for forwarding conformance samples to a certified, third party, testing laboratory for testing. Conformance samples will be taken a minimum of each lot or every 100,000 square feet of material whichever results in more tests. HDPE samples will be tested for thickness, yield, elongation @ yield, elongation @ break, and puncture resistance. Samples will be tested to insure conformance with the specifications listed within Table 1 of this section.
- B. No HDPE material shall be installed until conformance testing is complete on that material and results show that the delivered material meets the requirements of the specifications. Material which fails to meet the requirements of the conformance testing shall be rejected and not utilized within the project. Rejected material will be replaced with material meeting the specifications at no additional cost to the Owner. The Contractor shall pay for all costs associated with this conformance testing and retesting of new material, if necessary.

1.05 FIELD TESTING

A. The Contractor shall submit results of the field destructive and non-destructive field testing in writing to the Engineer at the end of every day in which geomembrane welding and seaming has been conducted. The results shall indicate location of the test, passing or failure of the test, and any remedial action taken.

1.06 AS-BUILT DRAWINGS

A. The Contractor shall maintain and submit as-built drawings showing panel layout with identifying panel numbers, the location of all seams, the location of destructive test samples with identification numbers and the location of all repairs. The Contractor shall submit a table showing the correspondence between the Manufacturer's roll number and the assigned panel numbers. Updated as-built drawings shall be submitted within one week after each one hundred thousand square feet of geomembrane has installed.

1.07 THE ENGINEER

A. The Engineer reserves the right to, and may place a quality control technician at the geomembrane factory to observe geomembrane manufacturing. Any material rejected at the factory shall not be shipped to the Project Site. Regardless of whether a technician representing the Engineer is present at the factory, or not, the Contractor shall have sole responsibility for meeting the requirements of this specification.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S EXPERIENCE

A. The Manufacturer of the geomembrane material described in these specifications shall have previously demonstrated his ability to produce this membrane by having successfully manufactured a minimum of ten (10) million square feet of similar lining

material for hydraulic lining installations.

2.02 60 MIL HDPE LINER, DOUBLE-SIDE TEXTURED

A. Geomembrane to be utilized in the storage lagoon shall consist of high density polyethylene (HDPE) manufactured of new first quality products designed and manufactured specifically for the purpose of liquid containment. The geomembrane material shall have a nominal thickness of 60 mil and a minimum thickness of 54 mil and meet the specifications in Table 1.

General Description: 60 mil HDPE Double-Sided Textured			
PROPERTY	FREQUENCY	ASTM TEST METHOD	HT60 MIL
Thickness-(nominal) (mils)			60
Thickness-(min. average) (mils)	Per roll	D5994	57
• Lowest individual of 8 of 10 values			54
Lowest individual of 10 values			51
TENSILE PROPERTIES (min average)	50,000 SF	D638 Type IV Specimen @ 2in/min	126
• Yield Strength (min lb/in)			90
• Break Strength (min lb/in)			12
Break Elongation (min %)			100
Tear Resistance (min. average) (lb)	50,000 SF	D1004	42
Puncture Resistance (min. average) (lb)	50,000 SF	D4833 FTMS 101/Method 2065 ²	90
Carbon Black Content (range) (%)	50,000 SF	D1603/D4218	2.0-3.0
Carbon Black Dispersion	50,000 SF	D5596	Note
Density (min. average) (g/cc)	Resin Batch	D1505/D792	0.940
Stress Crack Resistance (hr)	Resin Batch	D5397 (App.)	200
Dimensional Stability(max. average) (%)	Resin Batch	D1204	± 2
Seam Properties: 1. Shear Strength, lb/in		D4437	120 88 & FTB

Table 1 Geomembrane properties General Description: 60 mil HDPE Double-Sided Textured

*Table Notes:

- 1. Testing frequencies are rounded to the nearest full roll.
- 2. FTMS has been replaced with 4833. Value shown for comparison purposes only. Carbon Black Dispersion for 10 different views: all 10 in Categories 1 or 2.

PART 3 - EXECUTION

2. Peel Strength, lb/in

3.01 STORAGE

A. Storage and handling of the geomembrane shall conform to the Manufacturer's

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recommendation and shall be done in a manner as to prevent damage to any part of the geomembrane. Any portion of the geomembrane that is damaged shall either be repaired or cut out as determined by the Engineer and/or Manufacturer's representative. Costs associated with repairing or replacing geomembrane due to damage occurring during storage on site or during delivery shall be covered by the Contractor.

3.02 GEOMEMBRANE INSTALLER

A. The installation of the geomembrane shall be performed by the Manufacturer of the material or an installer certified by the Manufacturer using the Manufacturer's installation methods and recommendations/requirements at no additional cost to Owner. The geomembrane installer shall also be responsible for installation of the non- woven geotextile fabric at no additional cost to Owner. All the installer supervisors overseeing the geomembrane installation shall have over ten million square feet of geomembrane supervisory experience. All field technicians shall have over one million square feet of seaming experience.

3.03 SUBGRADE PREPARATION

- A. The General Contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for liner installation unless otherwise agreed and approved by the Engineer.
- B. Surfaces to be lined shall be smooth and free of debris, roots, and angular or sharp rocks to a depth of six (6) inches. All liner subgrade material shall consist of well-graded material free of organics, trash, clay-balls or other harmful matter. No sharp edged stones larger than three eights (³/₈) inch, nor *any* stones larger than three quarter (³/₄) inch diameter or hard objects shall be in contact with the liner material. The surface shall be compacted in accordance with project specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects. The subgrade shall have no sudden sharp or abrupt changes in grade.
- C. The Contractor shall protect the subgrade from becoming too dry, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the engineer and geomembrane manufacturer) installed over the subgrade until the placement of the liner begins. Subgrade found to have cracks greater than ½ inch in width or depth or which exhibit swelling, heaving or other similar conditions shall be reworked by the contractor to remove said defects in the subgrade.
- D. Surface acceptance: upon request, the geomembrane manufacturer or supplier will provide the Engineer with a written acceptance of the surface lined. The installer shall also certify that anchor trenches, slopes and grades are acceptable and will not affect the performance or durability of the geomembrane.

3.04 ANCHOR TRENCH SYSTEM

A. Excavation - The anchor trench shall be excavated to the lines and widths shown on the drawings. Trenches shall be excavated only the distance required for that day's installation. The corners of the trench shall be slightly rounded where the geomembrane

adjoins the trench to minimize sharp bends.

B. Backfill - Material used to backfill the anchor trenches shall be approved by the Engineer. No sharp edged stones larger than three eights (3/8) inch, nor *any* stones larger than three quarter (3/4) inch diameter or hard objects shall be in contact with the liner material. The material shall be placed in six (6) inch loose lifts and shall be compacted to 95 percent of the maximum dry density at a moisture content within 2 percent of optimum moisture content as defined by ASTM D698. Field compaction tests, utilizing the nuclear method outlined in ASTM D2922 or other methods approved by the Engineer, will be made as backfilling of the anchor trenches proceed.

3.05 FIELD PANEL PLACEMENT

- A. Identification and Location of Field Panels Each panel used for installation shall be given an identification number consistent with the shop drawings. The identification number shall be related to a manufacturing roll number that identifies the resin type, batch number and date of manufacture.
- B. Field panels shall be installed at locations shown on the shop drawings. If panels are installed in a location other than that indicated on the shop drawings, the revised location shall be noted in the field on a layout drawing. The Contractor shall provide the Engineer, in writing at the end of each day of geomembrane installation, with the identification and locations of panels installed and notify the Engineer of any revised panel locations.
- C. Weather Conditions Geomembrane shall not be installed during any precipitation, in the presence of excessive moisture, in areas of standing water, or during high winds. The Engineer shall be the final authority on determining proper weather conditions for geomembrane installation.
- D. Placement Geomembrane panels shall be placed using equipment and procedures so as not to damage the geomembrane or the subgrade surface and in a manner to minimize both wrinkles and stretching. Sufficient material slack shall be provided to allow for geomembrane expansion and contraction.
- E. Personnel working on the geomembrane shall not smoke, wear shoes that can damage the geomembrane or engage in actions which can result in damage to the geomembrane.
- F. Damaged panels shall be repaired in accordance with the geomembrane manufacturer's recommendations or removed. Remedial measures shall be approved by the Engineer.

3.06 TEMPORARY ANCHORAGE

- A. Sandbags shall be placed to prevent uplift of the geomembrane by the wind. The geomembrane shall <u>NOT</u> be installed if there are high winds.
- 3.07 FIELD SEAMING
 - A. Equipment Field seam welding equipment shall be capable of continuously monitoring and controlling the temperature in the zone of contact where the machine is joining the geomembrane.
 - B. Layout The seams shall be generally oriented parallel to the slope. Where necessary,

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horizontal seams shall be located five feet minimum from the toe of the slopes. Individual panels of geomembrane material shall be overlapped as recommended by the Manufacturer. The area to be welded shall be cleaned and prepared according to the procedures specified by the Manufacturer.

- C. Welds:
 - 1. Fusion welding consists of placing a heated wedge, mounted on a self propelled vehicular unit, between two (2) overlapped sheets such that both sheets are heated to temperatures ranging from 600 degrees F to 850 degrees F. After being heated by the wedge, the overlapped edges pass through a asset of preset pressure rollers which compress the panels together forming a continuous homogenous fusion weld. The fusion welder is equipped with a temperature readout device which continuously monitors the temperature of the weld. Geomembrane panels shall be seamed using double track hot wedge welding. Detail seaming around pipes and concrete structures and seaming for patches shall be fabricated with fillet extrusion welds.
 - 2. Extrusion Fillet Welding: Extrusion welding consists of introducing a ribbon of molten resin along the edge of the seam overlap to the two sheets to be welded. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.
- D. Weather Seaming shall not take place when the temperature is below 40 degrees Fahrenheit or above 100 degrees Fahrenheit except under approval of Engineer. Seaming shall not take place during rain, snow, sleet or other wet conditions or when the subgrade beneath the geomembrane is frozen. The Engineer shall be the final authority on determining proper weather conditions for seaming.
- E. Seam Preparation:
 - 1. Fusion Welding:
 - a. Overlap the panels approximately four (4) to six (6) inches.
 - b. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt, and debris.
 - c. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and fishmouths.
 - 2. Extrusion Welding:
 - a. Overlap the panels a minimum of three (3) inches.
 - b. Temporarily bond the panels to be welded taking care not to damage the geomembrane.
 - c. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt, and debris of any kind prior to grinding.

- d. Grind seam overlap and weld within 15 minutes of grinding. In manner that does not cause excessive damage to the geomembrane. If excessive damage to the geomembrane occurs the panel shall be replaced at no additional cost to the Owner. The engineer will have the final authority on determining if the panel has been excessively damaged.
- e. Purge the extruder prior to beginning the seam to remove all heat-degraded extruded from the barrel.
- f. Keep welding rod clean and dry.

3.08 LAGOON LEAK TEST

- A. The Contractor, his subcontractors and suppliers are responsible for ensuring that liner is properly installed and capable of satisfying the following performance requirements in consideration of the site conditions:
 - 1. Lagoon leakage shall be less than 6 inches per year at the lagoon operating depth in accordance with the Montana Department of Environmental Quality Design Standards.
 - 2. A lagoon leak test shall be performed as specified herein, and any follow up testing required based on the initial leak tests. The Contractor shall fill the lagoons with water to the maximum operating level at no cost to the Owner. The Contractor shall be responsible for procuring all applicable permits associated with filling the lagoons with water.
 - 3. The Contractor shall construct the lagoon leak test measuring device(s) as per the drawings. The leakage test measuring device(s) shall accurately test lagoon leakage while taking into account precipitation and evaporation. The device(s) shall be filled with water and tested for leaks prior to installation in the lagoon. Any leaks found in the devices shall be repaired by the Contractor at no additional cost to the Owner. The Contractor shall then install the lagoon leak test measuring devices in the lagoons.
 - 4. The leakage test shall be conducted over a *fourteen (14) day period*. Upon initial installation the Engineer shall measure and record the initial water level reading. At the conclusion of the test (fourteen days from the initial reading) the Engineer shall observe and record a final water level reading. The Engineer will determine if the lagoon meets the Montana DEQ leakage standards.
 - 5. Should the lagoon leak test fail, the Contractor will be responsible for correcting deficiencies in the liner and conducting another leakage test at no cost to the Owner in all cells.

3.09 LINER ACCEPTANCE

- A. The Geomembrane will be accepted by the Owner and Engineer when all of the following have been completed:
 - 1. The entire installation is finished or an agreed upon subsection of the installation is

finished.

- 2. All Installers QC documentation is completed and submitted to the owner.
- 3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.
- 4. Leak Test meeting project requirements complete.
- 3.10 WARRANTY AND GUARANTEE
 - A. The manufacturer and installer shall each provide a written warranty. The manufacturer shall provide a five (5) year warranty on the material. The installer shall provide a two (2) year warranty on the installation.

PART 4 - FACTORY FABRICATION QUALITY CONTROL

- 4.01 MANUFACTURING QUALITY ASSURANCE & CONTROL
 - A. The Manufacturer of geomembrane material shall perform quality control testing of all geomembrane produced in accordance with the Geosynthetics Research Institute Standards GM-13. Certified results of factory quality control testing shall be submitted to the Engineer prior to or upon delivery to the site.
- 4.02 TEST WELDS
 - A. Sampling
 - 1. Test welds shall be performed at the beginning of each seaming period and at least once each five (5) hours for each welding apparatus used that day. Test welds shall be made under the same conditions as exist for the geomembrane seaming. The test welds shall be at least three feet long and shall be made by joining pieces of geomembrane at least nine (9) inches wide.
 - B. Field Testing
 - 1. Two random samples shall be cut from the test weld. The samples shall be tested in shear and in peel in accordance with ASTM D751 and ASTM D4437 using a field tensiometer supplied and operated by the Installer. The welds shall exhibit a Film Tearing Bond (FTB). If a specimen fails the entire sampling and testing procedure shall be repeated. If any of the second set of specimens fail, the welding machine shall not be accepted for seaming until the deficiencies have been corrected and two (2) consecutive passing seam tests are achieved.

4.03 FIELD SEAM TESTING

- A. General
 - 1. One hundred percent (100%) of all field seams shall be subjected to Engineer approved non-destructive seam testing.
- 4.04 AIR PRESSURE TESTING
 - A. All double-track welds shall be air pressure tested to a minimum of 25 psi according to

the Manufacturer's recommendations. The pressure may not drop over 4 psi in a five minute period or the seam fails. Failing seams shall be remedied according to the Manufacturer's recommendations until the seam passes the air pressure tests. Air pressure feed holes shall be repaired by extrusion welding.

- B. Equipment for Air Testing:
 - 1. An air pump capable of generating and sustaining a pressure of 30 psi.
 - 2. A rubber hose with fittings and connections.
 - 3. A sharp hollow needle with a pressure gauge capable of reading and sustaining a pressure of 30 psi.
- C. Procedure for air testing:
 - 1. Seal both ends of the seam to be tested.
 - 2. Insert the needle in the sealed channel.
 - 3. Inflate the test channel to a pressure between 25-30 psi, in accordance with the following schedule, close valve, and allow time for the injected air to come into equilibrium in the channel. Observe initial pressure after this time.

MATERIAL	INITIAL PRESSURE SCHEDULE		MAX. PRESSURE DIFF.
MIL	PSI	PSI	AFTER 5 MINUTES
40	25	30	4
50	26	30	4
60	27	30	4
80	30	30	4
100	30	30	4

- 4. Observe and record the air pressure five minutes after the relaxing period ends. If loss of pressure exceeds the value above or if the pressure does not stabilize, locate the faulty area and repair.
- 5. Upon completion of the pressure test the end of the seam opposite the pressure gauge is cut. A decrease in gauge pressure must be observed or the air channel will be considered blocked and the test will be repeated after the blockage is corrected.
- 6. Remove the needle and seal resulting hole by extrusion welding.
- 7. Record test results.
- 8. In the event of a non-complying air pressure test, the following procedure shall be followed:
 - a. Check seam-end seals and retest seams.
 - b. If non-complying test reoccurs, cut one (1) inch samples from each end of the seam and additional samples at the distance specified.

- c. Preform destructive field peel test on the samples.
- d. If all samples pass destructive testing remove the overlap left by the wedge welder and perform an Air Pressure/Soap Test or Vacuum Test.
- e. If a leak is detected by the Air Pressure/Soap or Vacuum Test, repair by extrusion welding. Test repair by Vacuum Testing.
- f. If no leak is discovered by Vacuum Testing, the seam will pass non-destructive testing.
- g. If one (1) or more samples fail the peel test, additional samples will be taken.
- h. When two (2) passing samples are located, the seam between the two (2) locations will be considered complying. The area outside of this length will be considered non-complying and the entire length extrusion welded.
- i. Test the entire length of the repaired seam by vacuum testing.

4.05 AIR PRESSURE TESTING/SOAP TESTING

- A. This test is used when the seam fails the air pressure test due to slow pressure loss. The procedure is to constantly supply pressure to the seam air channel while spraying the length with a soap and water solution and visually examining the seam for bubbles.
- B. Procedure for Air Pressure/Soap Testing:
 - 1. Trim excess overlap material off at edge of seam.
 - 2. Insert needle gauge assembly in opposite ends of the seam to be tested to show that pressure is continuous throughout the channel.
 - 3. Maintain 30 psi, but do not exceed 30 psi under any circumstances.
 - 4. Apply soap solution to the weld edge and visually examine for bubbles.
 - 5. If no bubbles appear the problem is with the inside track "secondary weld". This seam is acceptable providing it has passed the peel tests.
 - 6. If any bubbles appear on the outside track "primary weld", repair defect by extrusion welding and vacuum test the repair.

4.06 VACUUM BOX TESTING

- A. All extrusion welds shall be vacuum tested in accordance with Manufacturer's recommendations.
- B. Equipment for vacuum testing:
 - 1. Vacuum box consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly and a vacuum gauge.
 - 2. Vacuum pump assembly or compressor with a venturi equipped with a pressure controller and pipe connections.
 - 3. A rubber pressure/vacuum hose with fittings and connections.

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- 4. A soap solution with a means to apply the solution.
- C. Procedure for Vacuum Testing:
 - 1. Trim excess overlap for seam.
 - 2. Apply soap solution to the area to be tested.
 - 3. Place vacuum box over the area and apply sufficient downward pressure to seal the box against the liner. Activate the vacuum motor and look for soap bubbles.
 - 4. Ensure that a leak tight seal is created.
 - 5. For a period of not less than five (5) seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
 - 6. If no bubbles appear after five (5) seconds, turn off the motor and move overlap and repeat the process.
 - 7. If a non-complying test occurs, mark all areas where soap bubbles appear and repair the marked areas. After repairs are completed retest the repaired areas. Repeat as needed until all areas pass the test.

4.07 DESTRUCTIVE TESTING - LABORATORY

A. One (1) destructive test sample shall be taken randomly at a minimum average frequency of one (1) test location every 500 feet of seam length and submitted to the Engineer. Seam destructive samples shall be sent by the Engineer to an approved third party laboratory and tested for shear strength and peel adhesion (ASTM D4437). Testing shall be paid for by the Contractor. Five (5) specimens shall be tested for each test method. Four (4) out of the five (5) specimens must exhibit FTB for each round of peel and shear testing. In addition, four (4) of the five (5) individual specimens and the average of the five (5) peel and shear tests must meet or exceed the specified strength requirements.

4.08 DESTRUCTIVE TESTING - FIELD

A. The Installer shall duplicate the laboratory testing (Section 7.05) using a field tensiometer provided by the Installer. The results of field testing shall be submitted to the Engineer immediately after testing.

4.09 REPAIRS

A. All seams which have failed destructive or non-destructive tests shall be repaired. All defects, holes, blisters or other signs of damage shall also be repaired. Repairs shall be conducted under the supervision of the Engineer according to the Manufacturer's specifications. Every repair shall be non-destructively tested according to Part 7 of this specification. Repairs in excess of 150 lineal feet shall require a destructive test.

4.10 DOCUMENTATION

- A. GENERAL
 - 1. The Contractor shall provide the Engineer with the following documentation for approval before, during and after liner installation as appropriate:

- a. Geomembrane layout sequence
- b. Details of welding and seaming operations
- c. Non-destructive seam testing methods and schedule
- d. Test weld method and schedule
- e. Manhole welding details
- f. Destructive test sampling from field seamed liner and schedule
- g. Repair procedures
- h. QA/QC Plan
- i. QA/QC forms for job
 - i. Delivery/Inventory Checklist
 - ii. Certificate of Acceptance of Soil Subgrade Surface
 - iii. Panel Placement Form
 - iv. Test Weld Form
 - v. Panel Seaming Form
 - vi. Non-Destructive Testing Form
 - vii. Destructive Test Log
 - viii. Daily Field Report
 - ix. As-built drawings of panel placements

END OF SECTION 31 35 26.16

SECTION 31 41 00 SHORING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Work related to sheeting, shoring, bracing, and excavation support systems needed to accomplish construction of buildings, tanks, facilities, utilities, and piping.
- B. Related sections include, but are not limited to:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Section 03 30 00 Cast-in-Place Concrete
 - 3. Division 1 General Requirement Specification Sections
 - 4. Division 31 Earthwork Specification Sections.
- 1.02 SUBMITTALS
 - A. Shop Drawings and Product Data: Submit, in accordance with Section 01 33 00. In general, include drawings and supporting calculations for shoring for Engineer review and approval.
 - B. Submittals shall include:
 - 1. Excavation support plan.
 - 2. Movement monitoring plan.
 - 3. Trench excavation plan.
 - 4. Movement measurement and data and reduced results indicating movement trends.
 - 5. Documentation that shoring plan or system has been designed by a registered Professional Engineer if required.
 - C. Design calculations of bracing and shoring showing member stresses and connections due to imposed loads. Calculations shall be sealed by a qualified professional engineer.

1.03 QUALITY ASSURANCE

A. An OSHA approved competent person shall review the soil classification presented in the Geotechnical Report in the field. Excavations shall comply with the requirements of OSHA 29 CFR, Part 2926, Subpart P, "Excavations and Trenches." Excavation safety is the responsibility of the Contractor. All excavations greater than 20 feet in depth shall be designed by a registered

Professional Engineer.

- B. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.
- C. Sheeting, shoring, and bracing shall not affect structural integrity of existing structures, utilities, or Work, and shall allow for sufficient clearances necessary to install associated appurtenances adjacent to new Work.
- D. Sheeting, shoring, and bracing shall not penetrate walls or slabs of new Work unless approved by the Engineer.
- E. Provide surveys to monitor movements of critical facilities.
- 1.04 REGULATORY REQUIREMENTS
 - A. Work outlined in this Section shall conform to OSHA regulations and all applicable codes and regulations for worker safety.

PART 2 - PRODUCTS

- 2.01 SHEETING, SHORING, AND BRACING
 - A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and be the sole responsibility of the contractor.

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work. Shoring, sheeting, and bracing shall also be provided as necessary to protect workers and the public.
 - B. Sheeting, shoring, and bracing shall be installed to prevent solids from entering excavation below or through sheeting.
 - C. Open cut excavations are to be evaluated by a registered Engineer and protected against surface water intrusion.

3.02 EXCAVATION SUPPORT PLAN

- A. Prepare an excavation support plan addressing the following topics:
 - 1. Select and install shoring system such that no adverse impact occurs on existing structures, utilities, or facilities.
 - 2. Details of shoring, bracing, sloping, or other provisions for worker protection from hazards of caving ground.
 - 3. Design assumptions and calculations.
 - 4. Methods and sequencing of installing excavation support.

- 5. Proposed locations of stockpiled excavated material.
- 6. Minimum lateral distance from the crest of slopes for vehicles and stockpiled excavated materials.
- 7. Anticipated difficulties and proposed resolutions.

3.03 MOVEMENT MONITORING PLAN

- A. Prepare movement monitoring plan addressing following topics:
 - 1. Survey control.
 - 2. Location of monitoring points.
 - 3. Plots of data trends.
 - 4. Interval between surveys.
 - a. Interval shall not be less than once per week during performance of work until the permanent structure is complete to the ground level and shall continue weekly for a period of four (4) weeks after completion of the work (or longer if movement persists).
 - 5. Remedial action and engineer notification plan should movement of existing structures occur during performance of the Work.
- 3.04 REMOVAL OF EXCAVATION SUPPORT
 - A. Remove excavation support in a manner that will maintain support as excavation is backfilled.
 - B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.
 - C. Remove excavation support in a manner that does not leave voids in the backfill.

3.05 TRENCHES

- A. Provide trench excavations exceeding four (4) feet in depth with adequate safety systems.
- B. For trench excavation exceeding five (5) feet in depth, provide adequate safety systems meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION 31 41 00

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 05 16 AGGREGATES FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Aggregate materials.
- B. Related Sections include, but are not limited to:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
 - 4. Division 32 Exterior Improvements Specification Sections.
 - 5. Section 31 23 21 Fill and Backfill.
 - 6. Section 31 23 33 Trenching and Backfilling.
 - 7. Section 32 11 23 Aggregate Base Courses.
 - 8. Section 33 31 19 Site Piping.
 - 9. Section 32 13 13 Concrete Pavement.
- 1.02 SUBMITTALS FOR REVIEW
 - A. Section 01 33 00 Submittals: Procedures for submittals.
 - B. Samples: Submit, in air-tight containers, 40 pound sample of each type of aggregate to testing laboratory. Submit Laboratory Results to Engineer.
- 1.03 QUALITY ASSURANCE
 - A. Section 01 40 00 Quality Control: Field Samples.
 - B. Material Source: Submit name of imported material supplier(s). Provide materials from the same source throughout the Work. Change of source requires Engineer approval.

PART 2 - PRODUCTS

- 2.01 AGGREGATE MATERIALS
 - A. Coarse Aggregate (Concrete Mix and Type A1): Well graded crushed stone or gravel conforming to the requirements of ASTM C33, Gradation 67.
 - B. Coarse Aggregate (Surface Course and Type A2): Gravel; angular crushed, or natural stone; free of shale, clay, friable material and debris; graded in accordance with Montana Department of Transportation specifications. For all aggregate surface areas.

- C. Coarse Aggregate (Base Course and Type A3): Gravel; Angular crushed, or natural stone; free of shale, clay, friable material and debris; graded in accordance with Montana Department of Transportation referenced specifications, Section 816, Class 5.
- D. Fine Aggregate (Concrete Mix and Type A4): Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C33.
- E. Coarse Aggregate (Type A5): All gravel for Granular Foundation shall be in accordance with the following table of gradations:

TABLE OF GRADATIONS – GRANULAR FOUNDATION		
Sieve Size Percent Passing		
4 inch (100 mm)	100	
No. 4 (4.75 mm)	25-60	
No. 200 (0.075 mm)	3-12	

- F. Granular Fill (Base course under cast-in-place on-grade slabs): Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100 percent passing a 1¹/₂ inch (38-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve.
- G. Structural Fill (as described in the project drawings): Fully compliant with MPWSS Section 02234 4" Minus Sub-Base Course.
- 2.02 SOURCE QUALITY CONTROL
 - A. Section 01 40 00 Quality Control: Source testing and analysis of aggregate material.
 - B. Coarse Aggregate Material Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698.
 - C. Fine Aggregate Material Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698.
 - D. If tests indicate materials do not meet specified requirements, change material or material source and retest.
 - E. Provide materials of each type of aggregate from the same source throughout the Work.

PART 3 - EXECUTION

- 3.01 STOCKPILING
 - A. Stockpile materials in accordance with Section 31 14 13.
- 3.02 STOCKPILE CLEANUP
 - A. Cleanup stockpiles in accordance with Section 31 14 13.

END OF SECTION 32 05 16

SECTION 32 05 19 GEOSYNTHETICS FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Geogrid fabric beneath asphalt road section;
 - 2. Non-woven geotextile fabric beneath concrete foundations/slabs as indicated on the project drawings.

B. Related Sections include, but are not limited to:

- 1. The General Conditions, Supplemental Conditions, and General Requirements apply to work of this section.
- 2. Division 1 General Requirements Specifications Sections.
- 3. Division 31 Earthwork Specifications Sections.
- 4. Division 32 Exterior Improvements.

1.02 REFERENCES

- A. Reference Standards include, but are not limited to:
 - 1. Montana Department of Transportation Standard Specifications, latest edition.
 - 2. ASTM D6241 CBR Puncture, Latest Edition.
 - 3. ASTM D4355 UV-Resistance, Latest Edition.
 - 4. ASTM D4491 Permeability, Latest Edition.
 - 5. ASTM D4533 Trapezoid Tear Strength of Geotextiles
 - 6. ASTM D4632 Grab Tensile Strength and Elongation, Latest Edition.
 - 7. ASTM D4751 Apparent Opening Size (AOS), Latest Edition.
 - 8. ASTM D4759 Determining Specification Performance for Geosynthetics
 - 9. ASTM D4873 Guide for Identification, Storage, and Handling of Geosynthetics, Latest Edition.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Provide product data on Geogrid and Geotextile Fabric.
- C. Submit manufacturer's installation instructions. Indicate special procedures and conditions requiring special attention.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. The geotextile rolls shall be furnished with suitable wrapping for protection against

GEOSYNTHETICS FOR EXTERIOR IMPROVEMENTS

moisture and extended ultraviolet exposure prior to placement.

- B. Rolls shall be stored in a manner which protects them from the elements. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days.
- C. The geotextile rolls shall be labeled as per ASTM D 4873, "Guide for Identification, Storage, and Handling of Geosynthetics".

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Geogrid Fabric
 - 1. The Geogrid fabric within the asphalt roadway section shall have the following minimum performance properties:

Property	Test Method	Value
% U.S. Manufactured		100%
Aperture Dimensions		1"x1.4"
Rib Thickness		0.03"x0.03"
Tensile Strength @ 2%	ASTM D-6637	280 x 450 lb/ft
Tensile Strength @ 5%	ASTM D-6637	580 x 920 lb/ft
Ultimate Tensile Strength	ASTM D-6637	850 x 1300 lb/ft
Junction Efficiency	GRI-GG2-05	93%
Flexural Stiffness	ASTM D-7748	250,000 mg·cm
Aperture Stability		0.32 m·N/deg
Resistance to Installation Damage	ASTM D-6637	95% SC; 93% SW; 90% GP
Resistance to LT Degrad.	EPA 9090	100%
UV Resistance at 500 hr.	ASTM D-4355	100%

- 2. The Geogrid fabric shall be GridPro BXP-11, Type 1 or approved equal.
- B. Non-Woven Geotextile
 - 1. The non-woven geotextile fabric shall have the following minimum performance properties:

Property	Test Method	Value
% U.S. Manufactured		100%
Grab Tensile Strength	ASTM D-4632	205 lb.

Grab Elongation	ASTM D-4632	50%
CBR Puncture	ASTM D-6241	525 lb.
Trapezoidal Tear	ASTM D4355	80 lb.
UV Resistance at 500 hr.	ASTM D-4355	70%
Apparent Opening Size	ASTM D-4751	80 US Std. Sieve
Permittivity	ASTM D-4491	1.5 sec ⁻¹
Water Flow Rate	ASTM D-4491	110 gpm/ft ²

2. Non-woven geotextile fabric shall be Geotex 801 by Propex Geosolutions – 4019 Industry Drive, Chattanooga, TN 37416.

PART 3 - EXECUTION

- 3.01 EXAMINATION
 - A. Verify subgrade has been inspected, gradients and elevations are correct; surface is dry, and ready to receive Work.
- 3.02 PREPARATION OF SUBSOIL
 - A. Correct irregularities in subgrade gradient and elevation by scarifying a minimum of 6inches, reshaping, and re-compacting.
 - B. Do not place on soft, muddy, or frozen surfaces.
- 3.03 PLACEMENT
 - A. Geotextile and geogrid fabric shall be placed in strict accordance with Manufacturer's recommendations.
 - B. The fabric shall be laid out smooth without wrinkles or folds on the prepared subgrade in the direction of the construction traffic.
 - C. Adjacent geotextile/geogrid rolls shall be overlapped a minimum of 2.5 feet; ends of rolls shall be overlapped 3 feet unless manufacturer specifies otherwise.
 - D. On curves, the fabric may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and shall be held in place by staples, pins or aggregate piles.
 - E. Damaged areas shall be repaired by overlaying the area with sufficient material to overlap on all edges by at least 2.5 feet.
 - F. The aggregate base material shall be placed by end dumping onto the geotextile/geogrid from the edge or over previously placed base aggregate. Construction equipment shall not be allowed directly on the geotextile fabric.
 - G. A minimum of 12 inches of aggregate must be placed on the geotextile/geogrid prior to the movement of construction equipment above the fabric.

- H. Turning movements must be carefully monitored to avoid rutting of the aggregate. Any ruts occurring during construction shall be filled with additional gravel aggregate and compacted to the specified density.
- I. If placement of the backfill causes damage to the geotextile/geogrid, the damaged area shall be repaired as described in Section 3.03.E.
- J. Install in the locations as indicated on drawings.
- 3.04 FIELD QUALITY CONTROL
 - A. Section 01 40 00 Quality Assurance: Field inspection.
- 3.05 SCHEDULE OF LOCATIONS
 - A. Use Geogrid Fabric in the following locations:
 - 1. Beneath asphalt roadway section and where indicated in the project drawings.
 - B. Use Geotextile Reinforcement in the following locations:
 - 1. Where indicated in the project drawings

END OF SECTION 32 05 19

SECTION 32 11 23 AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes general requirements and procedures for furnishing and installing base and pavement courses, including:
 - 1. Subbase Course.
 - 2. Aggregate Base Course.
- B. Related Sections include, but are not limited to:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 General Requirement Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
 - 4. Division 32 Exterior Improvements.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. American Concrete Institute (ACI)
- C. American Society for Testing Materials (ASTM)
- D. MDT Specifications (latest edition)
- 1.03 SUBMITTALS
 - A. Subbase Course
 - 1. Provide appropriate material date source testing for each granular material. Include name location of source, date of testing, and sample gradations. Tests shall not be more than 180 calendar days before date of submittal.
 - B. Aggregate Base Course
 - 1. Submit gradation report on sample of aggregate base to be used.

1.04 SEQUENCING AND SCHEDULING

- A. Construct aggregate base only after all of the following have been completed:
 - 1. Subgrade has been corrected for instability problems and successfully passed a rolling test performed by the Contractor and witnessed by the Engineer.
 - 2. Subgrade has been checked for conformance to line and string tolerances (stringline).
- B. Aggregate base to be completed and approved by Engineer prior to placement of bituminous surfaces.

AGGREGATE BASE COURSES

- 1.05 QUALITY ASSURANCE
 - A. Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during work.
 - B. In-place finished thickness will not be acceptable if exceeding following allowable variation from thickness specified herein:
 - 1. Aggregate Base Course: Plus or minus one-half inch.

PART 2 - PRODUCTS

- 2.01 SUBBASE COURSE
 - A. Subbase shall be Type A or B materials as specified in Section 31 05 16 unless otherwise indicated.
- 2.02 AGGREGATE BASE COURSE
 - A. Aggregate Base Course shall be as indicated on the Construction Drawings and as specified in Section 32 05 16.
- 2.03 AGGREGATE SURFACE COURSE
 - A. Aggregate Surface Course shall be as indicated on the Construction Drawings and as specified in Section 32 05 16.

PART 3 - EXECUTION

- 3.01 AGGREGATE BASE COURSE
 - A. Preparation:
 - 1. Verify subsoil has been inspected; gradients and elevations are correct.
 - 2. Prepare the sub-base course.
 - 3. Verify subsoil is compacted to specified density and that subgrade test results have been submitted prior to placing aggregate course.
 - 4. Subgrade to be completed and approved by Engineer prior to installation of the aggregate base course.
 - 5. Verify subgrade is dry.
 - B. Construction Requirements; conform to MDT Specifications:
 - 1. Place aggregate in maximum 6-inch layers and compact to specified density. When placing over geotextile fabric, place in minimum 8 inch layers.
 - 2. Level and contour surfaces to elevations and gradients indicated.
 - 3. Compact by mechanical means as specified in Section 01 40 00.
 - 4. Install aggregate base in accordance with Detail Drawings.
 - 5. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

- 6. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- C. Field Quality Control:
 - 1. The Owner shall have an independent testing laboratory sample the aggregate base materials, determine the moisture/density relationships and gradation, and perform field moisture/density tests at locations determined by Engineer.
 - 2. If, during progress of Work, tests indicate that compacted materials do not meet specified requirements, remove defective Work, replace, and retest. Contractor shall bear all costs associated with repair and retesting of defective Work.

3.02 TOLERANCES

- A. Finished Grade:
 - 1. Line and Grade Tolerance: The final aggregate base surface will be checked for conformance to specified tolerances by the "stringline" method prior to approval to pave the surface. Grade shall be ± 0.03 feet of grade.

END OF SECTION 32 11 23

SECTION 32 12 16 ASPHALT PAVING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Bituminous Pavement.
- B. Related Work:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
- 1.02 REFERENCES
 - A. Reference Standards include:
 - 1. ASTM D946 Penetration-Graded Asphalt Cement for Use in Pavement Construction.
 - 2. ASTM D1559 Test of Resistance to Plastic Flow of Bituminous Mixtures. Using Marshall Apparatus.
 - 3. ASTM D2950 Test for Density of Bituminous Concrete in Place by Nuclear Methods.
 - 4. TAI (The Asphalt Institute) MS-2 Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.
 - 5. TAI (The Asphalt Institute) MS-3 Asphalt Plant Manual.
 - 6. TAI (The Asphalt Institute) MS-8 Asphalt Paving Manual.
 - 7. TAI (The Asphalt Institute) MS-19 Basic Asphalt Emulsion Manual.
 - 8. Montana Department of Transportation (MDT) Standard Specifications for Road Construction and Bridge Construction, 2008 Edition.
- 1.03 SUBMITTALS FOR REVIEW
 - A. Section 01 33 00 Submittals: Procedures for submittals.
 - B. Product Data: Furnish data on aggregates, asphalt cement, bituminous mixtures, and other materials required for the mix in accordance with Section 01 33 00 and 01 40 00 at least 7 days prior to beginning paving operations.
 - C. Asphalt Mix Formula.
- 1.04 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

ASPHALT PAVING

- A. When referenced, perform Work in accordance with the Montana State Highway Department standard Specifications for Road and Bridge Construction, latest edition.
- B. Paving: Designed for H20 classification.
- C. Mixing Plant and Mixing Plant Operations: Conform to the Montana State Highway Department Standard Specifications for Road and Bridge Construction, latest edition, and The Asphalt Institute (TAI) MS-3 Asphalt Plant Manual.
- D. Obtain all materials from same source throughout project unless approved by the Engineer.
- E. Paved surfaces shall be warranted against any materials and/or workmanship defects for a period of twelve months from placement.
- F. The mix design and development of the Job Mix Formula shall be generated by a laboratory accredited by the AASHTO Materials Reference Laboratory (AMRL) at the Contractor's expense.
- 1.05 REGULATORY AND ENVIRONMENTAL REQUIREMENTS
 - A. Do not place asphalt when ambient air temperature (in the shade and away from artificial heat) or base surface temperature is less than 40 degrees F. or when surface is wet, dirty, or frozen.
 - B. No Work will be permitted in the spring until the frost has disappeared and the subgrade is stable so as to support the equipment without rutting, shoving, pumping, or other displacement.
 - C. Conform to applicable code for paving work on public property.
 - D. Conform to Section 01 50 00. Minimize interference with traffic.
 - E. Conform to the Montana Department of Environmental Quality Clean Air Standards and Storm Runoff Surface Water Standards.
 - F. Dispose of all waste material or reject material by approved methods.
- 1.06 SEQUENCING AND SCHEDULING
 - A. Construct aggregate base only after all of the following have been completed:
 - 1. Subgrade has been corrected for instability problems and successfully passed a rolling test performed by the Contractor and witnessed by the Engineer.
 - 2. Subgrade has been checked for conformance to line and string tolerances (stringline).
 - B. Aggregate base to be completed and approved by Engineer prior to placement of bituminous surfaces.
 - C. The Contractor shall provide a 48 hour notice for scheduling prior to paving operations.
 - D. Contractor shall allow aggregate base, asphalt base course, and curb to undergo one freeze thaw cycle before installing surface course. Aggregate base course, asphalt base course, and curb installation shall be required for final completion with surface course of

asphalt required for final completion.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. Asphalt Cement: Asphalt Cement shall be produced in accordance with Section 818 of the MDT Standard Specification and meeting the following requirements:
 - 1. ASTM 6373 (AASHTO M320) Asphalt Binder have a PG grading of:
 - 2. PG 58-28
 - B. Aggregate for Mix:
 - 1. Section 32 05 16 in accordance with the Montana State Highway Department Standard Specifications for Road and Bridge Construction, latest edition.
 - C. Asphalt Paving (Bituminous) Mixture (Base Course) shall have the following properties:
 - 1. The Engineering shall approve the job mix formula submitted by the Contractor. Once the job mix formula is established, all mixtures furnished for the Project shall conform within the following maximum permissible variation:

a.	Aggregate passing No. 4 and larger sieves	+ or - 5.0%
b.	Aggregate passing No. 8 to No. 100 sieves	+ or - 3.0%
c.	Aggregate passing No. 200 sieves	+ or - 2.0%
d.	Asphalt	+ or - 0.4%
e.	Temperature of mixture	$+ \text{ or - } 20^{\circ}$

2. The asphalt mixture shall have the following test properties:

a.	Marshall Stability	1200 lbs. (minimum)
	Marshall Flow (units of 0.01 in.)	
c.	Air Voids	3 to 7 percent

- 3. Adjustment of the job-mix base course formula may only be made with written approval of the Engineer.
- D. Asphalt Paving (Bituminous) Mixture (Wear Course) shall have the following properties:
 - 1. The Engineering shall approve the job mix formula submitted by the Contractor. Once the job mix formula is established, all mixtures furnished for the Project shall conform within the following maximum permissible variation:

a.	Aggregate passing No. 4 and larger sieves	+ or - 5.0%
b.	Aggregate passing No. 8 to No. 100 sieves	+ or - 3.0%
c.	Aggregate passing No. 200 sieves	+ or - 2.0%
d.	Asphalt	+ or - 0.4%

2. The asphalt mixture shall have the following test properties:

a.	Marshall Stability	1200 lbs. (minimum)
	Marshall Flow (units of 0.01 in.)	8 to 18
c.	Air Voids	3 to 5 percent

3. Adjustment of the job-mix wear course formula may only be made with written approval of the Engineer.

E. Tack Coat:

- 1. SS1H and CSS1H Emulsion meeting the appropriate requirements of ASTM for the specific grade of emulsion and the MDT Standard Specifications. Non-tracking tack products may also be used as approved by the Engineer.
- 2. Water should be clean and free of impurities, either in solution or colloidal suspension. The presence of ions, both positive and negative, must be carefully monitored.
- 3. Storage and handling of the emulsion should be performed in accordance with MS-19.
- 4. All conventional asphalt emulsions shall be diluted with water at a 50:50 ration. Polymer modified and non-tracking emulsions shall not be diluted. Dilution of the emulsion product should be performed at the emulsion terminal or in a tank at the asphalt plant. Emulsion should not be diluted in the distributor at the project site.
- 5. Never allow asphalt emulsion to freeze.
- 6. Use pumps with proper clearances for handling to avoid binding and seizing. Avoid repeated pump cycling or frequent pumping.
- 7. DO NOT mix different classes, grades, or types of emulsified asphalt in storage tanks, transports, or distributors. Make sure tanks are totally clean before changing to another class, grade, or type.
- 8. Always pump from bottom of tank.
- 9. Never overheat asphalt emulsion.

2.02 PAVEMENT MARKING PAINT

- A. Paint shall be J.E. Bauer Company, Traffic Paint; Tnemec, Traffic Paint; Glidden-Durkee, Romark Traffic; PPG, Traffic & Zone Marking Paint; or equal.
- B. Provide paint striping and logos as shown on the Drawings.
- C. Provide colors as selected by the Engineer from the manufacturer's standard color range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that compacted subgrade is dry, stable, compacted to specified density, at proper temperature, and to proper elevations and grade slopes. Do not begin asphalt-paving construction without Engineer's authorization.

ASPHALT PAVING

B. Each course shall be compacted and hardened to such a degree that it will not be displaced or otherwise damaged before another course may be placed thereon.

3.02 PREPARATION

- A. Notify Engineer and Owner at least 72 hours in advance of temporary disruptions of traffic along route of construction.
- B. Saw cut and tack all joints between new and existing pavement.
- C. For asphalt overlay sections, mill a one (1) foot strip along all edges of the overlay area.
- D. The Contractor shall review the proposed paving sequence with the Engineer prior to placement of bituminous course.
- E. All surfaces shall be checked and approved by the Engineer prior to paving.
- F. Existing courses must be dry prior to and during placement of any bituminous pavements.
- G. Wearing course shall not be placed when the air temperature in the shade and away from artificial heat, is 50°F or less, unless otherwise approved by the Engineer.
- H. Pavement shall not be installed on frozen or thawing ground.

3.03 TACK COAT

- A. All equipment shall conform to MDT Standard Specifications for Road and Bridge Construction, latest edition, Section 151.
 - 1. Tack distributor shall be designed, equipped, maintained, and operated so that tack material is applied at the specified rate per square yard with uniform pressure over the required width application.
 - 2. The distributor shall be equipped with an onboard computer that determines the relationship between the distributor travel speed and pump speed to ensure a consistent application rate.
 - 3. An accurate and calibrated thermometer with a range covering the specified application temperature for tack material shall be mounted at approximately center height of the tank with the stem extending into the tack material.
 - 4. The distributor shall have a full circulating system with a spray bar, adjustable laterally and vertically. The spray bar shall be maintained at a constant height above the pavement under variable load conditions.
 - 5. Ensure that all nozzles are of the same size and type to ensure uniform application of emulsion.
 - 6. Ensure that all nozzles are at the same angle to ensure uniform application of emulsion.
 - 7. The distributor shall be checked and calibrated. A certificate of the calibration shall be posted in the driver's compartment stating that the distributing system is in good working condition and when used with the charts and instructions furnished by the manufacturer will give the required results. The certificate shall bear the date of

calibration and signature of the calibrating agency.

- B. Always maintain proper distributor spray bar height and spray nozzle angle for proper coverage.
- C. Always maintain proper distributor speed.
- D. Always sweep and clean surfaces to be tack coated.
- E. Never apply more tack coating than can be covered by the same day's operation.
- F. Never apply tack coating when ambient air temperature is consistently below 40° F or when surface is wet.
- G. Never over-spread tack coating. If "fat spots" develop, spread out excess oil by pneumatic tire rolling before placing pavement.
- H. Always allow enough time for tack coat to "break" before placing pavement.
- I. Apply tack coat as directed in Section 401 of the MDT Standard Specifications for Road and Bridge Construction, latest edition and NAPA's Best Practices for Emulsion Tack Coats. Hand spray wands and crack-sealing buckets are not acceptable methods of applying tack coat emulsion except on the vertical face of an adjoining lift of pavement.
- J. Apply bituminous tack coat to existing bituminous pavement and to the surface of each lift or course constructed, other than the final course. Apply in a uniform rate with no missed areas permitted. Application rates shall be approved by the Engineer prior to commencing Work.
- K. The bituminous tack coat shall be applied at a uniform rate of not less than:
 - 1. 0.10 gallons per square yard, for undiluted asphalt emulsion (as supplied from the emulsion terminal); application rate shall be adjusted if necessary to attain bond between courses.
 - 2. 0.20 gallons per square yard, for diluted asphalt emulsion (with water added at the terminal or plant emulsion tank).
- L. The temperature of emulsion shall be between 70 and 160 degrees F at the time of application.
- M. Apply immediately prior to the placement of the next bituminous course or lift. Do not allow public traffic on tack coated areas. The tack coat shall be applied in a manner that offers the least inconvenience to traveling public.
- N. Apply the tack coat on the same day as the proposed surfacing is to be performed. Where emulsified asphalt is specified, dilute one part of water to one part of emulsion and apply the mixture at two times the undiluted rate of application. Allow water to evaporate completely before beginning paving operations. At request of Contractor, Engineer may approve a change in the dilution ratio of the water- emulsion mixture. Sampling and testing of the emulsion product will be performed at the discretion of the Engineer.

3.04 ASPHALT PAVEMENT CONSTRUCTION

- A. All mixtures shall be spread and finished with a self-propelled, bituminous paver, to the required section, leaving the mixture uniformly dense, smooth, and free from irregularities.
- B. The speed of the bituminous paver shall be controlled to place the mixture uniformly and continuously without tearing or gouging. The speed shall not exceed the Manufacturer's recommendation, and shall be coordinated with the output of the plant to provide for a smooth, continuous operation, minimizing starting and stopping.
- C. Perform test strip compaction in field under observation of Engineer to determine the percentage of the asphalt mixture's maximum density achievable. If, in the Engineer's opinion, Contractor is unable to achieve the specified density corresponding with 95 percent of the maximum Marshall density (ASTM D1559), Contractor shall achieve an asphalt compaction equaling or exceeding that obtained in the test strip.
- D. Compact pavement by rolling to specified density as follows:
 - 1. Compaction shall consist of initial or breakdown rolling, intermediate rolling, and final or finish rolling with rollers meeting all requirements of MDT Standards Specifications and which are approved by the Engineer.
 - 2. Breakdown rolling shall consist of one or more complete coverages with a rubber tired roller.
 - 3. Breakdown rolling shall be followed by intermediate rolling with either a rubber tired roller or a vibratory steel roller and shall be continued until the surface is tightly bound and shows no displacement under the roller.
 - 4. Intermediate rolling shall be completed before the mat temperature falls below 185° F.
 - 5. Final rolling shall be performed with a steel roller and shall continue until roller marks are eliminated. Contractor may be required to modify rolling sequence to best suit the construction conditions.
 - 6. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
 - 7. Compaction shall be a minimum of 92% of the daily theoretical maximum density (ASTM D-2041).
- E. Uniformly blend pavement surface into elevations at curbs, valve box castings, and other critical points of contact. Place pavement so that the pavement is ¹/₄" higher than the edge of the structure after the pavement has been compacted.
- F. Do not allow drainage to be impeded or casting covers to become difficult to remove.
- G. All transverse and longitudinal joints, high or low areas, and surface irregularities, shall be leveled, filled, or raked prior to compaction. Any loose material dropped on previously compacted lanes shall be removed immediately.

- H. Ensure joints made during paving operations are straight, clean, vertical, and free of broken or loose material. Joints shall be tacked and constructed with adequate bond on abutting surfaces. Vertical construction joints in successive courses shall be placed so that joints do not fall on the same vertical plane.
- I. Rolling shall begin at the edges and proceed parallel to the road centerline, each trip overlapping the previous roller pass. On paving an echelon or abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure. Rolling shall begin at the low elevation and progress to the high elevation by overlapping of longitudinal passes, paralleling the centerline. Displacement resulting from reversing the direction of a roller or from other causes shall be corrected immediately.
- J. The sequence of rolling operations and the selection of type and number of rollers shall be commensurate with production, and shall be adequate to obtain the specified density before the mat temperature falls below 185° F.
- K. Install all bituminous pavement 3-inches and greater in thickness in a minimum of two lifts. Maximum thickness of a base course lift shall be 3-inches.
- L. Ensure surface of completed asphalt pavement is true to lines, profiles, and elevations indicated and matches existing grade.
- M. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.
- N. The surfaces of previously placed layers shall be swept and a tack coat applied before spreading the next layer.
- O. The overall thickness shown on the Drawings shall be the minimum finished, in- place, compacted thickness of bituminous pavement.
- P. Protect newly paved surfaces from traffic and mechanical injury until surface has cooled to 140°F.
- Q. Any low or high defective areas shall be corrected immediately. Corrective Work shall include patching, cutting out the surface and replacing with fresh, hot bituminous mixture, or by milling the surface.
- R. Clean up paving area.
- S. Ensure manhole covers are clean of all asphalt material and tack coat and returned to the condition they were prior to asphalt paving activities.

3.05 PAVEMENT MARKINGS

- A. Remove all dirt, oil, grease, and other foreign material from areas of pavement to be marked. Contractor is responsible for all preparation and layout.
- B. Apply paint only on thoroughly dry surfaces when atmospheric temperature is above 40 °F and when weather is favorable.
- C. Apply respective markings in colors as indicated and sizes and dimensions as indicated,

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or match existing colors and markings.

- D. Contractor shall replace and/or restore all pavement markings after temporary patching or Work has removed such markings.
- E. Contractor shall maintain pavement markings as required during all phases of construction.
- F. Apply painted permanent pavement markings with a maximum coverage rate of 100 square feet per gallon with a 0.015 inch minimum film thickness on bituminous and concrete paved areas, and 0.020 inch minimum film thickness on seal coated areas.
- G. Apply paint with atomizing spray type striping machine. Markings shall have clear- cut edges, true and smooth alignment, and uniform thickness. Do not permit traffic on pavement until markings are thoroughly dry. Other pavement markings shall be painted with the standard templates in an appropriate proportion.
- H. Apply respective markings in colors as indicated and sizes, locations, and dimensions as follows:
 - 1. All parking stalls to be marked with 4" wide striping, color as indicated on Drawings.
 - 2. Crosswalk markings shall be as indicated on Drawings.
 - 3. Pavement arrows, lettering, and symbol dimensions shall conform to MUTCD Standards.
 - 4. All handicapped parking stalls shall be marked with striping and symbols in accordance with Owner and ADA Standards. Handicapped stalls to include both van accessible and non-van accessible. Locations as directed by Owner, or as shown on the drawings. Color shall be blue.
- I. Contractor shall be responsible to replace and/or restore all pavement markings after temporary patching or other Work has removed such markings.
- 3.06 FIELD QUALITY CONTROL
 - A. Section 01 40 00 Quality Control: Field inspection and testing.
 - B. Perform field and laboratory testing by an independent testing laboratory appointed and paid for by the Contractor.
 - C. Determine maximum density in accordance with ASTM D2041, and compact each course in the field to a density not less than 92 percent of the Maximum Density attained by the theoretical maximum density method.
 - D. Perform field density testing in accordance with ASTM D2950; minimum frequency of one test per 2,000 square feet per lift, or once per day, whichever is more frequent. Ensure that the density gauge is properly calibrated and correlated to core density tests for the mix being used.
 - E. Notify testing laboratory to perform density tests when testing is to be performed during construction. Do not proceed with additional Work until results have been verified.

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- F. If, during progress of Work, tests indicate that compacted materials do not meet specified requirements, remove defective Work, replace, and retest. Contractor to bare all costs associated with defective pavement Work.
- G. Perform gradation analysis of aggregate once for each 500 tons of mix produced, as construction progresses. Test base course and wear course for oil content and air voids to differentiate different mix designs.
- 3.07 TOLERANCES
 - A. Flatness: Maximum variation of 3/16 inch measured with 10-foot straight edge.
 - B. Scheduled Compacted Thickness: Within 1/4 inch of specified thickness.
 - C. Variation from true elevation: Within 1/4 inch.
 - D. Variation from horizontal location: Within ¹/₄ inch.
 - E. Transverse slope of surface course shall not vary from the slope shown on Drawings by more than plus or minus ¹/₄ inch in 12 feet.
 - F. Asphalt cement content within 0.24% of approved mix design as determined by daily cutoff report.

END OF SECTION 32 12 16

SECTION 32 31 13 CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Fence framework, fabric, and accessories.
 - 2. Excavation for post bases, concrete foundation for posts, and center drop for gates.
- B. Related Sections include, but are not limited to:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
 - 4. Division 32 Exterior Improvements.

1.02 REFERENCES

- A. Reference Standards include:
 - 1. ANSI/ASTM A123 Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A90/A90M Test Method for Weight of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 3. ASNI/ASTM F567 Installation of Chain-Link Fence.
 - 4. ASTM A116 Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
 - 5. ASTM A120 Pipe, Steel, Black, and Hot-dipped Zinc Coated (Galvanized) Welded and seamless, for Ordinary Uses.
 - 6. ASTM A121 Zinc-Coated (Galvanized) Steel Barbed Wire.
 - 7. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 8. ASTM A370 Mechanical Testing of Steel Products.
 - 9. ASTM A392 Zinc-Coated Steel chain-Link Fence Fabric.
 - 10. ASTM A428 Weight of Coating on Aluminum-Coated Iron or Steel Articles.
 - 11. ASTM A491 aluminum-Coated Steel chain Link Fence Fabric.
 - 12. ASTM A569 Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.
 - 13. ASTM A585 Aluminum Coated Steel Barbed Wire.

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- 14. ASTM C94 Ready-mixed Concrete.
- 15. ASTM F552 Terminology Relating to Chain Link Fencing.
- 16. ASTM F567 Installation of Chain Link Fence.
- 17. ASTM F573 Residential Zinc-Coated Steel chain Link Fence Fabric.
- 18. ASTM F626 Fence Fittings.
- 19. ASTM F900 Industrial and Commercial Swing Gates.
- 20. ASTM F1043 Specifications for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
- 21. ASTM F1083 Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded for Fence Structures.
- B. Chain Link Fence Manufacturers Institute (CLFMI) Product Manual.
- 1.03 SYSTEM DESCRIPTION
 - A. Fence Height: 6 feet with 3-inch clear terminal.
 - B. Line Post Spacing: At intervals not exceeding 10 feet.
 - C. Three strands of barbed wire at top.
- 1.04 SUBMITTALS
 - A. Submit in accordance with Section 01 33 00.
 - B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
 - C. Product Data: Provide data on fabric, posts, accessories, fittings, and hardware.
- 1.05 PROJECT RECORD DOCUMENTS
 - A. Submit under provisions of Section 01 78 00.
 - B. Accurately record actual locations of fence perimeter post relative to project site.
- 1.06 QUALITY ASSURANCE
 - A. Perform Work in accordance with ANSI/ASTM F567.
- 1.07 QUALIFICATIONS
 - A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum of three years' experience.
- 1.08 FIELD MEASUREMENTS
 - A. Verify that field measurements are as indicated on Shop Drawings.
- 1.09 DELIVERY, STORAGE, AND HANDLING
 - A. Delivered materials shall be stockpiled and stored at locations approved by the Owner until required for installation. Materials shall be stored in accordance with manufacturer's

instructions.

B. Contractor shall inspect materials upon delivery for loss or damage in transit. Contractor shall be responsible for the replacement of damaged materials; damaged materials shall be removed from the site.

PART 2 - PRODUCTS

2.01 FENCE MATERIALS

- A. Fence Components
 - 1. Fabric Wire: ASTM A392 zinc coated wire fabric woven in a 2-inch mesh from 9gauge wire. Top selvage twist and bottom selvage knuckle end closed.
 - 2. Line Posts: 2-3/8 inch O.D. galvanized steel Type I or Type II round posts in accordance with the requirements of the CLFMI Product Manual.
 - 3. Corner and Terminal Posts: 2-7/8 inch O.D. galvanized steel Type I or Type II round posts in accordance with the requirements of the CLFMI Product Manual.
 - 4. Top Rails and Post Braces: 1-5/8 inch O.D. galvanized steel tube weighing 1.83 lbs per foot.
 - a. Top rails shall be in lengths not less than 18 feet and shall be fitted with galvanized steel couplings for connecting the lengths into a continuous run. The couplings shall not be less than 6 inches long, with 0.070 inches minimum wall thickness, and shall allow for expansion and contraction of the rail.
 - b. Post braces shall be provided for each gate, corner pull, and end post, and shall consist of a brace rail extending to each adjacent line post at approximately midheight of the fabric, and a truss consisting of a galvanized steel rod not less than 3/8 nominal diameter from the line post back to the gate, corner, pull, or end post, with a turnbuckle or other equivalent provision for adjustment.
 - 5. Post Tops: Galvanized steel ornamental tops provided with a hole suitable for the through passage of the top rail. The post tops shall fit over the outside of posts and shall exclude moisture from posts.
 - 6. Tension Bars: 3/16 inch by ³/₄ inch galvanized steel, not less than 2 inches shorter than the normal height of the fabric with which they are to be used. One tension bar shall be provided for each end and gate post, and two for each corner and pull post.
 - 7. Ties or Clips: Aluminum or galvanized steel of sufficient strength for application.
 - 8. Bands or Clips: Aluminum or galvanized steel per ASTM F-626. Attachment bolts shall be 5/16 x 1-1/4 inch galvanized carriage bolts with nuts.
 - 9. Tension Wire: 7-gauge coil spring wire, galvanized, located at the bottom of fabric.
 - 10. Barbed Wire Supporting Arms: Arms shall be at an angle of approximately 45 degrees, and shall be fitted with clips or other means of attaching three strands of barbed wire. With 45 degree arms, the top wire shall be approximately 12 inches

horizontally from the fence line and the other wires spaced uniformly between the top of the fence fabric and the outside strand. Barbed wire arm shall be sufficient strength to withstand a weight of 250 pound applied at the outer strand of barbed wire.

11. Barbed wire strands shall consist of three strands of twisted wire, zinc coated, conforming to ASTM A121, chain link fence grade, with 4 point barbs on 5-inch centers.

2.02 ELECTRICAL GROUNDS

- A. Electrical grounds consisting of copper coated steel rods having a nominal diameter of five-eighths inch or more and a minimum length of eight feet shall be provided along each fence line.
- B. Grounds rods shall be driven to an elevation approximately flush with the ground surface, at points directly below or adjacent to the fence wire, and each ground rod shall be connected to the fence with a solid No. 6 gauge copper wire. The ground wire shall be attached to the ground rod and to the fence wires with approved type metal clamps in such a manner that each longitudinal fence wire is electrically grounded. No more than one connection will be required on woven wire and chain link fabric, that being near the bottom at each ground rod.

2.03 CONCRETE

- A. Concrete shall have minimum compressive strength of 3,000 psi at 28 days, using three-fourths inch maximum size aggregate.
- B. Non-shrink grout shall consist of one part Portland cement to three parts clean, wellgraded sand, non-shrinking grout additive and the minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

- 3.01 INSTALLATION
 - A. Installation framework, fabric, accessories, and gates shall be done by skilled mechanics in accordance with ANSI/ASTM F567.
 - B. <u>Install in accordance with the fencing details shown on Sheet GC-31 of the project</u> <u>drawings</u>.
 - C. Terminal posts shall be set at the beginning and end of each continuous length of fence and at changes in vertical or horizontal alignments.
 - D. Terminal posts shall be set in concrete with a hole diameter of three (3) times the diameter of post being set (minimum), at post embedment depth required for an 6- foot fence, 36 inches minimum or as indicated by manufacturer.
 - E. Line posts shall be set in concrete with a hole diameter of 9 inches minimum, at a depth and post embedment to a depth of 36-inches minimum. Line post shall be set equidistant at intervals not exceeding 10 feet. Measure the interval parallel to the grade of the

proposed fence and in the line of the fence from center to center of the posts.

- F. Gate posts shall be set in concrete with a minimum hole diameter of three (3) times the diameter (minimum) of post being set, at a post embedment depth required for the size and type of gate installed, 48 inches minimum or as indicated by the manufacturer.
- G. Sleeves may be used in order to leave voids in new concrete construction. Half- fill the void with non-shrink hydraulic cement and force the post to the bottom of the hole and plumb. Thoroughly work additional grout into the hole so as to leave no voids. Crown the grout to shed water.
- H. Top rail shall be supported at each post so that a continuous brace from end to end of each stretch of fence is formed. Securely fasten the top rail to the terminal posts and join with couplings to allow for expansion and contraction.
- I. Tension wire shall be stretched from end to end of each stretch of fence. Place tension wire within the bottom 4-inches of the fabric. The tension wire shall be taut and free of sag.
- J. Chain link fabric shall be placed on the outside of the area enclosed. Place the fabric by securing one end, applying sufficient tension to remove all slack before making attachments elsewhere. Tighten the fabric to provide a smooth uniform appearance free from sag. Use stretcher bars with tension bands or other suitable devices at 15 inch maximum intervals. The fence fabric shall be installed 3 inches above finished grade level. Ground clearance shall be measured at each post, with a tolerance of ± 2 inches. Fabric shall be fastened to the line posts at intervals not exceeding 15 inches vertically. Fasten the fabric to the rail or tension wire at intervals not exceeding 24 inches horizontally.
- K. Fence sides shall run parallel with adjacent City streets, avenues, or roads where applicable.
- L. Gate fabric shall be fastened to the frame on all four sides with tension rods per manufacturer's recommendations.
- M. Install all gate accessories and hardware per manufacturer's recommendations.
- N. Install barbed wire on supporting arms above the fence posts. Extend each end member of gate frames sufficiently above the top member to carry three stands of barbed wire in horizontal alignment with the fence. Pull each strand taut and securely fasten to each supporting arm and extended member.

3.02 ERECTION TOLERANCES

- A. Maximum Variation from plumb: ¹/₄ inch.
- B. Maximum offset from true position: 1 inch.
- C. Components shall not infringe adjacent property lines.

END OF SECTION 32 31 13

CHAIN LINK FENCES AND GATES

SECTION 32 80 00 IRRIGATION

PART 1 - GENERAL

1.01 SUMMARY

- A. The scope of work includes all labor, materials, tools, supplies, equipment, facilities, transportation and services necessary for, and incidental to performing all operations in connection with design, furnishing, delivery, and installation of the irrigation system, complete as shown on the drawings and as specified herein.
- B. Section Includes:
 - 1. Piping
 - 2. Manual valves
 - 3. Automatic control valves
 - 4. Master control valves
 - 5. Flow sensors
 - 6. Transition fittings
 - 7. Miscellaneous piping specialties
 - 8. Sprinklers
 - 9. Drip irrigation specialties
 - 10. Automatic controllers
 - 11. Automatic controller accessories
 - 12. Controller decoders
 - 13. Electrical control wiring
 - 14. Valve boxes and materials
 - 15. Main line accessories
 - 16. Backflow prevention device

1.02 CONTRACT DOCUMENTS

A. Shall consist of specifications, general conditions, and the drawings. The intent of these documents is to include all labor, materials, and services necessary for the proper execution of the work. The documents are to be considered as one. Whatever is called for by any parts shall be as binding as if called for in all parts.

1.03 RELATED DOCUMENTS AND REFERENCES

A. Drawings and general provisions of the Contract, including General Conditions and Supplementary Conditions apply to this Section.

- B. Related Sections:
 - 1. Section 31 14 13 Soil Stripping and Stockpiling
 - 2. Section 32 90 00 Landscaping
 - 3. Section 32 92 19 Seeding
 - 4. Section 32 97 00 Restoration of Disturbed Areas
 - 5. Division 26 Electrical Specifications

1.04 SUBSTITUTIONS

- A. Refer to General Conditions for regarding "Or Approved Equal" Items
- B. "Or approved equal" means that the contractor may propose alternates for certain items, with justification for such alterations, including possible reductions in cost. All cost reductions derived from these changes shall be credited to the end user of the project.
- C. Proprietary materials and equipment found herein have been specified for optimal performance of the irrigation system. Available manufacturers are listed, but not limited to those listed in these specifications. "Or Approved Equal" items shall meet the specifications and performance requirements per plans, schedules and details. All material and equipment substitution requests shall be approved by the Engineer.
- D. Approval of substitution of material and/or products, other than those specified shall not relieve the Contractor from complying with the requirements of the contract documents and specifications. The Contractor shall be responsible, at their own expense, for all changes that may result from the approved substitutions, which affect the installation or operations other items of their own work and/or the work of other Contractors.

1.05 VERIFICATION

- A. Sheet GC-10 identifies the areas that are to be landscaped (grass and evergreen trees) and general locations of the control valve boxes. The Irrigation System designed and installed by the Contractor shall provide for double-coverage, automated watering of the grass areas and individual, automated watering for the trees and (if applicable) shrubs.
- B. Irrigation piping and related equipment are drawn diagrammatically. Scaled dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions and immediately notify the Engineer of discrepancies between the drawings or specifications and the actual conditions. Although sizes and locations of plants and or irrigation equipment are drawn to scale wherever possible, it is not within the scope of the drawings to show all necessary offsets, obstructions, or site conditions. The Contractor shall be responsible to install the work in such a manner that it will be in conformance to site conditions, complete, and in good working order.
- C. Piping and equipment is to be located within the designated planting areas wherever possible unless specifically defined or dimensioned otherwise.

1.06 DEFINITIONS

A. Lateral Piping: Downstream from control valves to sprinklers, specialties, and drain

valves. Piping is under pressure during flow.

- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Mainline Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- E. Engineer: The person or entity, appointed by the Owner to represent their interest in the review and approval of the work and to serve as the contracting authority with the Contractor. The Engineer may appoint other persons to review and approve any aspects of the work.
- F. Substantial Completion Acceptance: The date at the end of the Planting, Planting Soil, and Irrigation installation where the Engineer accepts that all work in these sections is complete and the Warranty period has begun. This date may be different that the date of substantial completion for the other sections of the project.
- G. Final Acceptance: The date when the Engineer accepts that the plants and work in this section meet all the requirements of specification. It is intended that the materials and workmanship warranty for Planting, Planting Soil, and Irrigation work run concurrently.

1.07 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location of valve boxes is approximate. Design and layout of lateral piping and zones to be determined by Contractor. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 200 psig.
 - 2. Lateral Piping: 150 psig.
- D. Each pressure zone shall be designed to deliver 20 gpm but no more than 30 gpm of nonpotable water to the specified planting areas on the contract drawings.

1.08 SUBMITTALS

- A. Refer to the contract Supplementary Conditions for policy and procedures related to submittals.
- B. Irrigation Plan
 - 1. Contractor shall submit a plan view map of each planting area with the following items indicated:
 - a. Location of valve box

- b. Layout of valves within the valve box
- c. Location of low voltage wire
- d. Location of mainline piping
- e. Location of lateral piping
- f. Location and type of sprinkler head
 - i. Nozzle size (water demand)
- g. Water demand calculations for each pressure zone (designed for 20 gpm, but no zone shall exceed 30 gpm)
- 2. Contractor shall submit an As-Built map of the irrigation system with the following items indicated:
 - a. Location of valve box
 - b. Layout of valves within the valve box
 - c. Wiring schematic of valves to controller (ex: what color wire strand is what zone number within the controller program)
 - d. Location of low voltage wire
 - e. Location of mainline piping
 - f. Location of lateral piping
 - g. Location and type of sprinkler head
 - i. Nozzle size (water demand)
 - h. Water demand calculations for each pressure zone (no zone shall exceed 30 gpm)
- C. Product Data
 - 1. For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - a. This submission may be done digitally and all documents shall be submitted in one PDF document.
 - 2. Clearly identify on each submitted sheet by underlining or highlighting (on each copy) the specific product being submitted for approval. No substitutions of material or procedures shall be made concerning these documents without the written consent of an accepted equivalent by the Engineer.
 - 3. Equipment or materials installed or furnished without prior approval of the Engineer, may be rejected by the Engineer and the Contractor shall be required to remove such materials from the site at their own expense.
- D. Other Submittals: Submit for approval:
 - 1. Qualification Data: For qualified Installer.

- 2. Field quality-control reports.
 - a. Static pressure reading at POC(s): Submit prior to installation of irrigation system.
 - b. Testing data from pressure testing

1.09 OBSERVATION OF THE WORK

- A. The Engineer may inspect the work at any time. They may remove samples of materials for conformity to specifications. Rejected materials shall be immediately removed from the site and replaced at the Contractor's expense. The cost of testing materials not meeting specifications shall be paid by the Contractor.
- B. The Engineer shall be informed of the progress of the work so the work may be observed at the following key times in the construction process. The Engineer shall be afforded sufficient time to schedule visit to the site. Failure of the Engineer to make field observations shall not relieve the Contractor from meeting all the requirements of this specification.
 - 1. Equipment and sprinkler head layout review (stake of flag locations of equipment prior to trenching)
 - 2. Trenching, directional boring, and sleeving review
 - 3. Hydrostatic pressure testing
 - 4. Adjustment and coverage test
 - 5. Pre-maintenance observation
 - 6. Final acceptance / system malfunction corrections

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Irrigation Installer whose work has resulted in successful irrigation system installation.
 - 1. Experience: Five years experience in irrigation system installation in addition to requirements in Standard General Conditions and Supplementary Conditions.
 - 2. Installer's Field Supervision: Requires Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 1.11 WARRANTY
 - A. The Contractor shall warranty all workmanship and materials for a period of 24 months following the acceptance of the work.
 - B. Any parts of the irrigation work that fails or is defective shall be replaced or reconstructed at no expense to the Owner including but not limited to: restoring grades that have settled in trenches and excavations related to the work. Reconstruction shall

include any plantings, soil, mulch or other parts of the constructed landscape that may be damaged during the repair or that results from soil settlement.

- C. The date of acceptance of the work and start of the Warranty period shall be determined by the Engineer, upon the finding that the entire irrigation system is installed as designed and specified, and found to be operating correctly, supplying water evenly to all planting and/or lawn areas.
- D. Neither the final acceptance nor any provision in the contract documents shall relieve the Contractor of responsibility for faulty materials or workmanship. The Contractor shall remedy any defects within a period of 7 days (s) from the date of notification of a defect.
- E. Provide extended warranty for period equal to original warranty period, for replaced irrigation material.
- 1.12 DELIVERY, STORAGE, AND HANDLING
 - A. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
 - B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.
 - C. Replacements
 - 1. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

1.13 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without written permission from the Engineer.

1.14 EQUIPMENT TO BE FURNISHED TO THE OWNER

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Spray Sprinklers and Rotors: Equal to 10 percent of amount installed for each type and size indicated.
 - 2. Emitters/Bubblers: Equal to 10 percent of amount installed for each type indicated.
- 1.15 EQUIPMENT TO BE FURNISHED TO OWNER
 - A. Two (2) sets of keys for each automatic controller

- B. Two (2) sets of keys for backflow preventer cage
- C. Three (3) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project
- D. Five (5) Extra sprinkler heads, nozzles, shrub adapters, nozzle filter screens, for each type used on the project
- E. Two (2) quick coupler keys to match manufacturer type of quick coupler
- F. Drip-Tube System Tubing: Equal to 10 percent of total length installed for each type and size indicated
- 1.16 EXCAVATING AROUND UTILITIES
 - A. Contractor shall carefully examine the civil, record, and survey drawings to become familiar with the existing underground conditions before digging.
 - B. Do not begin any excavation until all underground utilities have been located and marked. The Contractor is responsible for knowing the location and avoiding utilities that are not located by a locator.
 - C. Determine location of underground utilities and perform work in a manner that will avoid possible damage. Hand excavate, as required. Maintain stakes and or markings set by others until parties concerned mutually agree to their removal.

1.17 POINT OF CONNECTION

- A. The point of connection of the irrigation system to its electrical power sources shall be provided by a licensed electrical Contractor per governing codes at the location shown on the drawings.
- B. The irrigation Contractor (licensed or not as an electrical contractor) will connect the power to provided junction box or grounded plug receptacle.
- C. The point of connection of the irrigation system to its non-potable water source, including the main shutoff valve and backflow preventer shall be provided by a licensed plumbing Contractor per governing codes at the location shown on the drawings. The minimum size and water pressure of the pressurized line will be as noted on the irrigation drawing.

1.18 AS BUILT RECORD SET OF DRAWINGS

- A. Immediately upon the installation of any buried pipe or equipment, the Contractor shall indicate on the progress record drawings the locations of said pipe or equipment. The progress record drawings shall be made available at any time for review by the Engineer.
- B. Before final acceptance of work, the Contractor shall provide an as built record set of drawings showing the irrigation system work as built. The drawings shall be transmitted to the Engineer in paper format and as a pdf file of each document on compact disk or flash drive. The drawings shall include all information shown on the original contract document and revised to reflect all changes in the work. The drawings shall include the following additional information
 - 1. All valves shall be numbered by station and corresponding numbers shall be shown

on the as built record set of drawings.

- 2. All main line pipe or irrigation equipment including sleeves, valves, controllers, irrigation wire runs which deviate from the mainline location, backflow preventers, remote control valves, grounding rods, shut-off valves, rain sensors, wire splice locations, and quick coupling valves shall be located by two (2) measured dimensions, to the nearest one-half foot. Dimensions shall be given from permanent objects such as buildings, sidewalks, curbs, walls, structures and driveways. All changes in direction and depth of main line pipe shall be noted exactly as installed.
- C. As built record set of drawings shall be signed and dated by the Contractor attesting to and certifying the accuracy of the as built record set of drawings. As built record set of drawings shall have "As Built Record Set of Drawings", company name, address, phone number and the name of the person who created the drawing and the contact name (if different).
- D. The Owner shall make the original contract drawing files available to the Contractor.
- 1.19 CONTROLLER CHARTS:
 - A. Provide one controller chart for each automatic controller installed.
 - B. On the inside surface of the cover of each automatic controller, prepare and mount a color- coded chart showing the valves, main line, and systems serviced by that particular controller. All valves shall be numbered to match the operation schedule and the drawings. Only those areas controlled by that controller shall be shown. This chart shall be a plot plan, entire or partial, showing building, walks, roads and walls. The plan, reduced as necessary and legible in all details, shall be made to a size that will fit into the controller cover. This print shall be approved by the Engineer and shall be protected in laminated in a plastic cover and be secured to the inside back of the controller cabinet door.
 - C. The controller chart shall be completed and approved prior to acceptance of the work.

PART 2 - PRODUCTS

- 2.01 MATERIALS GENERAL
 - A. All materials shall be of standard, approved and first grade quality and shall be new and in perfect condition when installed and accepted.
 - B. Refer to the Irrigation Schedule on the drawings, or the specifications herein for specific components and manufacturers.
 - C. No substitutions without written authorization and approval from the Engineer.
 - D. Approval of any items or substitutions indicates only that the product(s) apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted. The Contractor shall be responsible for the performance of substituted items. If the substitution proves to be unsatisfactory or not compatible with other parts of the system, the Contractor shall replace said items with the originally specified items,

including all necessary work and modifications to replace the items, at no cost to the owner.

- 2.02 PIPING SCHEDULE & FITTINGS
 - A. Install components having pressure rating equal to or greater than system operating pressure.
 - B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
 - C. Mainline Pipe shall be rigid unplasticized Schedule 40 PVC. Mainline Pipe shall be gasketed.
 - D. Lateral Pipe shall be butt- fused, socket-fused or Oetiker-clamped DR13.5 HDPE, conforming to ASTM D2239, ASTM D2737, ASTM D3035, ASTM D and AWWA C901 standard specifications for Polyethylene pressure pipe and tubing. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, deleterions, wrinkles, and dents.
 - E. All pipe shall be continuously and permanently marked with the following information.
 - 1. Manufacturer's name or trademark, size, schedule and type of pipe, working pressure At 73 degrees F. and National Sanitation Foundation (N.S.F.) approval.
 - F. Mainline Pipe from shall be a gasketed pipe. All Lateral Pipe shall be installed with buttfused or mechanically-clamped pipe joints. Drip emitter line may be installed with barbed fittings of the same manufacturer.

2.03 PIPING JOINING MATERIALS

- A. General
 - 1. All plastic pipe fittings shall be permanently marked with the following information:
 - a. Manufacturer's name or trademark, size, schedule and type of pipe, working pressure at 73 degrees F. and National Sanitation Foundation (N.S.F.) approval.
 - 2. All plastic pipe fittings to be installed shall be molded fittings manufactured of the same material as the pipe and shall be (individually) suitable for butt-fusing, mechanically-clamped, or Oetiker clamped connection.
 - 3. All plastic pipe fittings shall provide the same pressure performance as the pipe itself. For the PVC Mainline Pipe, that shall be equivalent to Schedule 40, or 158 psi. maximum operating pressure. For the HDPE Lateral Pipe, that shall be 160 psi. maximum operating pressure.
 - 4. Sections of polyethylene pipe should be joined into continuous lengths on the job site above ground. If the joining method is the butt fusion method, it shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 500 Degrees F, alignment, and 150 psi interfacial fusion pressure.

Butt fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications, nor in fabrications where shear or structural strength is important. Flanges, unions, grooved-couplers, transition fittings and some mechanical couplers may be used to mechanically connect HDPE pipe without butt fusion. Connection method shall be approved by the Engineer. Refer to the manufacturer's recommendations

- 5. Slip fitting socket taper shall be so sized that a dry unsoftened pipe end, conforming to these special provisions, can be inserted no more than halfway into the socket. Plastic flange fittings will not be permitted. Only schedule 80 fittings may be threaded.
- 6. When connection is plastic to metal, plastic male adaptors shall be used. The male adaptor shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be Teflon Tape.
- B. Fittings- Butt Fused or Mechanically Clamped
 - 1. All Lateral Pipe fittings shall be HDPE DR 13.5 butt-fused or mechanicallyclamped. Fittings shall be manufactured by Lasco, Spears or acceptable equal.
- C. Fittings- Gasketed
 - 1. All Mainline Pipe fittings shall be gasketed ductile iron.
 - 2. Fittings shall be manufactured by Harco or acceptable equal.
- D. Fittings Mainline to Lateral
 - 1. Connection between Mainline Pipe and Lateral control valve piping can be made using HDPE DR 13.5 butt-fused or mechanically-clamped.
 - 2. Fittings shall be manufactured by Harco or acceptable equal.
- E. PVC to HDPE Transition
 - 1. HDPE to PVC transition shall be accomplished with a threaded coupling. The PVC pipe shall have a solvent welded, NTP-threaded, female fitting. The HDPE shall have a butt-fused, NTP-threaded, male fitting. The threaded transition shall be properly thread taped and secured to avoid leakage.
- F. Fittings- Saddle Tees
 - 1. Shall not be permitted.
- G. Solvent Cement
 - All solvent cement and primer shall be manufactured by the same manufacturer for use together. Cement and primer products shall be manufactured with all virgin materials only. Solvent cement shall be NSF listed and shall meet or exceed ASTM D-2564. Primer shall be NSF listed and shall meet or exceed ASTM F-656.

2.04 AUTOMATIC CONTROL VALVES

- A. Automatic irrigation control valves shall be of the same manufacturer as the selected automatic irrigation controller and have the following features:
 - 1. Normally closed, electronically-actuated, diaphragm-operated, remote-control valve. The valve will be capable of operating between 20 and 220 psi. with a flow range of between 20 and 150 gpm. Pressure loss shall be 1.7 psi maximum at 60 gpm.
 - 2. Globe body style with 2-inch Female National Pipe Thread (FNPT) inlet and outlet.
 - 3. Flow control mechanism with removable handle that will regulate flow from full on to completely off.
 - 4. Body and bonnet shall be molded of non-corrodible, glass-reinforced nylon, rated to 220 psi. The body of the valve shall have brass inserts, with through-holes, which will accept the bonnet bolts. The bonnet bolts shall be serviceable with a slotted screwdriver, Phillips screwdriver, or a hex wrench, and shall be held captive in the bonnet when the bonnet is removed from the valve body.
 - 5. The diaphragm assembly shall be of molded EPDM construction, reinforced with nylon fabric and have an EPDM seating material.
 - 6. Internal filter as well as a self-cleaning metering rod, so only clean water can enter the solenoid chamber. An optional filter cleaning system that cleans a stainless steel filter each time the valve opens and closes shall be available.
 - 7. All metal parts internal to the valve shall be manufactured from corrosion-resistant stainless steel.
 - 8. An adjustable pressure regulating device with a calibrated dial for setting of the outlet pressure. (The regulator shall be capable of adjusting the outlet pressure from between 20 and 100 psi. when inlet pressure is 15 psi. or greater than regulated outlet pressure. The regulated downstream pressure shall remain constant regardless of variations in upstream pressure. The regulation shall be maintained when valve is manually operated with use of internal bleed valve.
 - 9. Standard solenoid shall be a 24 VAC unit with a 370mA inrush current and 190mA holding current at 60 cycles and a 475 mA inrush current and 230 mA holding current at 50 cycles.
 - 10. Solenoid shall be an encapsulated, one-piece unit with captive plunger. It shall be equipped with manual internal and external bleed capability to release the upper chamber water to the downstream piping, or to atmosphere, allowing the valve to open.
 - 11. No less than a five-year, exchange warranty (not prorated).
- B. The automatic irrigation control valves shall be the ICV-201G-AS as manufactured by Hunter Industries Incorporated, San Marcos, California, or pre-approved equal
- C. All automatic control valves shall be connected with gasketed gray manifold pieces to

allow for valve maintenance if required in the future.

2.05 RISERS

- A. Stationary Spray Heads
 - 1. All stationary spray heads shall have Hunter model SJ-512 pre-manufactured swing assemblies or equal approved in advance by the Engineer. Swing assembly shall be 1/2"x 1/2"x 1/2"x 12" NPT.
- B. Rotor Pop-up Sprinklers
 - 1. All 1" inlet rotor pop-up sprinklers shall have an adjustable pre-assembled double swing joint riser. Swing joints shall be Rain Bird model TSJ-12 or equal approved in advance by the Engineer. Swing joints shall be 1" x 12" and shall be threaded both ends.
 - 2. All 3/4" inlet rotor pop-up sprinklers shall have an adjustable pre-assembled swing assembly risers. Swing assemblies shall be Rain Bird model TSJ-12075 or equal approved in advance by the Engineer. Swing assemblies shall be 3/4" x 12" and shall be threaded both ends.
- C. Quick Coupling Valves
 - 1. All quick coupling valves shall have an adjustable pre-assembled double swing joint riser. Swing joints shall be Lasco model G13S-218 or equal approved in advance by the Engineer. Swing joints shall be 1" x 18" and shall be threaded both ends. The swing joint riser shall be of proper pipe size to match quick coupling valve threads.

2.06 VALVE BOXES

- A. General
 - All valve boxes containing automatic valves shall be Jumbo model(s) at a minimum. All remote control valves, manual control valves, zone shut-off valves, gate valves or globe valves, quick coupling valves, grounding rods, air relief valves, and 120 volt and communication wiring splices, unless otherwise indicated, shall be installed in valve access box of proper size as required for easy access to the valve. All covers to be T- Cover type and locking. All valve boxes shall be of the same manufacturer. Locking bolts shall be delivered to the Owner unless directed otherwise by the Engineer.
 - 2. All valve boxes shall be installed with 8" of 3/4" minus washed, compacted gravel below the box to allow water to drain from box if maintenance within the valve box is required.
- B. Grounding Rods
 - 1. Standard box for all ground rod installations to be Carson 910-10-4 or NDS 212BCB ELEC, with gray cover.
- C. Lateral, Isolation, Quick Coupling, and Drain Valves
 - 1. Standard box for all lateral, isolation, quick coupling, and drain valves to be Carson

910- 10-4 or NDS 212BCB with locking green cover. Provide 4" PVC pipe sleeve valve box extensions as required.

- 2. All boxes for valves 3" and larger shall be Carson 1419-12-4 or NDS 214BCB with locking green cover.
- D. Control Valves
 - Standard box for all electric control valves, shall be Carson L-1730-18 or NDS 17"x30" standard box with locking green cover. Provide matching valve box extensions as required. Contractor is allowed to use smaller valve boxes and place 2 control valves per box rather than 4 in one box.
- E. Air Relief Valves
 - 1. Standard box for air relief valves shall be Carson 1220-12-4 or NDS 218BCB with locking green cover. Provide matching valve box extensions as required.
- F. Pull Boxes
 - Standard box for all electrical and communication cable pull boxes shall be Carson 1419- 12-4 or NDS 214BCB ELEC with locking gray cover, electrical marking. Provide matching valve box extensions as required.

2.07 SPRINKLER HEADS

- A. General
 - 1. Sprinkler heads shall be constructed of bronze, brass, stainless steel, cast iron and/or non-metallic materials.
 - 2. All heads of a particular type and for a particular function in the system shall be of the same manufacture and shall be marked with the manufacturer's name and identification, in such a position that they can be identified without being removed from the system.
- B. All rotor heads shall be model I-20-04 as manufactured by Hunter Industries, or preapproved equal.
- C. All spray heads shall be models Pro-PSU as manufactured by Hunter Industries, or preapproved equal.
- 2.08 DRIP TUBING AND EMITTERS
 - A. Drip tubing and emitters shall be used for irrigating hedges, shrubs and trees as shown on the drawings. Drip tubing and emitters shall have the following features:
 - 1. In-line, pressure-compensating, non-draining, non-clogging emitters;
 - 2. Built-in check valves;
 - 3. Operating pressure range from 15 to 50 psi;
 - 4. UV resistant, kink resistant, flexible;
 - 5. Natural color.

B. Drip tubing and emitters shall be PLD-10 (1 gpm. emitters) with emitter spacing of 12" or 18" as specified on the drawings, manufactured by Hunter Industries, or approved equal.

2.09 AUTOMATIC IRRIGATION CONTROLLER

- A. The automatic field controller shall have the following features:
 - 1. Modular design that is provided with adequate available stations to control all pressure zones from each irrigation stub-out at the specified locations on the contract drawings.
 - 2. When installed or removed, the modules, and station count shall be automatically recognized by the controller.
 - 3. UL listed, NEMA 3R rated cabinet for use in the outdoor models. The front panel of the controller shall be removable to allow for remote programming.
 - 4. No less than three independent programs (A, B, C) with 4 start times per program for a total of up to 12 start times per zone. Watering times for each station shall be available from 1 minute to 120 minutes in 1-minute increments and in 10 minute increments from 120 minutes up to 6 hours.
 - 5. No less than 4 weekly schedule options to choose from: 7-day calendar, 31-day interval calendar, odd day programming and even day programming. It shall also have a 365-day calendar clock to accommodate true odd-even watering. The controller shall be capable of determining and displaying the total run time input for each program.
 - 6. Capability to store a program in backup memory for easy retrieval, and also have a test program for quick system checks.
 - 7. Capable of identifying field wiring problems through the use of a troubleshooting feature.
 - 8. Operation shall be available in automatic, semi-automatic and manual modes. All programming shall be accomplished by use of a programming dial and selection buttons with user feed-back provided by a LCD display.
 - 9. Rain sensor on-off switch that allows the user to override a sensor that has suspended watering. The controller shall have a programmable rain delay that turns off the controller for a predetermined period of time, from 1 to 7 days, and shall allow the sensor input to be programmed by station.
 - 10. Seasonal adjust feature that allows for station run times to be changed from 0% to 300% in 10% increments to compensate for weather changes.
 - 11. Programmable event day off to prevent watering on a selected day of the week. It shall also have a programmable delay between valve stations. Delays between stations shall be programmable in 5 second increments from 0 to 60 seconds and in 1-minute increments from 60 seconds up to 4 hours. A pump start/master valve circuit shall be included (if necessary), and shall be programmable by station.

- 12. Transformer input shall be 120 VAC, 60Hz or 230 VAC 50Hz depending on requirements. Transformer output shall be 24 VAC, 1.0A. Maximum output per station shall be 24 VAC, 0.56A.
- 13. Program backup shall be provided by a non-volatile memory circuit that will hold the program data indefinitely. It shall also track time of day, and date indefinitely.
- 14. Metal Oxide Varistors (MOVs) on the power input portion and the secondary output portion to help protect the micro-circuitry from power surges. The secondary MOVs shall be enclosed in the station modules for easy servicing.
- 15. Self-diagnostic, electronic short circuit protection that detects a faulty circuit, continues watering the remainder of the program, and reports the faulty station on the display. The diagnostic function shall also be capable of being initiated manually by the user.
- 16. No less than 2 options for remote control use, the ROAM remote control package that enables remote operation of the controller up to 1000 feet away and the ICR remote control package that enables remote operation of the controller up to 2 miles away. Connection of remotes to the controller shall be provided through the SmartPort® outlet. The controller shall have central control capability through the Irrigation Management and Monitoring System (IMMSO).
- B. The controller shall be installed in accordance with the manufacturer's published instructions.
- C. The controller shall carry a conditional two-year exchange warranty.
- D. The automatic controller(s) shall be the PRO-C series controller as manufactured for Hunter Industries Incorporated, or pre-approved equal.

2.10 CONTROL CABLE

- A. All electrical control and ground wire shall be irrigation control cable as manufactured by Paige Electric Co., Box 368, Union, NJ 07083, telephone 800-327-2443 or equal approved in advance by the Engineer. All control cable shall be 14-gauge and all common cable shall be 12-gauge unless otherwise indicated on the drawings, and rated for direct burial applications.
- B. All wiring to be used for connecting the automatic remote control valve to the automatic controllers shall be 600 volt, soft drawn solid copper single conductor wire meeting the requirements of ASTM B-3 or B-8, -55° C to +60° C temperature rated with 0.045" polyethylene insulation. All control cable shall be marked with manufacturer identification, voltage rating, size and type and shall bear UL file number.
- C. All cables shall be tested physically and electrically in accordance with UL Standard 493, and 83, paragraphs 28.1, 29.1 and 29.2. All reels and cartons shall bear UL labels.
- D. All control or "hot" wires shall be of color coded irrigation control cable. When more than one valve is operated by a single controller station provide separate control wire from the controller to each valve. All control cable shall run continuously from the

controller to the valve without splicing.

- E. Connection to remote control valve solenoid shall be made with 3M DBY/DBR Splice kits and located in valve the box.
- F. Verification of wire types and installation procedures shall be checked to conform to local codes
- G. All control cable shall be installed in conduit to allow pulling new wire in the event of wire failure.
- 2.11 120 VOLT WIRING
 - A. Refer to Division 26
- 2.12 GROUNDING
 - A. General
 - 1. All controllers shall be properly grounded in accordance with manufacturer's installation requirements

2.13 OTHER MATERIALS

- A. Materials to be furnished
 - 1. Two keys for each automatic controller.
 - 2. Two isolation valve keys for each type of valve installed. Five heads of each type installed with nozzles.
 - 3. Two automatic control valves for each size and type installed.
 - 4. Five sprinkler head adjustment tools for each size and type of sprinkler installed.
 - 5. The above equipment shall be turned over to the Owner at the conclusion of the project. Before final inspection can occur, evidence that the Owner has received materials must be shown to the Engineer.
- B. All other materials, not specifically described but required for a complete and proper irrigation system installation, shall be new, first quality of their respective kinds, and subject to the approval of the Engineer
- 2.14 CONCRETE
 - A. All concrete used for securing irrigation system components shall be 3,000 psi at 28 days, transit mixed. Provide certifications with each delivery

2.15 BACKFLOW PREVENTION DEVICE

- A. Backflow Prevention Device:
 - 1. All backflow prevention devices shall be manufactured by Wilkins, or pre-approved equal.
- 2.16 BACKFLOW PREVENTER CAGE
 - A. A heavy-duty steel mesh cage with rust proof finish. The caging shall be sized to allow

space for the entire piping assembly associated with the Backflow Preventer unit, and all associated equipment.

- B. The cage shall include the manufacturers' standard tamper proof locking mechanism.
- C. Provide a concrete base to prevent un-warranted access into the cage.
- 2.17 DETECTABLE WARNING TAPE
 - A. General Requirements: Marking tape for easy buried pipeline detection and below ground identification and warning, detectable with a non-ferrous metal detector when buried at the proper depths.
 - B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following or approved equal:
 - 1. T. Christy Enterprises
 - 2. NMC (National Marker Company)
 - 3. Pro-Line Safety Products
 - C. Description: 3" wide detectable tape of 5 mil overall thickness, with a .35 mil solid aluminum foil core muli-ply composition, acid, alkaline and corrosion resistant. The tape tensile strength is in accordance with ASTM 882-80A and shall not be less than 4500 PSI. Tape The color is Blue to conform with the APWA Uniform Color Code. The text shall indicate "Irrigation" lines.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. All equipment shall be installed to meet all installation requirements of the product manufacturer. In the event that the manufacturer's requirements cannot be implemented due to particular condition at the site or with other parts of the design, obtain the Engineer's written authorization and approval for any modifications.
- B. Extreme care shall be exercised at all times by the Contractor in excavating and working in the project area due to existing utilities and irrigation systems to remain.
- C. The Contractor is responsible for identifying and maintaining any existing irrigation main lines that supply water to areas on the site as noted on the drawings and outside of the proposed limit of work. The Contractor shall relocate or replace any existing irrigation main line piping as required to provide a continuous supply of water to all areas of existing irrigation on site.
- D. Group valves and general irrigation equipment together where practical and install within planting areas.
- E. Final site conditions and existing and proposed plantings shall determine final locations and adjust coverage. Minor changes in locations of the above from locations shown shall be made as necessary to avoid existing and proposed trees, piping, utilities, structures,

etc. at the contractor's expense or when directed by the Engineer.

- 1. The Contractor shall be held responsible for relocation of any items without first obtaining the Engineer's approval. The Contractor shall remove and relocate such items at their expense if so directed by the Engineer.
- F. Prior to any work the Contractor shall stake out locations of all pipe, valves, equipment and irrigation heads and emitters using an approved staking method and maintain the staking of the approved layout in accordance with the drawings and any required modifications. Verify all horizontal and vertical site dimensions prior to staking of heads. Do not exceed spacing shown on drawings for any given area. If such modified spacing demand additional or less material than shown on the drawings, notify the Engineer before beginning any work in the adjacent area.
- G. Prior to starting any work, Contractor shall obtain a reading of existing static water pressure (no flow condition) at the designated point of connection and immediately submit written verification of pressure with date and time of recording to Engineer.
- H. All sprinkler irrigation systems shall require backflow prevention. All backflow prevention devices shall meet and be installed in accordance with requirements set forth by local codes and the health department.
- I. Stub out main line at all end runs and as shown on drawings.
- J. No fittings shall be installed on pipe underneath pavement or walls.

3.02 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in other specifications bound herein.
- B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 24 inches below finished grade.
 - 2. Lateral Piping: 18 inches.
 - 3. Drain Piping: 12 inches.
 - 4. Sleeves:
 - a. 24" under sidewalks
 - b. 30" under driveways
 - c. 36" under streets.

3.03 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Engineer's approval

before excavation.

3.04 PIPE INSTALLATION

- A. Location and Arrangement: Approved submittal plan drawings indicate location and arrangement of piping systems. Install piping as indicated on approved submittal.
- B. Install piping free of sags and bends.
- C. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- D. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- E. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- F. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- G. Install PVC piping in dry weather when temperature is above 40°F. Allow joints to cure at least 24 hours at temperatures above 40°F before testing.
- H. Install water hammer arresters, if needed, between connection to main line and lateral valves aboveground or in control-valve boxes.
- I. Install piping in sleeves under parking lots, roadways, and sidewalks.
- J. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. NPS 1-1/2 and Smaller: Plastic-to-metal transition fittings.
 - b. NPS 2 and Larger: AWWA transition couplings.

3.05 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- D. Plastic Pipe shall be installed in a manner so as to provide for expansion and contraction as recommended by the manufacturer.
- E. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

- 3. PVC Nonpressure Piping: Join according to ASTM D 2855.
- 4. The solvent-weld joints shall be allowed to set at least 24 hours before pressure is applied to the system on PVC pipe.
- 5. Only the solvent cement recommended by the pipe manufacturer shall be used. All plastic pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer and it shall be the Contractor's responsibility to make arrangements with the pipe manufacturer for any field assistance that may be necessary. The Contractor shall assume full responsibility for the correct installation.
- F. All HDPE DR 13.5 joints shall be butt-fused or mechanically-clamped.
- G. All plastic to metal joints shall be made with plastic male adaptors. The solvent-weld joints shall be made dry.
- H. Thrust Blocks
 - 1. Provide concrete thrust blocks for all pipe as required by the schedule on the drawings. All thrust blocks shall bear directly on undisturbed earth. Center pipe in the middle of thrust block.
- 3.06 VALVE INSTALLATION
 - A. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
 - 1. Install valves and PVC pipe with restrained, gasketed joints.
 - B. Pressure-Reducing Valves: Install in boxes for automatic control valves.
 - C. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- 3.07 AUTOMATIC CONTROL VALVES PRESSURE REGULATORS
 - A. Install Adjustable pressure regulator on every valve, for use with latching valve solenoid.
 - B. Set pressure regulation to 5% higher than Zone Design presser on Valve Schedule per drawings.
- 3.08 VALVE BOX INSTALLATION
 - A. Install one valve box for each type of valve installed as per the details.
 - B. Install boxes where indicated on Contract Drawings and perpendicular to edge of paving and parallel to each other. Allow 12 inches clearance between adjacent valve boxes.
 - C. Automatic Control Valve Boxes:
 - 1. Install flush with topsoil grade in lawn areas.
 - 2. Install 1" above topsoil grade in planter beds.
 - D. Gravel sump, eight inch minimum depth shall be installed at the base of each valve box after compaction of all trenches.

- E. Permanently label valve number and or controller letter on top of valve box lid using a method approved by the Owners Representative.
- F. HDPE Valve Boxes: Install to a 30" depth with valve box lids located below mulch layer.
- 3.09 SPRINKLER INSTALLATION
 - A. Flush system after hydrostatic test is completed before installing sprinkler heads.
 - B. Install sprinkler heads to final grade where sod lawn will be installed. Make necessary field adjustments for full coverage.
 - C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.
 - D. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated on the drawings or details.
- 3.10 DRIP IRRIGATION INSTALLATION
 - A. Irrigation specialty type, arrangement, sizes, water-flow data, and mounting heights are shown on Drawings and details.
 - B. Install drip tubing at finished grade over weed barrier fabric, cover with mulch.
 - C. Install drip tubes with direct-attached emitters with plastic tubing stake per manufacturer's specifications.
 - D. Install dripline tubing per drawings and manufacturer's specifications.
 - E. Install drip control zone kits per drawings and manufacturer's specifications.
 - F. Clamp fittings with Oetiker clamps or approved equal when operating pressure exceeds specific drip tubing fitting requirements.
 - G. When installing drip tubing, install soil staples as listed below:
 - 1. Sandy Soil One staple every three (3') feet and two (2) staples on each change of direction (tee, elbow, or cross).
 - 2. Loam Soil One staple every four (4') feet and two (2) staples on each change of direction (tee, elbow, or cross).
 - 3. Clay Soil One staple every five (5') feet and two (2) staples on each change of direction (tee, elbow, or cross).
 - H. Cap or plug all openings as soon as lines have been installed to prevent the intrusion of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
 - I. Thoroughly flush all water lines before installing valves and other hydrants.
- 3.11 AUTOMATIC CONTROLLER
 - A. Equipment Mounting: Install all controllers on the interior of the buildings.
 - B. Setup controller to operate with all sensors, flow sensors and master valves for proper

system operation.

- C. Controller shall be tested with complete electrical connections. The Contractor shall be responsible for temporary power to the controller for operation and testing purposes.
- D. Connections to control wiring shall be made within the controller cabinet. All wire shall follow the pressure mainline insofar as possible.
- E. Electrical wiring shall be in conduit from controller to electrical outlet per Engineer's plans and specifications. A licensed electrical Contractor shall be responsible for installing all wiring to the controller, in order to complete this installation. A disconnect switch shall be included.

3.12 WIRING

- A. Low Voltage
 - 1. Control wiring between controller and electrical valves shall be installed in the same trench as the main line where practical. The wire shall be bundled and secured to the lower quadrant of the trench at 10 foot intervals with plastic electrical tape.
 - 2. When the control wiring cannot be installed in the same main line trench it shall be installed a minimum of 18 inches below finish grade and a bright colored plastic ribbon with suitable markings shall be installed in the trench 6 inches below grade directly over the wire.
 - 3. An expansion loop shall be provided every 1000 feet in a box and inside each valve box. Expansion loop shall be formed by wrapping wire at least eight (8) times around a ³/₄ inch pipe and withdrawing pipe.
 - 4. All control wire splices not occurring at control valve shall be installed in a separate splice valve box.
 - 5. All control wiring shall be installed in separate sleeves.
- B. High Voltage
 - 1. All electrical work shall conform to local codes, ordinances and any authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.
 - 2. The Contractor shall provide 120-volt power connection to the automatic controller unless noted otherwise on drawings.

3.13 BACKFLOW PREVENTION DEVICE

- A. Backflow Prevention Device shall be installed in a locking backflow cage.
 - 1. Lock cage after installation.
- B. Pressure Vacuum Breaker shall be installed 12" above highest elevation of irrigation system. Refer to drawings for proper elevation.
- 3.14 CONNECTIONS

- A. Comply with requirements for piping per Engineers Drawings and Specifications for water supply from exterior water service piping, water meter, and vault to Point of Connection. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring, equipment and decoders between controller and automatic control valves.
- 3.15 IDENTIFICATION
 - A. Permanently label valve number on top of valve box lid using a method proposed by the Contractor and approved by the Engineer. Method shall be highly resistant to wear.
 - B. Valve Identification Tags: Install tags on each automatic control valve with corresponding valve number per the valve schedule. Install on Master Valve with initials "MV". Secure tags to each valve in visible location without impeding valve operation.
 - C. Detectable Warning Tape: Install continuous, underground, detectable warning tapes 6 inches below finished grades, directly above all underground mainline and lateral piping.
- 3.16 BACKFILLING AND COMPACTING
 - A. Irrigation trenches shall be carefully backfilled with material approved for backfilling and free of rocks and debris one (1) inch in diameter and larger. When back filling trenches in areas of imported or modified planting soil, replace any excavated subsoil at the bottom and the imported soil or modified planting soil at the top of the trench.
 - B. Backfill shall be compacted with approved equipment to the following densities
 - 1. Backfill under pavement and within 2 feet of the edge of pavement: Compact to 95% or greater of maximum dry density standard proctor.
 - 2. Backfill of subsoil under imported planting mixes or modified existing planting soil: Between 85 and 90% of maximum dry density standard proctor.
 - 3. Backfill of imported planting mixes or modified existing planting soil: Compact to the requirements of the adjacent planting mix or planting soil as specified in section "Planting Soil".
 - C. Finished grade of all trenches shall conform to adjacent grades without dips or other irregularities. Dispose of excess soil or debris off site at Contractor's expense.
 - D. Any settling of backfill material during the maintenance or warranty period shall be repaired at the Contractor's expense, including any replacement or repair of soil, lawn, and plant material or paving surface.
- 3.17 REPAIR OF PLANTING SOIL
 - A. Any areas of planting soil including imported or existing soils or modified planting soil which become compacted or disturbed or degraded as a result of the installation of the irrigation system shall be restored to the specified quality and compaction prior to beginning planting operations at no additional expense to the Owner. Restoration

methods and depth of compaction remediation shall be approved by the Engineer.

3.18 TESTING AND INSPECTION

- A. Closing-in Uninspected Work
 - 1. Do not allow or cause any of the work in this section to be covered up or enclosed until it has been inspected, tested, and approved by the Engineer.
 - 2. Where trenches are not closed at the end of the day Contractor shall accept all liability for any damage or injury that may result from open trenches. Provide barricades and warning tape as necessary around all open trenches.
- B. Flushing
 - 1. Before backfilling the mainline, and with all control valves in place, but before lateral pipes are connected, completely flush and test the mainline and repair for all leaks; flush out each section of lateral pipe before sprinkler heads are attached.
- C. Testing
 - 1. Make all necessary provisions for thoroughly bleeding the line of air and debris. Before testing, fill the line with water for a period of at least 24 hours.
 - 2. After valves have been installed, test all live water lines for leaks at a pressure of 100 psi for a period of two hours, with all couplings exposed and with all pipe sections centerloaded.
 - 3. Furnish all necessary testing equipment and personnel.
 - 4. Correct all leaks and retest until acceptance by the Engineer.
 - 5. All couplings/joints shall remain exposed until the pressure test has been approved by the Engineer.
- D. Final Inspection
 - 1. Thoroughly clean, adjust, and balance all systems.
 - 2. Demonstrate the entire system to the Engineer, proving that all remote control valves are properly balanced, that all heads are properly adjusted for radius and arc of coverage, and that the installed system is workable, clean, and efficient

3.19 INSTRUCTIONS

- A. Record Drawings
 - 1. Record accurately on one set of black and white prints of the site plan all installed work including both pressure and non-pressure lines.
 - 2. Upon completion of each increment of work, transfer all such information and dimensions to the print. The dimensions shall be recorded in a legible and workmanlike manner. Maintain as-built drawings on site at all times.
 - 3. All payment requests shall be accompanied by interim record drawings showing all work completed to that date. No payment request will be processed without an

acceptable interim record drawing. Finished record drawings must be received and approved by the Engineer before final payment will be approved.

- 4. Make all notes on drawing in pencil (no ball point pen). When the work has been completed, transfer all information from the field record print to a set of reproducible drawings.
- 5. Dimension from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavement, etc.). Locations shown on as-built drawings shall be kept day to day as the project is being installed. All dimensions noted on drawings shall be 1/8-inch in size (minimum).
- 6. Show locations and depths of the following items:
 - a. Point of connection(s)
 - b. Routing of sprinkler lateral lines (dimension maximum 200 feet along routing and at all changes in direction)
 - c. Gate valves
 - d. Sprinkler control valves
 - e. Quick coupling valves
 - f. Routing of control and power wires
 - g. Sprinkler heads
 - h. Other related irrigation equipment
- B. Controller Charts
 - 1. As-Built drawings must be approved by Engineer before charts are prepared.
 - 2. Provide one controller chart for each controller supplied showing the area covered by automatic controller, of the maximum size controller door will allow.
 - 3. The chart is to be a reduced drawing of the actual as-built system. Chart shall be a photo positive with different colored shading used to show area of coverage for each station. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic. The chart shall be mounted in the controller using Velcro or equal type of semi-permanent fastening device.
 - 4. All controller charts must be completed and approved prior to final payment.
- C. Operation and Maintenance Manuals
 - 1. Coordinate with requirements of Section 01 77 00 to provide the following:
 - 2. Prepare and deliver to the Engineer within ten calendar days prior to completion of construction, all required and necessary descriptive material in complete detail and sufficient quantity, properly prepared in four individually bound copies of the operations and maintenance manual. The manual shall describe the material installed and shall be in sufficient detail to permit operating personnel to understand, operate

and maintain all equipment. Spare parts lists and related manufacturer information shall be included for each equipment item installed. Each complete, bound manual shall include the following information:

- a. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment with names and addresses of local manufacturer representatives.
- b. Complete operating and maintenance instructions on all major equipment.
- 3. In addition to the above maintenance manuals, provide the maintenance personnel with instructions for system operation and show written evidence to the Owner at the conclusion of the project that this service has been rendered.

3.20 MAINTENANCE

- A. System Operation
 - 1. During and following installation of the irrigation system, the Contractor shall operate the irrigation system as required to maintain healthy turf. The Contractor shall continue to operate the irrigation system until the project is substantially complete and all construction Punch List items are satisfactorily complete as determined by the Engineer.

3.21 GUARANTEE PERIOD

- A. Guarantee
 - 1. The entire irrigation and water system shall be guaranteed to give satisfactory service for a period of one year from date of acceptance by the Owner.
 - 2. Should any trouble develop within the time specified above due to inferior or faulty materials or workmanship, the trouble shall be corrected at no expense to the Owner.
 - 3. Any and all damages resulting from faulty materials or workmanship shall be repaired by the Contractor to the satisfaction of the Owner, at no cost to the Owner.
- B. Guarantee Period Services
 - 1. The Contractor shall winterize the system and perform spring start-up of the system during the guarantee period. These functions shall be coordinated in advance with the Owner, and the Owner's personnel shall be encouraged to participate.
 - 2. Upon re-energizing the system, the Contractor shall repair any leaks or breaks and shall check each head and valve, making any adjustment necessary.
 - 3. The irrigation system shall preform and provide coverage equal to performance at the time of acceptance by the Owner. If the system does not perform equal to the performance at the time of acceptance, the Contractor shall repair/replace components necessary to obtain original performance at no additional cost to the Owner.

END OF SECTION 32 80 00

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PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Seeding (also see Section 32 90 19).
 - 2. Planting.
 - 3. Erosion control mulch.
 - 4. Hydro-mulch.
 - 5. Erosion control mat.
 - 6. Turf reinforcement mat.
 - 7. Hardwood mulch.
 - 8. Landscaping materials.
 - 9. Fertilizer.
 - 10. Landscape maintenance.
 - 11. Landscape warranty.
- B. Related Sections
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork Specification Sections.
 - 4. Division 32 Exterior Improvements.

1.02 **DEFINITIONS**

- A. Growing Season: May 1 through September 30
- B. Weeds Any vegetation that is either not planted or seeded that is within areas to be seeded or planted as part of this Contract.
- C. Planting Bed Planted areas around the screening building, blower building, and east of treatment cell #3 and the polishing reactor.
- D. Noxious Weeds As defined by the MDT Standard Specifications
- 1.03 REFERENCES
 - A. Montana Standard Specifications for Road and Bridge Construction, 2008 edition, referred to as MDT Standard Specifications in this specification section.

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- B. General Permit No. MTR100000 (or its successor), Effective Date January 1, 2013 and Expiration Date December 31, 2017 - Authorization to Discharge under the National Pollutant Discharge Elimination System, referred to as the State's Construction General Permit in this specification section.
- 1.04 SUBMITTALS FOR REVIEW
 - A. Section 01 33 00 Submittal Procedures.
 - B. Seed Data: Provide seed testing data and labeling consistent with MDT Standard Specifications.
 - C. Plant Material: Include quantities, sizes, quality and sources for plant materials.
 - D. Submit samples or product data sheets and installation specifications/details of the following materials (if applicable). Contractor shall not place materials until Engineer reviews submittal and provides a submittal review noting no exceptions taken:
 - 1. Landscape Rock
 - 2. Landscape Gravel
 - 3. Hardwood Mulch
 - 4. Erosion Control Mulch, including anchoring approach
 - 5. Hydro-Mulch
 - 6. Erosion Control Mat
 - 7. Weed Control Barriers
 - 8. Landscape Edging
 - E. Proposed seeding equipment and methods.
- 1.05 SUBMITTALS AT PROJECT CLOSEOUT
 - A. Section 01 77 00 Closeout Procedures for submittals.
 - B. Maintenance Data: Include maintenance instructions for all seeding and planting areas including cutting / pruning method and maximum height; types, application frequency, and recommended coverage of fertilizer and/or mulching.
- 1.06 REGULATORY REQUIREMENTS
 - A. Comply with regulatory agencies and MDT Standard Specifications for herbicide, insecticide, pesticide, and fertilizer application rates and composition.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. See Section 01 60 00 for product delivery, storage, and handling requirements.
 - B. Deliver seed mixture in sealed containers, open or damaged packaging is not acceptable.
 - C. For Engineer's field review, each bag of seed delivered to the site shall bear a tag with labeling meeting MDT Standard Specification requirements.

- D. Deliver fertilizer in waterproof bags, labeled according to state law and bearing weight, chemical analysis, name of manufacturer, and warranty of producer.
- E. Deliver plants after preparations for planting have been completed, and install within the same working day. Prior to planting:
 - 1. Set plants in cool, covered, and shaded area;
 - 2. Protect from weather;
 - 3. Protect from mechanical damage;
 - 4. Keep roots moist.

1.08 PLANTING BED ESTABLISHMENT PERIOD

- A. The Planting Bed Establishment Period shall begin immediately after installation, with the approval of the Engineer, and continue for forty-five (45) growing season days within the same growing season, seventy-five (75) growing season days if the growing season spans more than one calendar year, or thirty (30) days after Substantial Completion, whichever is latest.
- B. During the Planting Bed Establishment Period the Contractor shall:
 - 1. Water all plants to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of one (1) inch of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the hardwood mulch or flood the plants and turf.
 - 2. Prune plants and replace hardwood mulch as required.
 - 3. In planting beds, remove grass, weeds, and other undesired vegetation, including the root growth, before they reach a height of 3 inches and/or re-seed, whichever comes first.
 - 4. Spray with approved insecticides and fungicides to control pests and ensure plant survival in a healthy growing condition, if recommended by a certified horticulturalist.
 - 5. Mechanically remove or spot spray with approved herbicide all weeds.
 - 6. Remove plants that die during the Planting Bed Establishment Period and replace each plant with one of the same size and species, following the specifications for allowable planting schedule.

1.09 SEEDING BED ESTABLISHMENT PERIOD

- A. The Seeding Bed Establishment Period shall begin immediately after installation, with the approval of the Engineer, and continue until:
 - 1. A Notice of Termination can be filed for the State's Construction General Permit, and meeting all the requirements of the State's Construction General Permit; and
 - 2. No single bare area is greater than 36 square feet.

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- B. During the Seeding Bed Establishment Period the Contractor shall:
 - 1. Water all seeded areas to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is the equivalent of one (1) inch of absorbed water per week either through natural rainfall or augmented by periodic watering. Apply water at a moderate rate so as not to displace the mulch or seed flood the plants and turf.
 - 2. Mechanically remove or spot spray noxious weeds prior to reseeding and such that noxious weeds are less than 10 percent of the overall coverage in the Seeding Bed, with no area greater than 100 square feet that is more than 50 percent noxious weed coverage at the end of the Seeding Bed Establishment Period.

PART 2 - PRODUCTS

- 2.01 TOPSOIL
 - A. Per specification Section 31 05 13.
- 2.02 SEED
 - A. Area surrounding Screening Building, UV/Blower Building and parking lot as defined on Sheet GC-10 of the project drawings: Seed shall be Premium Sunny Brand Lawn or Classic Shade/Sun Brand Mixtures as provided by Agassiz Seed & Supply or approved equal.
 - B. Seed shall meet MDT Standard Specifications, except the following additional provisions shall apply / supersede the MDT Standard Specifications:
 - 1. Seed shall have a minimum 80 percent germination rate and maximum inert matter and other seeds of 4%. Maximum weed seed shall be 0.5 percent.
 - 2. Seed shall be tested within six months prior to date of seeding and conform to latest seed laws of the State of Minnesota. A certified test report shall be submitted to the Engineer at least 21 days before seeding begins.
 - 3. Origin of native species shall be limited to North Dakota, eastern Montana, South Dakota, or western Minnesota.
 - C. Temporary cover crop, if used, shall be per MDT Standard Specifications.
- 2.03 FERTILIZER
 - A. Fertilizer shall meet MDT Standard Specifications. In the case where both Class I and Class III seed are applied, the Class III fertilizer will apply.
- 2.04 EROSION CONTROL MULCH
 - A. Erosion control mulch shall meet the MDT Standard Specifications.
- 2.05 HYDRO-MULCH
 - A. Hydro-mulch shall meet the MDT Standard Specifications.

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- 2.06 EROSION CONTROL MAT
 - A. Erosion Control Mat shall be classified as ECB 2, as outlined in Table 856-1 of the MDT Standard Specifications.
- 2.07 TURF REINFORCEMENT MAT (TRM)
 - A. As shown on the Drawings.
- 2.08 HARDWOOD MULCH
 - A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of 2" ground or shredded bark in its natural color.
- 2.09 LANDSCAPE ROCK
 - A. Landscape rock shall be water worn river rock 20 percent maximum jagged edges 3/4inch to 1 1/2-inch diameter, ASTM C33.
- 2.10 LANDSCAPE GRAVEL
 - A. Landscape gravel shall be as shown on the Drawings.
- 2.11 LANDSCAPE EDGINGS
 - A. As shown on the Drawings.
- 2.12 WEED-CONTROL BARRIERS
 - A. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8oz/sq. yd.
- 2.13 PLANT MATERIAL
 - A. Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings.
 - B. Plants shall have healthy root systems developed by transplanting or root pruning. Plants shall not be pot bound.
 - C. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
 - D. Contractor shall not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
 - E. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required.
 - F. Labeling:
 - 1. Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species.

2. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

PART 3 - EXECUTION

- 3.01 TOPSOIL PREPARATION
 - A. Verify that prepared topsoil meets the topsoil and grading specifications and is ready to receive work of this Section.
 - B. Kill all weeds prior to planting or seeding.
 - 1. For broad removal of weeds, Contractor shall use disking or mechanical removal.
 - 2. Herbicide shall only be allowed for spot spraying and if the herbicide will not have a detrimental effect on the intended seeded or planted species.
 - C. Fill all depressions to provide a smooth grade. Sticks, stones, and other rubbish on the surface shall be raked and removed.
 - D. Seeding: Immediately prior to sowing seed, soil shall be loosened to a depth of approximately three (3) inches all areas except slopes steeper than 2 horizontally to 1 vertically, using discs, harrows, or other suitable equipment.
 - E. Planting: Immediately prior to planting, soil shall be dug and loosened to a depth of approximately 1.25 times the pot depth and diameter using hand or rotary drill equipment.
 - F. On slopes, the cultivating equipment shall operate in a general direction at right angles to the direction of surface drainage.
 - G. On slopes steeper than 2 horizontally to 1 vertically, no loosening of the soil will be required except that created by equipment used in the finishing operations.
- 3.02 SEEDING BEDS
 - A. Seed all disturbed areas designated for revegetation.
 - B. Stake out areas to receive different seed mixes.
 - C. Seeding Equipment Requirements.
 - 1. The specified seed or seed mixture shall be drilled in uniformly using a grass drill equipped with individually mounted adjustable spring loaded, double disk furrow openers fitted with depth bands and packer wheels. The drill furrow spacing shall not exceed 8 inches. The depth control bands shall be of a size to provide final planting depth of ½ to ¾ inch. Packer wheels shall have adjustable spring tension and be mounted individually on each furrow opener or be mounted independently with a press wheel situated to follow directly behind each opener. The seed box shall be equipped with a positive feed mechanism which accurately meters free flowing introduced (tame) grasses in a uniform manner and shall have agitators which prevent seed bridging. If chaffy native grasses are part of the specified seed mixture, the seed box shall be equipped with a positive feed with a positive feed picker-wheel mechanism with

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oversize teeth and augur style agitators which accurately meters the chaffy native grasses either in a mixture or separately in a uniform manner. The seed box shall have baffles or partitions that keep all seeds uniformly mixed during drilling.

- 2. Equipment to be used when Hydro-Mulch seeding is required shall be hydraulic equipment capable of uniformly mixing the specified seed in water for uniform distribution. The mulch may be applied simultaneously with the seed and fertilizer, or within 24 hours after application of seed and fertilizer.
- 3. Other Equipment. Power sprayers, blowers, hydraulic applicators, or broadcasters may be used on slopes steeper than 3:1 or areas too small to be seeded with a drill. The seeding rate shall be at least 120% of the normal rate, and the seed shall be covered by operating a drag harrow and a light packer over the seeded area.
- 4. Areas will be visually inspected for uniformity of application. Areas which do not reveal adequate and uniform coverage shall be reseeded at the Contractor's expense.
- D. Seasonal considerations for seeding shall be implemented per MDT Standard Specifications, Section 708.02C1d.
- E. No seed shall be sown when the wind velocity exceeds 15 miles per hour, in standing water, or on frozen ground.
- F. Do not sow within 24 hours after a rain event.
- G. Within the same work day, Contractor shall stabilize the soil surface with the appropriate surface stabilization (erosion control mulch, hydro-mulch, or erosion control mat) as shown in these specifications and/or the Drawings. Hydro-mulch shall be applied at the same time as seeding, unless approved by Engineer.
- H. Following surface stabilization, Contractor shall water seeded areas consistent with the Seeding Bed Establishment Period requirements.

3.03 PLANTING BEDS

- A. Contractor shall plant areas more than 30 days prior to the end of the Growing Season to limit the potential for frost heave.
- B. Do not plant when soil is excessively wet.
- C. Stake out and space plants as indicated on Drawings, in even rows with triangular spacing.
- D. Use topsoil for backfill.
- E. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- F. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- G. Within one hour of planting, Contractor shall spread hardwood mulch as shown on the Drawings and water planting areas with sufficient water consistent with the Planting Bed Establishment Period requirements, taking care not to cover plant crowns with wet soil or

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hardwood mulch.

3.04 SURFACE STABILIZATION

- A. Erosion Control Mulch shall be applied according to MDT Standard Specifications at a rate of 2 tons per acre with approximately 10 percent of the soil surface visible. Contractor shall anchor the mulch using either the punching or tackifier approach.
- B. Hydro-Mulch shall be applied per MDT Standard Specifications at a rate of 1 ton per acre with a minimum of 95 percent coverage.
- C. Erosion control mat shall be installed per the Drawings and manufacturer's recommendations, whichever is more stringent.
- D. Turf Reinforcement Mat shall be installed per the Drawings, which may include placing the TRM below the ground surface prior to seeding with an erosion control mat on the surface, if recommended by the manufacturer.
- 3.05 LANDSCAPE ROCK AND GRAVEL PLACEMENT
 - A. Landscape rock and gravel will be placed in areas identified in the Specifications and Drawings at a uniform depth of four inches, plus or minus 1 inch.
 - B. Provide a two (2) foot wide border of landscape rock at all structures not adjacent to asphalt or concrete surfaces.
 - C. Place landscape gravel on areas shown on the ADM landscaping plan noted with "Gravel" label.
 - D. Place weed control barrier and landscape edging (5-inch) prior to placement of landscape rock and gravel.
- 3.06 CLEANUP AND PROTECTION
 - A. During and after landscaping, keep pavements clean and work area in orderly condition.
 - B. Protect existing improvements from damage from landscaping operations.
 - C. Contractor shall clean up the site following work and repair any damage caused by landscaping operations, at Contractor's cost.
- 3.07 MAINTENANCE
 - A. Contractor shall be responsible for maintenance of the planting and seeding beds for the Planting and Seeding Bed Establishment Periods, respectively.
 - B. Contractor shall spot spray weeds in the landscape gravel and landscape rock areas before they reach a height of 3 inches and/or re-seed, whichever comes first.
 - C. If Contractor has used a temporary cover crop, Contractor shall mow temporary cover crop prior to cover crop re-seeding.

3.08 WARRANTY

- A. For Seeding Beds:
 - 1. Initial Acceptance:

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- All seeding beds shall be evaluated for Initial Acceptance after the seeding beds have been covered with the specified seed and the specified soil protection measure (such as erosion control mulch or mat) as shown on the Drawings. Initial Acceptance shall be based on the Contractor providing the Engineer with the specified submittals and a visual inspection by the Contractor and Engineer of the seeding beds.
- 2. Maintenance:
 - a. Contractor shall maintain the seeding beds, consistent with the Seeding Bed Establishment Period, until Final Acceptance.
 - b. Other maintenance activities may be completed at the Contractor's discretion to meet the Final Acceptance performance criteria. Contractor shall notify the Engineer of planned additional maintenance activities prior to implementation.
- 3. Final Acceptance:
 - a. Final Acceptance will occur at the end of the Seeding Bed Establishment Period.
 - b. If after a period of ninety (90) growing season days, vegetation coverage does not meet the minimum requirements outlined in the Seeding Bed Establishment Period, Contractor shall re-seed all areas that do not meet the minimum coverage, at Contractor's cost. A new Seeding Bed Establishment Period shall begin, except the maintenance period will be thirty (30) growing season days.
- B. For Planting:
 - 1. Initial Acceptance:
 - a. All planting areas shall be evaluated for Initial Acceptance after the plants have been installed and surrounding planting beds covered with hardwood mulch. Initial Acceptance shall be based on the Contractor providing the Engineer with the specified submittals and a visual inspection by the Contractor and Engineer of the planting beds.
 - 2. Maintenance:
 - a. Contractor shall maintain the planted beds, consistent with the Planting Bed Establishment Period, until Final Acceptance.
 - b. Other maintenance activities may be completed at the Contractor's discretion to meet the Final Acceptance performance criteria. Contractor shall notify the Engineer of planned additional maintenance activities prior to implementation.
 - 3. Final Acceptance:
 - a. Final Acceptance will occur at the end of the Planting Bed Establishment Period.
 - b. Prior to Final Acceptance, the Engineer shall determine if planted materials are in a healthy condition.
 - c. Contractor shall replace all dead or visibly dying plants consistent with the

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planting bed execution requirements.

- d. All replacement and associated repair activities shall be at the Contractor's expense.
- e. Contractor shall maintain newly planted areas for a period of fifteen (15) days.

END OF SECTION 32 90 00

SECTION 32 92 19 SEEDING (Reference MPWSS Section 02910)

All applicable portions of MPW standard specification Section 02910 shall apply with the following additions, deletions and/or modifications.

PART 2 - PRODUCTS

2.01 SEED

Add following:

E. Seed mixtures shall be proportioned as follows:

1. Dryland Seed.

Seed Species or Variety	Seed Mix %	Application Rate
Western Wheatgrass	20%	
Pryor Slender Wheatgrass	20%	
Crituna Thickspike Wheatgrass	30%	21 lbs. Per acre
Sudar Stream Bank Wheatgrass	20%	
Canada Bluegrass	10%	

Note: All seed shall be 98% pure and shall have a germination percentage of 90%. Do not sow immediately following rain, when ground is to dry, or during windy periods. Apply water with fine spray after seeding. Saturate to 3 inches of soil.

2. Lawn or Turf Grass Seed.

Lawn or turf grass seed shall be a blend of at least 24 percent Kentucky Bluegrass plus a blend of at least three other bluegrasses in approximately equal proportions. Acceptable blend grasses include Adelphi, Silkins, Birka, Nuglade, Rambo, Ram Eclipsey, Quantum, Merian, Nustar or others commonly used in the area by sod producers.

2.02 TOPSOIL

Add the following:

1. Topsoil shall be the existing top 6-12 inches of silty sand surface layer of soil at the site with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (1.0 inches or more in diameter), clay lumps or similar objects. Brush and other vegetation which will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary herbaceous growth such as grass and weeds do not need to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. The Contractor will be required to compact the topsoil to reduce settling and ensure a uniform grade in the disturbed areas.

2.04 FERTILIZER

Add the following:

C. Fertilize uniformly across all surfaces at the following rate:

Dryland Grass	<u>5</u>
Nitrogen	25 lbs/acre
Phosphate	25 lbs/acre
Lawn Grass	
Nitrogen	50 lbs/acre
Phosphate	50 lbs/acre

2.05 MULCH

Add the following:

A. Mulch with a loose 1-inch layer of straw.

PART 3 - EXECUTION

Add the following:

- 3.05 CARE OF SEEDED AREAS
 - D. All weeds including (spotted knapweed, leafy spurge, and all others identified by the State of Montana as non-native) shall be controlled by the Contractor while grass is becoming established and during the full one year warranty period after the project is complete and accepted by the Owner. Chemical control may be utilized where permitted by State Laws and regulations.

PART 4 - MEASURMENT AND PAYMENT

DELETE: Entire Section

END OF SECTION 32 92 19

SECTION 32 92 23 TOPSOIL AND SODDING

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
- 1.02 GENERAL
 - A. This section covers the work necessary to furnish, haul, and place approved topsoil and live sod on prepared areas at the locations shown on the Drawings or as directed by the Engineer.
- 1.03 SUBMITTALS
 - A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.
 - 1. Topsoil particle size analysis; characterization; acidity; salinity; organic matter percentage.
 - 2. Sod supplier name, address and telephone number.
 - 3. Grass mixture contained in sod.
 - 4. Manufacturer's Fertilizer Data Sheets.

PART 2 - MATERIALS

2.01 TOPSOIL

- A. Topsoil shall consist of friable surface soil reasonably free of grass, roots, weeds, sticks, stones, or other foreign materials.
- B. The topsoil shall consist of sandy loam, with soil particles within the following percentages: clay; 0-25; silt; 25-50; sand; 50-70; decomposed organic matter; 5-10.
- C. The clay content is optional.
- D. The soil shall have a soil acidity range between a pH 5.0 to pH 7.0. The soil salinity
- E. shall not exceed 3 millimhos per centimeter at 25oC (as described by USDA Circular
- F. No. 982).
- G. The Contractor shall notify the Engineer of the source of topsoil not less than 10 days prior to excavation.
- 2.02 SOD (Sod not included in the Montana State Hospital Wastewater Project)
 - A. Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period.

- B. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil.
- C. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials which might be detrimental to the development of the sod or to future maintenance.
- D. Sod shall be 100 percent Kentucky Bluegrass.
- E. Before harvesting, the turfgrass shall be mowed to a uniform height of not more than 5/8".
- F. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than 2 inches.
- 2.03 WATER
 - A. The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass. It shall be subject to the approval of the Engineer prior to use.

PART 3 - EXECUTION

3.01 GENERAL

- A. Areas to be solid, strip, or spot sodded are shown on the Drawings. Areas requiring special ground surface preparation such as tilling and those areas in a satisfactory condition which are to remain undisturbed shall also be shown on the Drawings.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil
- C. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
- D. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARING THE GROUND SURFACE

- A. Placing and spreading of topsoil shall not be done when the ground is frozen, excessively wet or otherwise in a condition detrimental to the work. Surfaces designated to be covered shall be lightly scarified just prior to the spreading operation. Compaction of topsoil will not be required.
- B. After placement is completed the surface of the topsoil shall be finished to a reasonably smooth surface.
- C. After application of the topsoil and grading of areas has been completed and before applying fertilizer, areas to be sodded shall be raked or otherwise cleared of stones larger

than 2 inches in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

- D. All areas to receive sod or turf grass seed shall have the native material properly scarified, a minimum of 6" of approved topsoil applied and lightly rolled, prior to installation of the sod or seed.
- E. Over-compaction the topsoil at any time before or during application of the sod or seed is not acceptable.
- 3.03 APPLYING FERTILIZER
 - A. Following ground surface preparation, fertilizer shall be uniformly spread at the rates specified below.
 - 1. All areas shall be fertilized with an inorganic chemical fertilizer with the following nutrients:
 - a. Nitrogen (Elemental) 40 lbs/acre
 - b. Phosphorus (P205) 60 lbs/acre
 - c. Potassium (K20) 30 lbs/acre
- 3.04 OBTAINING AND DELIVERING SOD <u>(Sod not included in the Montana State</u> <u>Hospital Wastewater Project)</u>
 - A. After inspection and approval of the source of sod by the Engineer, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 inches. Sod sections or strips shall be cut in uniform widths, not less than 10 inches, and in lengths of not less than 18 inches, but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside.
 - B. The sod shall be transplanted within 24 hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, permission to cut sod may be granted only after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.
- 3.05 LAYING SOD (Sod not included in the Montana State Hospital Wastewater Project)
 - A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. After establishment, if necessary to smooth surface, tamp and roll lightly to remove surface undulations. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across slopes exceeding 1:3.
 - 2. On slopes exceeding 1:6, and in V-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wood pegs not less than 12 inches in length and have a cross-sectional area of not less than 3/4 square inch. The pegs shall be driven flush with the surface of the sod.
- C. Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the Engineer, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches immediately prior to laying the sod.
- D. The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod, and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen when replacing it shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately 1 inch below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

3.06 WATERING

A. Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner which will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

3.07 ESTABLISHING TURF

- A. General. The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work.
- B. Protection. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the Engineer.

C. Mowing. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing specific areas. In the event that weeds or other undesirable vegetation are permitted to grow to such an extent that, either cut or uncut, they threaten to smother the sodded species, they shall be mowed and the clippings raked and removed from the area.

3.08 REPAIRING

A. When the surface has become bullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the Engineer, and shall then be re-sodded.

END OF SECTION 32 92 23

SECTION 32 97 00 RESTORATION OF DISTURBED AREAS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Restoration of all areas disturbed during construction.
 - 2. Restoration of all items not specifically identified for restoration, but damaged through construction.
- B. Related Sections include:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 General Requirements Specification Sections.
 - 3. Division 31 Earthwork.
 - 4. Division 32 Exterior Improvements.

1.02 REFERENCES

- A. Reference Standards include:
 - 1. Montana State Highway Department Standard Specifications for Road and Bridge Construction, latest edition.

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. Material Sections include:
 - 1. Topsoil and Sodding: Per Section 32 92 23.
 - 2. Aggregate Materials: Per Section 32 11 23.
 - 3. Seed: Per Section 32 92 19.

PART 3 - EXECUTION

- 3.01 EXECUTION
 - A. Observe all surface features requiring protection, removal and replacement, and/or restoration prior to construction.
 - B. The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

- C. The Contractor shall be responsible for all damage or injury to property of any character during the prosecution of the Work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the Work, or at any time due to defective Work or materials, and said responsibility will not be released until the Project shall have been completed and accepted.
- D. When any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work, or in consequence of the non-execution thereof by the Contractor, he shall restore, at his own expense, such property to the condition similar or equal to that existing before such damage or injury was done by repairing, rebuilding, or otherwise restoring as may be directed or he shall make good such damage or injury in an acceptable manner.

3.02 RESTORATION

- A. Restore all areas disturbed by construction to a condition equal to or better than existed prior to construction.
- B. Replace, restore, repair, or otherwise make good any damage done to any tree, bush, or shrub that is not specifically designated for removal.
- C. Restore items such as culverts, road signs, power poles, sodding, fences, driveways, mailboxes, and like, whether or not specifically identified on the Drawings, to a condition equal to or better than existed before construction.
- D. Replace or repair all concrete or asphalt roads or driveways, removed or damaged during construction with equal or better materials. Replace or repair to match existing conditions.
- E. Stabilize subgrade sufficiently to prevent mixing of granular material with subgrade prior to application of base material.
- F. Place topsoil per Section 32 92 23 and seed areas disturbed by construction in grassed areas per Section 32 92 19.
- G. All damage to streets, driveways, berms, etc. due to the Contractor's construction techniques and equipment shall be repaired at the Contractor's expense prior to final payment.
- H. Remove all excess dirt, concrete, and other debris from work area immediately upon completion of Work and deposit on-site in a disposal area designated by Owner. Contractor shall be required to clean site to the condition prior to the start of construction before final payment will be made.
- I. All restoration shall be completed prior to opening any section of Work.

END OF SECTION 32 97 00

DIVISION 33

UTILITIES

SECTION 33 01 10.58 DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Disinfection of potable water system.
 - 2. Testing and reporting results.
- B. Related Sections include, but are not limited to:
 - 1. Section 01 33 00 Submittal Procedures.
 - 2. Section 01 40 00 Quality Control.
 - 3. Section 01 77 00 Closeout Procedures.
 - 4. Section 33 31 19 Site Water Utility Distribution Piping.

1.02 REFERENCES

- A. Reference Standards include, but are not limited to:
 - 1. AWWA B300 Standard for Hypochlorites.
 - 2. AWWA B301 Standard for Liquid Chlorine.
 - 3. Federal Specifications BB-C-12a, O-C-114a, and O-C-602b.
 - 4. AWWA C651 Disinfection of Water Mains.
 - 5. Montana Public Works Standard Specifications.
- 1.03 SUBMITTALS FOR INFORMATION
 - A. Submit under provisions of Section 01 33 00.
 - B. Test Reports: Indicate results comparative to specified requirements
- 1.04 DEFINITIONS
 - A. Disinfectant Residual means the concentration of disinfectant in the treated water.
 - B. PPM means parts per million.
- 1.05 QUALITY ASSURANCE
 - A. Regulatory Agency Requirements: Comply with Montana Department of Environmental Quality (DEQ) requirements.
 - B. Perform work in accordance with AWWA C651 for the disinfection of water main
 - C. Testing Firm: Company specializing in testing potable water systems, approved by the DEQ. Contractor shall obtain sampling bottles from an approved laboratory and perform sampling per project requirements and sampling protocol. Contractor shall coordinate

DISINFECTION OF WATER UTILITY PIPING SYSTEMS

sampling and testing schedule with the laboratory. Contractor shall pay all testing fees and lab costs.

- D. Submit bacteriologist's signature and authority associated with testing.
- E. The cleaning and disinfection work shall be conducted prior to connection to the existing water lines or to any portion that has been put into service. Unless otherwise approved, hydrostatic testing shall be completed prior to final cleaning and disinfection.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect against damage and contamination.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60 and 80 degrees F.
- D. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

1.07 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 33 00 Submittal Procedures and Section 01 77 00 Closeout Procedures.
- B. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfection.
 - 3. Test locations.
 - 4. Initial and final disinfectant residuals (quantity in treated water) in ppm for each test.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each location test.
- C. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations.
 - 5. Initial and final disinfectant residuals in ppm for each test location.
 - 6. Coliform bacteria test results for each test.

PART 2 - PRODUCTS

2.01 ACCEPTABLE DISINFECTION CHEMICALS

- A. AWWA B300, Hypochlorite: Shall conform to Federal Specification O-C-114a, Type II, Grade B, or Federal Specification O-C-602b.
- B. AWWA B301, Liquid Chlorine: Shall conform to Federal Specification BB-C-120a.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Do not start Work until conditions are satisfactory.
- C. Select one form of chlorine for use in disinfection.
- D. Flush mains thoroughly before introduction of chlorinating material. Maintain flushing velocity in main of not less than 2.5 feet per second unless the Engineer determines that conditions do not permit the required flow to be discharged to waste.

3.02 DISINFECTION OF WATER SYSTEMS

- A. Provide and attach required tools, equipment, and materials to perform the Work of this Section. Disinfectant material shall be introduced into the water system in a manner approved by the Engineer. For wells, add the required amount of chlorination material into the casing before installation of pumping equipment. Agitate as required for thorough mixing.
- B. Use of calcium hypochlorite granules for use on solvent welded plastic or on screwed joint steel pipe is prohibited because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.
- C. Perform disinfecting in accordance with AWWA C651 prior to start-up. Coordinate with other Contractors, Engineer, and Owner.
- D. Inject treatment disinfectant into piping system to obtain 50 to 80 ppm residual.
- E. Test for disinfectant residual at each of the following locations:
 - 1. End of piping runs.
- F. Maintain disinfectant in system for 24 hours. If disinfectant residual is less than 25 ppm, repeat system treatment.
- G. All water supply and distribution mains shall be disinfected with chlorine prior to acceptance by the owner.
- H. As chlorinated water flows past new fittings and valves, related valves shall be operated so as to disinfect appurtenances and pipe branches. All valves shall be opened and closed several times during the contact period.
- I. Drain and flush using fresh water pumped through the system.
- J. Flush heavily chlorinated water from main until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the system.

- K. Provide bacteriological test at Owner or Engineer's request.
- L. Any sections of equipment in contact with water shall be swabbed with a chlorine solution prior to installation.
- M. Properly dispose of heavily chlorinated water supply in an environmentally acceptable manner.
- N. Contractor shall pay all testing costs.
- 3.03 BACTERIOLOGICAL TESTING
 - A. After disinfection and flushing, test water for bacteriological contamination. Samples for bacteriological analysis shall be collected in sterile bottles obtained from the testing laboratory and submitted for testing.
 - B. Samples shall be taken from the hydrants. Duplicate samples shall be collected from each hydrant.
 - C. Two or more successive test samples indicating bacteriological satisfactory water shall be obtained before facility is placed into operation.
 - D. If contamination is shown to be still present in the water supply, the disinfection procedure shall be repeated.
 - E. All testing costs shall be paid by Contractor.
- 3.04 FIELD QUALITY CONTROL
 - A. Section 01 40 00 Quality Control: Field inspection and testing.
 - B. Samples for bacteriological analysis shall be collected in sterile bottles.
 - C. Two or more successive test samples indicating bacteriological satisfactory water shall be obtained before any system is placed into operation.

END OF SECTION 33 01 10.58

SECTION 33 05 26 UTILITY IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Marking tape.
- B. Related Sections include, but are not limited to:
 - 1. Section 01 33 00 Submittals.
 - 2. Section 31 23 33 Trenching and Backfilling.
 - 3. Section 33 31 13 Site Sanitary Sewerage Piping
 - 4. Section 33 31 19 Site Water Utility Distribution Piping.
- 1.02 SUBMITTALS
 - A. Submit under provisions of Section 01 33 00.
 - B. Shop Drawings: Submit manufacturer's data on materials furnished indicating compliance with the specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Marking Tape:
 - 1. "Terra Tape" as manufactured by REEF Industries, Inc., or Omega Marking Company.
 - 2. Size: 3".
 - 3. Marking Tape Schedule and Warning Notice:

Pipeline	Warning Notice	Color
Sanitary Sewer	Caution Buried Sewer Line Below	Green
SS		
Force Main	Caution Buried Force Main Below	Green
AIR / FDD/ IMLR / V RAS / SCM / WAS	FA /	
Potable Water Main	Caution Water Line Buried Below	Blue
PW		
Non Potable Water	Caution Non Potable Water Line Buried Below	Purple
NPW		
Electric	Caution Electric Line Buried Below	Red
Gas	Caution Gas Line Buried Below	Yellow
OTHERS	Caution Buried Below	TBD

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the marking tape 24" below finished grade directly above and parallel with pipelines. Marking tape shall be installed for all site piping outlined in Sections 33 31 13, 33 31 19 and the Piping Schedule and shall be labeled in accordance with this section.
- B. At each manhole, bring the marking tape up to the manhole to a point approximately 24 inches below finished grade. Drill through the manhole and pull the detector tape through the manhole and label the loose end with a plastic marker. Grout hole with non-shrink grout or water stop material.

END OF SECTION 33 05 26

SECTION 33 31 00.10 ABANDONMENT OF PIPING AND MANHOLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. This section includes abandonment in place of existing pipelines and manholes as indicated on the drawings for abandonment.
- B. Related Sections include, but are not limited to:
 - 1. Section 01 31 00 Project Management and Coordination
 - 2. Section 01 33 00 Submittal Procedures
 - 3. Section 01 40 00 Quality Requirements
 - 4. Section 31 23 33 Trenching and Backfilling

1.02 REFERENCES

- A. Reference Standards include, but are not limited to:
 - 1. ASTM C150 Standard Specification for Portland Cement.
 - 2. ASTM C494 Standard Specification for Chemical Admixture for Concrete.
 - 3. ASTM C618 Standard Specification for Fly Ash and raw or Calcined Natural Pozzolan for use as Mineral Admixture in Portland Cement Concrete.
 - 4. ASTM C940 Standard test Method for Expansion and Bleeding of Freshly Mixed grout for Replaced Aggregate Concrete in the Laboratory.
 - 5. ASTM C1017 Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete.
 - 6. ASTM C1107 Standard Specification for Packaged Dry, Hydraulic Cement Grout (NonShrink).
- 1.03 DEFINITIONS
 - A. Abandonment: Pipeline abandonment consists of filling or plugging portions of existing manholes and pipelines with compacted base course, flowable fill or grout plugs, as indicated on the Drawings.
 - B. Bank Run Sand. Bank run sand shall be a locally available sand material to be used in abandoning existing manholes.
 - C. Flowable Fill. Flowable fill shall be controlled low-strength material consisting of fluid mixture of cement, fly ash, aggregate, water and with admixtures as necessary to provide workable properties. Placement of flowable fill may be by grouting techniques in pipelines or other restricted areas, or as mass placement by chutes or tremie methods in

unrestricted locations with open access. Long- term hardened strength shall be within specified range.

D. Backgrouting. Secondary stage pressure grouting to ensure that voids have been filled within abandoned pipes. Backgrouting will only be required at critical locations indicated on the Drawings or if there is evidence of incomplete flowable fill placements.

1.04 SUBMITTALS

- A. Submit flowable fill mix design report (if applicable).
 - 1. Flowable fill type and production method. Describe if fill will be mixed to final proportions and consistency in batch plant or if constituents will be added in transit mixer at placement location.
 - 2. Aggregate gradation of fill. Aggregate gradation of mix shall be used as pilot curve for quality control during production.
 - 3. Fill mix constituents and proportions including materials by weight and volume, and air content. Give types and amounts of admixtures including air entrainment or air generating compounds.
 - 4. Fill densities and viscosities, including wet density at point of placement.
 - 5. Initial time of set.
 - 6. Bleeding and shrinkage.
 - 7. Compressive strength.
- B. Submit sand gradation to be used in abandoning manholes.
- C. Submit technical information for equipment and operational procedures including projected injection rate, grout pressure, method for controlling grout pressure, bulkhead and vent design and number of stages for grout application.
- 1.05 QUALITY ASSURANCE
 - A. Perform Work in accordance with Section 01 40 00.
- 1.06 PROJECT CONDITIONS
 - A. Verify all dimensions of and between existing structures and locations of existing piping and equipment required for the proper abandoning of existing piping.
 - B. Contractor shall be responsible for verification of location of all existing piping and structures. Potholing and or excavation to expose existing piping, conduits, etc. may be required prior to installation of new piping or connection to existing piping. Adjustments to the locations of new piping may be required due to locations of existing piping and sequencing of construction that will be required. Adjustments required shall be at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 FLOWABLE FILL (if utilized)

ABANDONMENT OF PIPING AND MANHOLES

- A. Design Mix Criteria. Provide design of one or more mixes to meet design criteria and conditions for placement. Present information required by submittals, to include the following:
 - 1. Cement: ASTM C150 Type I or II. Volume and weight per cubic yard of fill. Provide minimum cement content of 50 pounds per cubic yard.
 - 2. Fly ash: ASTM C618, Class C or F. Volume and weight per cubic yard of fill. Provide minimum fly ash content of 200 pounds per cubic yard.
 - 3. Potable water: Volume and weight per cubic yard of fill. Amount of water determined by mix design testing.
 - 4. Aggregate gradation: 100 percent passing 3/8-inch sieve and not more than 10 percent passing No. 200 sieve. Mix design report shall define pilot gradation based on following sieve sizes: 3/8 inch, No. 4, 8, 16, 30, 50 100 and 200. Do not deviate from pilot gradation by more than plus or minus 10 percentage points for any sieve for production material.
 - 5. Aggregate source material: Screened or crushed aggregate, pit or bank run fine gravels or sand, or crushed concrete. If crushed concrete is used, add at least 30 percent natural aggregate to provide workability.
 - 6. Admixtures: use admixtures meeting ASTM C494 and ASTM C1017 as needed to improve pumpability, to control time of set and to reduce bleeding.
 - 7. Fluidifier: Use fluidifier meeting ASTM C937 as necessary to hold solid constituents in suspension. Add shrinkage compensator if necessary.
 - 8. Performance additive: Use flowable fill performance additive, if needed, to control fill properties.
- B. Flowable Fill Requirements:
 - 1. Unconfined compressive strength: minimum 75 psi and maximum 150 psi at 56 days as determined based on an average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.
 - 2. Placement characteristics: self-leveling.
 - 3. Shrinkage characteristics: non-shrink.
 - 4. Water bleeding for fill to be placed by grouting method in pipes: not to exceed 2 percent according to ASTM C940.
 - 5. Minimum wet density: 90 pounds per cubic foot.
- C. Grout Plugs
 - 1. Cement-based dry-pack grout conforming to ASTM C1107, Grade B or C.
 - 2. Manufactured Plug: Commercially available plug or cap specifically designed and manufactured to be used with pipe being abandoned.

2.02 BASE COURSE MATERIAL

ABANDONMENT OF PIPING AND MANHOLES

1. Base course used in the abandonment of manholes shall be in conformance with Parts 2.01.A, B, C and E of Section 32 05 16

2.03 BANK RUN SAND

- A. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D2487) meeting following requirements:
 - 1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D1140. Amount of clay lumps or balls may not exceed 2 percent.
 - 2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318: Plasticity index: not exceeding 7.
 - 3. Engineer shall consider locally available materials not meeting the above criteria on a case by case basis.

PART 3 - EXECUTION

3.01 CUTTING AND CAPPING OF MAINS

- A. Do not begin cut, plug, and abandonment operations until replacement pipe has been constructed and tested, all service connections have been installed, and main has been approved for use.
- B. Install plug, clamp, and concrete reaction block and make cut at location shown on drawings.
- C. Pipe to be abandoned shall not be valved off and shall not be cut or plugged other than as shown on drawings.
- D. After pipe to be abandoned has been cut and capped, check for other sources feeding abandoned pipe. When sources are found, notify Engineer immediately. Cut and cap abandoned pipe at point of other feed as directed by Engineer.
- E. Plug or cap ends or opening in abandoned pipe in manner approved by Engineer. Install concrete around cap and over pipe to ensure it's not penetrable by groundwater.
- F. Remove and dispose of surface identifications such as cleanouts, curb boxes, and valve boxes.
- G. Backfill excavations in accordance with Section 31 23 33.

3.02 PREPARATION FOR ABANDONMENT VIA FLOWABLE FILL

- A. Have fill mix design reports and other submittals required by Submittals accepted by Engineer prior to start of placement. Notify Engineer at least 24 hours in advance of grouting with flowable fill.
- B. Select fill placement equipment and follow procedures with sufficient safety and care to avoid damage to existing underground utilities and structures. Operate equipment at pressure that will not distort or imperil portion of work, new or existing.
- C. During placement of fill, compensate for irregularities in existing pipe, such as

obstructions, open joints, or broken pipe to ensure no voids remain unfilled.

- D. Perform demolition work prior to starting fill placement. Clean placement areas of debris that may hinder fill placement. Remove excessive amounts of sludge and other substances that may degrade performance of fill. Do not leave sludge or other debris in place if filling more than 2 percent of placement volume.
- E. Remove free water prior to starting fill placement.
- 3.03 EQUIPMENT FOR FLOWABLE FILL
 - A. Mix flowable fill in automated batch plant and deliver it to site in ready-mix trucks. Performance additives may be added at placement site if required by mix design.
 - B. Use concrete or grout pumps capable of continuous delivery at planned placement rate.

3.04 INSTALLATION OF FLOWABLE FILL

- A. Abandon existing piping underneath roadway and paved areas by completely filling pipe with flowable fill.
- B. Continuously place flowable fill from end to end with no intermediate pour points.
- C. Have filling operation performed by experienced crews with equipment to monitor density of flowable fill and to control pressure.
- D. Temporarily plug pipes which are to remain in operation during pouring/pumping to keep lines free of flowable fill.
- E. Pump flowable fill through bulkheads or use other suitable construction methods to contain flowable fill in lines to be abandoned. These pipes will act as injection points or vents for placement of flowable fill.
- F. Place flowable fill under pressure flow conditions into properly vented open system until flowable fill emerges from vent pipes. Pump flowable fill with sufficient pressure to overcome friction and to fill pipe from downstream end, to discharge at upstream end.
- G. Inject flowable fill through replaced ballast using grouting equipment and series of grout pipes discharging at bottom of placement, allowing fill to rise through ballast effectively filling all voids. Alternatively, sequentially place individual pieces of ballast at same time as flowable fill is placed. Do not fill with ballast more than 50 percent of volume at any level, to prevent nesting and void formation.
- H. Remediate placement of flowable fill which does not fill voids in pipe, or where voids develop due to excessive shrinkage or bleeding of fill, by using pressure grouting either from inside pipe or from surface.
- I. Plug each end of pipe being abandoned.
- 3.05 FORCE MAIN ABANDONMENT
 - A. Clean inside surface of force main at least 12 inches from ends to achieve firm bond and seal grout plug or manufactured plug to pipe surface. Similarly, clean and prepare

exterior pipe surface if manufactured cap is to be used.

- B. When using grout plug, place temporary plug or bulkhead approximately 12 inches inside pipe. Fill pipe end completely with dry-pack grout mixture.
- C. When using manufactured plug or cap, install fitting as recommended by manufacturer's instructions, to form water tight seal.
- D. Backfill to surface, above pipe or structures left in place, with flowable fill in restricted areas, compacted bank run sand in unrestricted areas to be paved or select fill in unrestricted areas outside of pavement. Place and compact backfill, other than flowable fill, in compliance with Section 31 23 33.
- E. Collect and dispose of excess flowable fill material off site.
- 3.06 ABANDONING MANHOLES
 - A. Contractor shall remove top slabs and first section of manholes to be abandoned and any other specified pumps or accessories prior to abandoning.
 - B. Contractor shall abandon manholes after piping has been grouted and abandoned.
 - C. Manholes shall be filled with base course material and compacted in 1-foot lifts.
- 3.07 PROTECTION OF PERSONS AND PROPERTY
 - A. Provide safe working conditions as required by OSHA and applicable state and local laws for employees throughout demolition and removal operations. Observe safety requirements for work below grade.
 - B. Maintain safe access to adjacent property and buildings. Do not obstruct roadways, sidewalks or passageways adjacent to work.

END OF SECTION 33 31 00.10

SECTION 33 31 13 SITE SANITARY SEWERAGE PIPING

PART 1 - GENERAL

- 1.01 RELATED SECTIONS
 - A. Drawings and Special Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
 - B. Section 40 27 00 Process Piping
- 1.02 SUMMARY
 - A. Furnish sewer pipe and fittings as specified in the Contract and this section. Pipe strength classifications are shown on the plans, listed in the Contract Documents or specified herein.
- 1.03 CERTIFICATION BY MANUFACTURER:
 - A. Furnish a manufacturer's certification for all pipe and fittings, certifying that the pipe and fittings meet the contract requirements.

PART 2 - PRODUCTS

- 2.01 POLYVINYL CHLORIDE (PVC) PIPE:
 - A. GENERAL
 - 1. Furnish PVC pipe produced by a continuous extrusion process, employing a prime grade of unplasticized polyvinyl chloride. Assure the grade used is highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals found in sewage and industrial wastes. Assure the material meets "Rigid Polyvinyl Chloride Compounds", ASTM Designation D-1784 requirements. Assure the pipe has self-extinguishing flammability characteristics.
 - B. GRAVITY SEWER PIPE
 - 1. Furnish gravity sewer pipe meeting one of the following requirements:
 - a. ASTM D-3034, "Standard Specifications for Polyvinyl Chloride Sewer Pipe and Fittings", with an SDR of 35 4"-15" (10 cm 38 cm).
 - ASTM F679, T-1 wall thickness (SDR35), "Standard Specifications for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings" 18"-27" (46 cm - 69 cm).
 - 2. Furnish pipe having nominal 12.5 feet (3.8 meters) laying lengths, except shorter lengths may be used adjacent to manholes, or other appurtenances. Assure each pipe section is marked, as a minimum, with size, SDR, "Sewer Pipe" and Code Number.
 - C. PRESSURE SEWER PIPE

- 1. Furnish pressure sewer pipe meeting ASTM D2241, "Standard Specification for Polyvinyl Chloride Plastic Pipe (SDR-PR), with an SDR of 26 and a pressure rating of 160.
- 2. Use a nominal laying length of 20 feet (6.1 meters), except shorter lengths may be used adjacent to bends or other appurtenances. Assure each pipe length is marked, as a minimum, with size, SDR or pressure rating or both, ASTM designation and manufacturer's name and code.
- D. PIPE JOINTING
 - 1. Furnish each pipe length with a bell designed to provide a watertight joint when jointing the bell and spigot with a rubber ring.
 - 2. Make a rubber gasket joint for PVC pipe and fittings using a rubber gasket compressed between the outer surface of the spigot and the inner surface of the bell. Assure the joint is completely sealed by the gasket so that the assembly remains watertight under all service conditions, including expansion, contraction, settlement and pipe deformation. Follow the manufacturer's recommendations when assembling the rubber ring joint.
- E. FITTINGS
 - 1. Assure all fittings for connecting all gravity and/or pressure piping and service lines are of the same material, construction and joint design as specified.

2.02 DUCTILE IRON PIPE:

- A. All Ductile Iron pipe and fittings utilized for sanitary sewer or in-plant process piping shall be in compliance with Section 40 27 00 Process Piping.
- 2.03 CONCRETE PIPE
 - A. GENERAL
 - Furnish concrete sewer pipe meeting ASTM Specifications C14, C76 or C655, latest revision, except as noted herein. Assure cement used to make concrete pipe is Type II A Modified, Type V, or other approved cement containing less than 5 percent Tricalcium Aluminate. The pipe strength classifications for C14, C76 or C655 specification pipe is listed in the plans or Contract Documents.
 - 2. The maximum absorption allowed is 7 percent. For pipe sizes smaller than 12 inches (30 cm) in diameter, assure the cement proportion in the concrete mixture is not less than 6-1/2, U.S. standard 94 pound bags per cubic yard (362 kg/m3) of concrete.
 - 3. Furnish pipe meeting the referenced ASTM specifications on permissible variations in pipe dimensions. Assure the barrel thickness is uniform to providing a constant flow area without projections across joints.
 - B. FITTINGS
 - 1. Assure all fittings for connecting all gravity and/or pressure piping and service lines are of the same material, construction and joint design as specified.

C. JOINTING MATERIALS

1. Make joints for concrete pipe using flexible, watertight, rubber-type gaskets meeting to ASTM C443, with a O-ring gasket confined in the pipe tongue groove.

D. PIPE JOINTING

1. Thoroughly clean the spigot and bell ends of the pipe before joint assembly. Follow the pipe and joint manufacturer's recommendations for pipe jointing. Check the position of the rubber gaskets and pipe assembly using a feeler gauge before backfilling the trench. Visually inspect and gauge pipe and joints from inside the pipe where pipe size permits to assure proper gasket position and joint gap tolerances.

E. MATERIALS TESTING

1. Have the pipe supplier furnish the Engineer with certified test results from an independent testing laboratory on the following: (a) crushing strength (3-edge bearing method), (b) absorption, and (c) hydrostatic test. Furnish test results for each pipe as specified in ASTM C14, C76 or C655, or a minimum 2 percent of the number of pipe supplied, whichever is greater. Cost of these tests to be borne by the pipe supplier.

2.04 HIGH DENSITY POLYETHYLENE (HDPE) PIPE:

- A. PIPE
 - 1. Furnish HDPE pipe meeting ASTM D3350, having a cell classification of PE 34-5434C. Assure dimensions and workmanship meet ASTM F714 requirements.
- B. FITTINGS
 - 1. Use wye or tee fittings for connecting service lines of the same material construction, and joint design as the main sewer pipe.
- C. PIPE JOINTING
 - 1. Heat fusion weld all field joints to meet the manufacturer's recommendations.
- D. OTHER PIPE MATERIALS:
 - 1. Other pipe materials may be specified at the discretion of the Engineer and Owner.
- 2.05 MANHOLES:
 - A. Construct manholes from precast concrete sections having frames, covers, and steps meeting applicable Standard Drawings.
 - B. Precast Concrete Sections
 - 1. Furnish manholes meeting ASTM C478; "Precast Reinforced Concrete Manhole Sections", specifically including mandatory rejection requirements.
 - C. Steps

- 1. Furnish non-corrosive steps, 12-inches in width, of ¹/₂" steel rod encased with polypropylene. Assure steps withstand 400 lb. vertical loads and 1,000 lb. pull-out resistance.
- D. Frames and covers
 - For paved areas furnish D & L Foundry A- 1178 ring and cover, or East Jordan Iron Works 3771/3772 series ring and cover, or approved equal. Assure that all covers have two pick holes, 1" minimum, 1 ¹/₄" maximum diameter. Cover lettering shall be "Sanitary Sewer". For gravel areas furnish D&L Foundry A-1172 with 1" cover or East Jordan Iron Works 3772 series cover, O-ring frame or approved equal, with recessed pick holes.
- E. Concrete Base
 - 1. Furnish precast concrete bases or field poured on undisturbed earth. Use concrete meeting Section 03 30 00 CAST IN PLACE CONCRETE

PART 3 - EXECUTION

3.01 PIPE AND SERVICE LINE INSTALLATION

- A. Excavation and Backfill
 - 1. Perform pipeline excavation and backfill meeting the applicable requirements of Section 31 23 33.
- B. Responsibility for Materials
 - 1. Be responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.
 - 2. Be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.
- C. Handling of Pipe
 - 1. Deliver and distribute all pipe to the site. Load and unload pipe, fittings and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop any materials. Do not roll or skid pipe handled on skidways against pipe already on the ground.
 - 2. In distributing the material at the site of the work, unload each piece opposite or near the place where it is to be laid in the trench. Keep the interior of all pipe and other accessories free from dirt and foreign matter at all times.
 - 3. Handle pipe to prevent damaging coating or lining. If any part of the coating or lining is damaged, make all repairs in a manner satisfactory to the Engineer.
- D. Laying Pipe
 - 1. Lay and maintain all pipe to the specified lines and grades with fittings, tees and

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manholes at the required locations. Establish line and grade using batter boards and string line, laser equipment or other approved methods. When batter boards and string line are used, use a minimum of three batterboards at all times.

- 2. Install wye or tee fittings in the mainline sewer for service line connections. Furnish wye or tee fittings of the same material, design and specifications as the sewer main pipe. Joint service pipe to tee branches or main line pipe other than PVC using special joint adapters manufactured specifically for jointing the two types of pipe.
- 3. Use tools and equipment, satisfactory to the Engineer, for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench to prevent damage to pipe materials and protective coatings and linings. Do not drop or dump any materials into the trench.
- 4. Take every precaution to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the Engineer. Clean and remove all sand, gravel, concrete and cement grout that has entered the lines during construction
- E. Tolerances
 - 1. Install the pipe within 1/2-inch (13 mm) of the specified alignment and within 114-inch (6 mm) of the specified grade.

3.02 MANHOLES

- A. Construction
 - 1. Construct manholes to the specified dimensions. Make invert channels smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Make changes in flow direction with a smooth curve of as large a radius as the manhole size will permit. Make changes in channel grade and size gradually and evenly. The invert channels may be formed directly in the manhole base concrete or by laying half-pipe in the concrete. Make the floor of the manhole outside the channel smooth and slope toward the channel at one inch per foot (8 cm per meter).
 - 2. Joint all connections between manhole walls and base and between wall sections adjusting rings and frame making the manhole watertight. For all horizontal joints located below the established high groundwater elevation, install a preformed rubber gasket joint. The established high groundwater level is shown on the plans or noted in the Special Provisions. For all sewer pipe to manhole joints, use gasketed, flexible, watertight connections that will accommodate differential settlement. Acceptable options for these connections to the manhole are as follows:
 - a. Adjacent Joints: Bell and spigot pipe joints with rubber sealing rings located within 12 inches (30 cm) of the manhole wall.
 - b. Compression-Type Flexible Connector: A resilient, flexible connection, cast into manhole wall, providing 10 degrees deflection.
 - c. Boot-Type Flexible Connector: A flexible, watertight connection consisting of a

rubber gasket or boot, metal expansion ring and a metal take-up clamp. Assure the expansion ring holds the gasket in the manhole wall, with the take-up clamp holding the gasket to the pipe.

- d. Options (b) and (c) are limited to precast manhole base inverts and other installations where the flexibility of the connection is not compromised.
- e. Construct manholes meeting ASTM C478, and the rejection criteria stated therein.
- f. Keep manhole construction within one manhole distant behind sewer pipeline construction.
- 3. Install adjusting rings on each manhole to bring the manhole top elevation to match the existing or specified ground elevations. Use manhole rings with a 2-inch minimum (5 cm) and 12-inch (30 cm) maximum height. Furnish adjusting rings reinforced with the same percentage of steel as the riser and top.
- B. Corrosion-Resistant Liner
 - 1. All manholes shall be equipped with a corrosion-resistant liner in accordance with Section 03 11 15 of these project documents.
- 3.03 SANITARY SEWER SERVICE LINES
 - A. Construct service lines meeting Standard Drawing 02730-2. Install the service line to the property line. Plug the end of the service line with a stopper and gasket, using a gasket of the same type used for pipe jointing. Do not grout the plugs.
 - B. Mark the sanitary sewer and storm drain service line ends at the property line using a steel fence post 5 feet (1.5 m) long, buried at least 2 feet (0.6 m). Place a 2" X 2" (5cm X 5 cm) wood marker extending from the pipe invert to ground line. Wire the 2" X 2" (5cm X 5 cm) marker to the steel fence post. Where applicable, mark the concrete curb to identify the service locations. Paint sanitary sewer service markers green and storm drain service markers gray.
- 3.04 TESTS
 - A. Make all tests after backfill is completed, but before any surface restoration or street surfacing. Be responsible for finding and repairing all breaks and leaks revealed by the tests. Additionally, perform all tests in the presence of the Engineer, resident inspector, or the Owner's other designated representative.
 - B. Light Test (Visual)
 - 1. After the trench has been backfilled and compacted as specified in Section 02221, perform a light test between manholes to checkhlignment and grade for pipe displacement. Excluding curved alignments shown on the plans, the completed pipeline is to permit a true circle of light to be visible from one manhole to the next. If alignment or grade is not that specified and displacement of pipe is found, remedy all defects.

- C. Leakage Test
 - 1. New sewer line will not be finally accepted until leakage tests are made assuring the Engineer that pipe laying and jointing are satisfactory.
- D. Water Test
 - 1. Where groundwater is at least 2 feet (0.6 m) above the sewer line, make tests by sealing off the section of lines between manholes and measuring the actual flow by collecting or pumping the discharge into barrels or other approved methods. Continue tests at a minimum of 4 hours for each section tested. Allow time to soak lines and manholes in advance of performing tests.
 - 2. When groundwater is not 2 feet (0.6 I11) above the pipe, test as follows: On flat slopes where the depth over the centerline of the pipe in the lower manhole of the section being tested will be not more than 10 feet (3 m), fill the upper manhole to 2 feet (0.6 m) over the top of the pipe or 2 feet (0.6 m) above the groundwater elevation (whichever is higher), and block the lower manhole. When the above conditions cannot be met, the Engineer may order testing the line in sections between manholes. Measure the leakage by checking the water level drop in the manhole over a 4 hour period.
 - 3. The allowable infiltration or exfiltration, including manholes, cannot exceed 200 gallons per day per mile of sewer per inch of pipe diameter (185 liters per day per kilometer of sewer per centimeter of pipe diameter). This does not exclude obvious and concentrated leaks and physical defects, such as open joints, pinched gaskets, cracked barrels or bells, etc. Make repairs on concentrated leaks, and as required to reduce infiltration or exfiltration leakage below the specified rate.
- E. Air Test (Alternative)
 - 1. As an alternate method to water testing, the Contractor may utilize low pressure air to test the sewer mains. Use the test procedure described below: Plug both ends of the pipe under test with airtight plugs and brace to prevent slippage and blowout. Furnish one plug with an inlet tap or other provision for connecting an air hose.
 - 2. Equip the air supply hose, connected between the air compressor and the plug, with a throttling valve, an air bleed valve and a high pressure shutoff valve for control. Equip the low pressure side of the throttling valve with a tee for a monitoring pressure gauge, protected by a gauge cock. This cock is kept closed except when the pressure loss is being timed.
 - 3. If the pipeline is submerged under groundwater, the back pressure, caused by the water head, is measured and added to the standard test pressures to compensate for the groundwater effect on the air test.
 - 4. Apply air slowly to the pipeline until the pressure reaches 4.0 psig(27.6 j). Throttle the air supply to maintain the internal pressure between 4.0 and psig (27.6-24.1 j) for at least 2 minutes. During this time check the plugs with soap solution to detect any plug leakage.

- 5. When the pressure reaches exactly 3.5 psig (24.1 j), disconnect the air supply, start a stop watch and record the time for the pressure to drop to 2.5 psig (17.2 j). The minimum time allowed for the pressure drop is computed on an air loss rate of 3.5 cfm (5.9m 3 /min) or an air loss rate of 0.0030 cubic feet per minute (cfrn) per square foot (0.055 m 3 /min1per square meter) of inner pipe surface area under test, whichever rate yields the least time for the pressure drop. Should the time of the pressure drop between 3.5 and 2.5 psig (24.1 - 17.2 j) be less than the allowable specified time, make the necessary leakage repairs and repeat the air test.
- Standard Drawing 02730-1 provides a nomograph which may be used to compute 6. testing times for air testing. The nomograph computes results based upon English (U.S. Customary) units.
- 7. For single pipe size test sections, the length limits for minimum test times obtained from Standard Drawing No.02730-1 entitled "Nomograph for Air Testing Gravity Sewer Mains" are contained in the following table.

Pipe Diameter, Inches	Test Section Length, Foot (m)	
(cm)	Minimum	Maximum
4 (10)	642(196)	1124(343)
6 (15)	429(131)	751 (229)
8 (20)	322(98)	564 (172)
10(25)	257(78)	450 (137)
12(30)	215(66)	376 (115)
15(38)	172(52)	300 (91)
18(46)	43(44)	1250 (76)
21(53)	123(37)	215 (66)
24(61)	107(33)	188 (57)

TABLE 3.1

LENGTH LIMIT FOR MINIMUM TEST TIMES

- 8. For test sections that are shorter than the minimum lengths, new test times must be calculated. This is done by multiplying the test time from the nomograph by the actual length of the test section (in feet) and then dividing the resultant product by the minimum test section length from the preceding table
- 9. For test sections exceeding the maximum lengths, either shorten the test section to an allowable length or use the water test.
- F. Number of Tests
 - 1. Perform the number of leakage tests directed by the Engineer to assure that materials and workmanship are acceptable. Repair defective joints using only approved methods. Replace pipe having cracked or broken barrels. Do not exceed 800 feet (240 m) of sewer line per test unless otherwise approved.
- G. T.V. Inspection

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- 1. All sewer mains shall be inspected using a television camera before final acceptance. A sewer line is deficient and unacceptable if (1) the alignment is outside the specified limits, (2) water ponds in any section are equal to or greater than 2 times the grade tolerance specified herein under Section 02730.3.E.1, or (3) the pipe has visible defects such as open joints, pinched gaskets, cracked barrels or bell, or similar defects.
- 2. Pay all costs incurred in any television inspection performed solely for Contractor benefit.
- 3. Record all television inspections in a format acceptable to the Owner. Pull the camera through the sewer at 30 feet per minute (9 meters per minute maximum). If the camera is pulled by attaching to the hose of a hydraulic sewer cleaner, assure the hose is not active during the pulling process.
- H. Deflection Testing
 - 1. The Engineer may require deflection testing of all or any portion of a flexible pipe installation to assure the construction quality. Flexible pipe is pipe that will deflect at least 2 percent without any sign of structural distress.
 - 2. Conduct deflection tests, when performed on PVC pipe, meeting ASTM D3034 and satisfy either of the following deflection limitations:

TABLE 3.2

DEFLECTION TESTING LIMITATIONS

Minimum Period Between Trench Backfilling & Testing	Minimum Mandrel Diameter as a Percent of Inside Pipe Diameter
7 Days	95.0
30 Days	92.5

- 3. Mandrels must have at least nine arms. Perform the mandrel test without mechanical pulling devices.
- I. Material and Equipment for Testing
 - 1. Furnish all labor, equipment and materials (including water) necessary for performing the sewer line tests at Contractor expense.

3.05 WATER AND SEWER MAIN SEPARATION

A. Horizontal and vertical separation between water and sewer mains is dictated by Montana Department of Environmental Quality.

3.06 MANHOLE LEAKAGE TESTING

- A. General:
 - 1. Conduct tests in the presence of and to the complete satisfaction of the Engineer.
 - 2. Should a manhole not satisfactorily pass testing, discontinue manhole construction in the Project until such manhole does test satisfactorily.

- 3. The contractor may choose the type of manhole testing to be done on this project if groundwater is below the bottom of the manhole. Both exfiltration testing and vacuum testing will be acceptable.
- 4. Provide tools, materials (including water), equipment and instruments necessary to conduct manhole testing specified herein.
 - a. Vacuum Testing Equipment:
 - i. Use vacuum apparatus equipped with necessary piping, control valves, and gauges to control air removal rate from manhole and to monitor vacuum.
 - ii. Provide an extra vacuum gauge of known accuracy to frequently check test equipment and apparatus.
 - iii. Vacuum testing equipment and associated testing apparatus are subject to approval by the Engineer.

iv. Provide seal plate with vacuum piping connections.

- b. Prior to testing, clean manholes thoroughly and seal openings both to the complete satisfaction for the Engineer. Seal openings using properly sized plugs.
- c. Perform testing with frames installed. Include the joint between the manhole and manhole frame in the test.
- d. The Contractor may elect to make a test for his/her own purposes prior to backfilling. However, only tests on installed (backfilling complete) manholes will be accepted by the Engineer.
- B. Vacuum Test Procedure: Test in accordance with ASTM C1244 and the following test procedures:
 - 1. Perform vacuum testing in accordance with the testing equipment manufacturer's written instructions.
 - 2. Create a vacuum of 10 inches of mercury and close the valves.
 - 3. Consider manhole acceptable when vacuum does not drop below 9 inches of mercury for the following manhole sizes and times:
 - a. 4-foot diameter 60 seconds
 - b. 5-foot diameter 75 seconds
 - c. 6-foot diameter 90 seconds
 - d. 7-foot diameter 105 seconds
 - e. 8-foot diameter -120 seconds
- C. Exfiltration Test Procedure: Groundwater must be below the bottom of the manhole to perform this test. Test in accordance with ASTM C969 and the following test procedures:
 - 1. Completely fill manhole to top of the frame with water.
 - 2. Allow water-filled manhole to stand a minimum of 4 hours prior to testing to allow

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absorbing in materials.

- 3. At commencement of test, fill manhole to top lip of manhole frame.
- 4. During a consecutive 4-hour long period, keep an accurate record of the amount of water to be added because of exfiltration. (How much water is added to maintain the water level at the top of the frame).
- 5. Consider the manhole acceptable when exfiltration rate does not exceed the following rate:

(0.1 gal) x (diameter in feet) x (head in feet) x (hours)

- D. Repair and Retest. Determine source of leaks in manholes failing acceptable limits.
 - 1. Repair or replace defective materials and workmanship, as is the case, before conducting such additional Manhole Acceptance Tests and such subsequent repairs and retesting as required until manholes meet the test requirements.
 - 2. Make repairs, replacements and retests at no additional expense to the Owner.

END OF SECTION 33 31 13

SECTION 33 31 19 SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Piping Materials and Fittings
 - 2. Polyethylene Encasement
 - 3. Valves
 - 4. Reaction Backing (Thrust Blocking)
 - 5. Bedding and Backfilling
 - 6. Yard Hydrants
 - 7. Fire Hydrants
 - 8. Appurtenances
 - 9. Pipe Installation
 - 10. Pipe Thrust Restraint
 - 11. Testing Gravity Lines
 - 12. Testing Pressure Mains
- B. Related Sections include, but are not limited to:
 - 1. Section 00 95 10 Special Provisions.
 - 2. Section 01 31 00 Coordination and Meetings.
 - 3. Section 01 33 00 Submittals.
 - 4. Section 01 40 00 Quality Control.
 - 5. Section 31 05 13 Soils for Earthwork.
 - 6. Section 31 23 33 Trenching and Backfilling.
 - 7. Section 32 05 16 Aggregates for Exterior Improvements.
 - 8. Section 33 01 10.58– Disinfection of Utility Piping Systems.
 - 9. Section 40 27 00 Process Piping General

1.02 REFERENCES

- A. Reference Standards include, but are not limited to:
 - 1. ASTM A536 Ductile Iron Castings.
 - 2. ASTM B88 Seamless Copper Water Pipe.
 - 3. ASTM D3139 Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.
 - 4. ANSI/AWWA C104/A21.4 Cement-Mortar Lining for Gray-Iron and Ductile-Iron Pipe and Fittings for Water.
 - 5. ANSI/AWWA C105/A21.5 Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids.
 - 6. ANSI/AWWA C110/A21.10 Gray-Iron and Ductile-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids.

- 7. ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Gray-Iron and Ductile-Iron Pressure Pipe and Fittings.
- 8. ANSI/AWWA C150/A21.50 American National Standard for Thickness Design of Ductile-Iron Pipe.
- 9. ANSI/AWWA C151/A21.51 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
- 10. ANSI/AWWA C153/A21.53 Ductile-Iron Compact Fittings, 3-Inch through 12-Inch, for Water and Other Liquids.
- 11. AWWA C509 Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems.
- 12. AWWA C550 Standard for Protective Epoxy Interior Coating for Valves and Hydrants.
- 13. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances.
- 14. AWWA C605 Underground Installation of PVC Pressure Pipe and Fittings.
- 15. AWWA C800 Standard for Underground Service Line, Valves, and Fittings.
- AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In., for Water.
- 17. AWWA C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In., for Water Transmission and Distribution.
- 18. ASTM D1784 Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.
- 19. ASTM D1785 Poly (Vinyl Chloride) Plastic Pipe, Schedules 40, 80, and 120.
- 20. ASTM D2241 Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- 21. ASTM D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe fittings, Schedule 80.
- 22. ASTM F477 Elastometric Seals (Gaskets) for Joining Plastic Pipe
- 23. NSF Standard No. 14, 60, and 61 National Sanitation Foundation.
- 24. WW-T-779c Federal Specifications
- 1.03 SUBMITTALS
 - A. Submit Shop Drawings per Section 01 33 00 for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, Joint Data, maximum loadings, and thrust restraints.
 - B. Provide a list of materials and corresponding suppliers.
 - C. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.

- 1. Submit design calculations for structural design of pipe thickness where pipe class or thickness is not specifically called out.
- D. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- E. Manufacturer's Instructions: For valves, hydrants, and specialties, furnish in accordance with Sections 01 61 00 and 01 77 00 manufacturer's printed instruction for delivery, handling, storage, assembly, installation, adjustment, special tool requirements, and maintenance requirements.
- F. In accordance with Section 01 77 00, provide records of measured depths of water mains, service leads, valves, connections, transition couplings, adapters, thrust blocking; measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements; measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work; field changes of dimension and detail.
- 1.04 QUALITY ASSURANCE
 - A. Perform Work in accordance with Section 01 45 00.
 - B. Valves: Manufacturer's name and pressure rating marked on valve body.
- 1.05 FIELD MEASUREMENTS
 - A. The Drawings indicate required pipe sizes and the general arrangement for major piping. Locations shall be verified in the field by the Contractor. Valves, fittings, and appurtenances shall be of such dimensions to allow for the installation of this piping substantially as shown on the Drawings. In the event it should become necessary to change the location of any of the work due to interference with other work, Contractor shall consult with the Engineer prior to making any changes and all such changes shall be made at no additional cost to the Owner.
 - B. Prior to roughing in any facilities or installation of piping and equipment, consult all related drawings including general, mechanical, electrical, etc., and inform self of materials, locations of structures, pipes, duct banks, electrical conduits, etc., which may impact the installation.
 - C. Discrepancies discovered before or after work has started, shall be brought to the attention of the Engineer immediately, and the Engineer reserves the right to require minor changes in the work to eliminate such discrepancies.
 - D. Pipe connections to equipment shall be subject to approval of Engineer and coordinated to meet the manufacturer's recommendations and requirements.
 - E. No work that connects directly to equipment shall be installed before complete shop drawings of said equipment have been reviewed and approved by the Engineer.

1.06 PROJECT CONDITIONS

A. Verify dimensions of and between existing structures and locations of existing piping and equipment for the proper installation of all new piping and equipment.

- B. Contractor shall be responsible for verification of location of all existing piping and structures. Potholing and or excavation to expose existing piping, conduits, etc. may be required prior to installation of new piping or connection to existing piping. Adjustments to the locations of new piping may be required due to locations of existing piping and sequencing of construction that will be required. Adjustments required shall be at no additional cost to the Owner.
- 1.07 DELIVERY, STORAGE, AND HANDLING
 - A. Delivered materials shall be stockpiled and stored at locations approved by the Owner until required for installation. Materials shall be transported, delivered, stored, and handled in accordance with Manufacturer's instructions and the requirements of Section 01 61 00.
 - B. Contractor shall inspect materials upon delivery for loss or damage in transit. Contractor shall be responsible for the replacement of damaged materials; damaged materials shall be removed from the Site.

1.08 REGULATORY REQUIREMENTS

A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE (DIP) AND FITTINGS

- A. The pipe and fittings furnished shall be of the Ductile Iron type as specified for each particular use or installation and shall be minimum Pressure Class 350 for pipe 4-12 inches and minimum Pressure Class 250 for pipe 14 inches and greater, unless otherwise noted.
- B. Materials:
 - 1. Ductile iron pipe shall conform to the requirements of AWWA C151/ANSI A21.51 with mechanical joints.
 - 2. Mechanical or push-on joints shall conform to the requirements of AWWA C111/ANSI A21.11.
 - 3. The weight, class, or nominal thickness and casing period shall be shown on each pipe. The manufacturer's mark, year produced, and letters "DI" or "Ductile" shall be cast or stamped on the pipe.
 - 4. Mechanical joint fittings shall conform to the requirements of AWWA C110/ANSI A21.10 rated at 250 psi or 350 psi for sizes larger than 16 inches in diameter, and AWWA C110/ANSI A21.10 or AWWA C153/ANSI 21.53 rated at 350 psi for sizes up to and including 16 inches. No plain end fittings shall be allowed.

- 5. Rubber gaskets shall conform to the requirements of AWWA C111. Gaskets used for air piping shall be EPDM.
- 6. All pipe joints and fittings shall have conductive gaskets with copper inserts or copper strap welded to the pipe and connected with silicone bronze bolt. The conductors shall be rated at 600 amps sustained current.
- 7. All ductile iron pipe and fittings shall be lined with cement mortar in accordance with AWWA C104/ANSI A21.4, unless otherwise noted. Ductile iron pipe and fittings used for air piping shall not be cement lined.
- 8. All ductile iron pipe and fittings shall be polyethylene encased in accordance with AWWA C105.
- C. Air line piping shall not be lined with cement.
- D. All exterior surfaces of pipe and fittings shall have a tar or bituminous seal coating conforming to AWWA C151. Spotty or thin seal coating, or poor coating adhesion, shall be cause for rejection of the materials.
- E. Retainer glands for restrained joints shall be American, US Pipe, or EBAA Iron, Inc. Mega Lug type, ductile iron, and be designed to meet or exceed the pressure classification of the corresponding pipe. Restraint glands for mechanical joint pipe shall be EBAA Iron, Inc. Megalug, Series 1100, or equal. Push joint pipe shall be restrained using restraint harnesses EBAA Iron, Inc. Megalug, Series 1700, or equal. Joint restraint systems shall be rated for at a minimum the design pressure of the pipe with a 2 to 1 safety factor.
- F. Restrained joint pipe may be used in lieu of joint restraint systems for push on and mechanical joint pipe. Restrained joint pipe shall be US Pipe TR Flex or American Flex Ring pipe, or equal.
- G. Nuts, bolts, and tie rod restraints shall be 304 stainless steel. Tee bolts for mechanical joints and fittings shall be "Cor-Blue" by NSS industries, or equal.
- H. See Section 33 05 26 for Utility Identification and tracer wire requirements.
- 2.02 POLYVINYL CHLORIDE (PVC) PIPE
 - A. The PVC pipe and fittings furnished shall be of the type as specified below for each particular use or type of installation.
 - B. Water Service Piping (1.5 to 2 inches diameter):
 - 1. As specified in the piping schedule presented in the Construction Drawings.
 - 2. Pipe, fittings, and valves shall be manufactured from a PVC compound which meets the requirements of Type I, Grade 1 PVC in accordance with ASTM D1784. Compound from which pipe is produced shall have a design stress rating of 2,000 psi at 23 degrees C, listed by the PPI.
 - 3. Pipe, fittings, and valves shall be Schedule 80.
 - 4. Pipe, fittings, and valves shall be installed in compliance with manufacturer's

recommendations and in accordance with ASTM D2274.

2.03 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. All high density polyethylene pipe shall be DR 11, unless specified otherwise, conforming to ANSI D-2239.
- B. All HDPE pipe to have standard ductile iron pipe size (DIPS) dimensions.
- C. All pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults. The physical appearance of the pipe having deformities such as concentrated ridges, discoloration, excessive spot roughness, pitting, varying wall thickness, etc., shall constitute sufficient basis for rejection.
- D. Ductile Iron Fittings:
 - 1. All ductile iron fittings connecting to polyethylene pipe are required to include stainless steel sleeve inserts inside the pipe and PE electrofusion MJ adapters as manufactured by Central Plastics Company or approved equivalent.
 - 2. PE electrofusion fittings may be substituted for ductile iron fittings at no additional cost to Owner. Fitting and piping shall be heat fused in accordance with ASTM D2657. Butt fusion fittings shall conform to ASTM D3261.
 - 3. Push-on or mechanical rubber gasket joints conforming to the compression gasket ring requirements of ANSI/AWWA C111/A21/11 and ASTM D3139, and as shown on Drawings.
 - 4. Provide stainless steel nuts, bolts, and glands.
- 2.04 GAS LINE
 - A. Gas Line provided and installed by others, contact Northwest Energy prior to earthwork activities.
- 2.05 POLYETHYLENE ENCASEMENT
 - A. Conform to and install per ANSI/AWWA C105/A21.5.
 - B. Install on all underground metallic items, including: ductile iron pipe, ductile iron fittings, metal body valves, other metal pipe and fittings, fire hydrants, stainless steel couplings, transition couplings, and service and testing tapping saddles.
- 2.06 REACTION BACKING (THRUST BLOCKS)
 - A. Conform to details shown on Drawings for bends, tees, fire hydrants, dead end plug, and service tap connections.
 - B. 3,000 psi concrete for pipe, fittings, and plugs unless specifically shown otherwise on Drawings.
- 2.07 BEDDING AND BACKFILLING
 - A. Materials: As specified in Section 31 23 33 for backfill and pipe bedding.
 - B. Aggregate Bedding: Fill Type A1 for over-excavation and Fill Type A5 for standard

bedding as shown on the Construction Drawings and specified in Section 32 05 16.

C. Material: Fill Type S1 or S2 as specified in Section 31 05 13.

2.08 VALVES

- A. Resilient Wedge Gate Valves: 4-inch to 12-inch.
 - 1. Minimum working pressure of 200 psi for 4-inch to 12-inch valves.
 - 2. Valve body and rubber-encapsulated wedge constructed of ductile iron or cast iron.
 - 3. Resilient seat gate, bubble-tight closure design.
 - 4. Meet or exceed the ANSI/AWWA C515 standards.
 - 5. Bronze stem and stem nut.
 - 6. Fusion Bonded Epoxy-coated interior and exterior in accordance with AWWA C550.
 - 7. Equipped with non-rising stem with 2-inch square operating nut, open left (counter clockwise) rotation.
 - 8. Provide adjustable valve box, riser, and cover. Provide stem extensions for all actuators. Extension length will vary with the depth of bury for each valve and shall extend to within one (1) foot of top of valve box. Provide all necessary appurtenances for complete operation of valve.
 - 9. Provide polyethylene encasement conforming to ANSI/AWWA C105/A21.5 for buried valves.
 - 10. Connections: Mechanical joint.
 - 11. Provide gaskets and stainless steel nuts and bolts.
 - 12. Markings shall be cast on the bonnet or body of each valve and shall show the manufacturer's name or mark, year valve casting was made, size of valve, the letters "C515", and the designation working water pressure.
 - 13. Manufacturer shall furnish an affidavit stating that the valve and all materials conform to the applicable AWWA requirements and all tests specified under the respective standard have been performed and have been met. Valves shall be NSF 61 certified.
 - 14. Approved manufacturers:
 - a. American Flow Control
 - b. Mueller Company
 - c. Waterous Valve Company
 - d. M & H Valve Company
 - e. Clow Valve Company
 - f. Or approved equivalent.

- B. Resilient Wedge Gate Valves, size 14" and Larger.
 - 1. Standard: AWWA C-515, AWWA C-509, Non-rising stem.
 - 2. Minimum rated working pressure: 250 psig for 18" and 150 psig for 30".
 - 3. Finish: Interior and exterior fusion bonded epoxy coating meeting or exceeding requirements of AWWA C550 and complying with NSF-61.
 - 4. Bevel Gear 6:1 Operator EXEECO IB8, or Approved Equivalent.
 - 5. Connections: Mechanical joint.
 - 6. Materials:
 - a. Valve Body, Stuffing Box, and Bonnet: Ductile iron, ASTM A536.
 - b. O-rings: Rubber.
 - c. Lower Thrust Washer: Derlin.
 - d. Upper Thrust Washer, Nuts, Bolts, and Flat Washer: Stainless steel.
 - e. Stuffing Box Gasket: Rubber o-ring.
 - f. Throat Flange Gasket: Rubber.
 - g. Stem and Wedge Nut: Manganese bronze.
 - h. Resilient Wedge: Ductile iron, ASTM A536 coated with rubber. The wedge shall symmetrically seal in both directions.
 - 7. Warranty: 10 years.
 - 8. Counterclockwise Open EPDM.
 - 9. Approved Manufacturer:
 - a. American Flow Control Series 2500.
 - b. US Pipe and Foundry Company.
 - c. Or approved equivalent.

2.09 NON-FREEZE YARD HYDRANTS

- A. Ground hydrants shall be self-draining, non-freezing, ductile iron construction with ³/₈" steel operating rod and 90° lift handle. Inlet connection shall be ³/₄" FTP and outlet nozzle shall be ³/₄" brass GHT.
- B. Ground hydrants shall have 1" galvanized steel casing pipe. Principal interior operating parts shall be brass and removable from the hydrant for servicing without excavating hydrant.
- C. Bury depth shall be 6.0 feet minimum.
- D. Hydrants shall be set in ²/₃ cubic feet of crushed gravel to allow for proper drainage of the hydrant, gravel shall be encased in filter fabric to prevent fouling of drain stone.
 Recommendation of the AWWA should be followed for installation of hydrants.

- E. Ground hydrants shall be Woodford Model R34 Freezeless Yard Hydrant or approved equal.
- 2.10 FIRE HYDRANTS (*if applicable*)
 - A. Fire hydrants shall be $5\frac{1}{4}$ " main value opening;
 - B. Three way (two hose nozzles, one pumper nozzle) with large radius, full flow openings field replaceable;
 - C. Must be approved to UL 246, FM 1510, ANSI/AWWA C502 Standards;
 - D. Post type, dry barrel design;
 - E. Dry top design with O-ring sealed oil reservoir;
 - F. Compression-type main valve, closes with pressure for positive seal, made of rubber and reversible;
 - G. Contoured shoe designed for full flow
 - H. Dual bronze drain valve for effective barrel drainage;
 - I. 10-year warranty on materials and workmanship;
 - J. Fire hydrants shall be Mueller® Super Centurion 250TM 3-way hydrant or approved equal.
- 2.11 VALVE BOXES
 - A. Valve boxes shall be three piece cast iron with a round base, Mueller H-10357 or Tyler Union.
 - B. The top of the valve boxes shall be $5\frac{1}{4}$ inches in diameter.
 - C. Valve box height shall be suitable for the burial depth of the valve and shall have sufficient length to permit at least 6-inches of adjustment above and below grade when the valve is laid to the specified depth. Adjustment shall be screw type.
 - D. Covers shall have the word "Potable Water" or "Non-Potable Water" or "Sewer" cast on top.
 - E. All buried valves shall have a full operator extension.

2.12 APPURTENANCES

- A. Bolts: Stainless steel underground bolts, including all bolts on fittings, valves, and transition couplers. Tee bolts for mechanical joints and fittings shall be "Cor-Blue" by NSS industries, or equal.
- B. Tie Bolts: Cretex Gasketed Pipe Joint Ties, or approved equivalent.
- C. Service and Tapping Saddles:
 - 1. All stainless steel tapped outlet, band clamps, nuts, bolts, and washers.
 - 2. Heavy gauge type 304 stainless steel shell construction, passivated welds, double bolt type with minimum band width of 6 inches, and rubber "O"-ring gasket pad

meeting ASTM D2000.

- 3. Meet or exceed the ANSI/AWWA C800 standards, 200 psig.
- 4. Approved manufacturers:
 - a. Romac Industries, Inc.
 - b. Dresser Industries.
 - c. The Ford Meter Box Company.
 - d. Approved equivalent.
- D. Tapping Sleeve:
 - 1. Stainless steel full wrap around body.
 - 2. All stainless steel tapped outlet, nuts, bolts, washers.
 - 3. Gasket to provide seal around full circumference of pipe.
 - 4. Approved manufacturers:
 - a. Romac Industries, Inc.
 - b. The Ford Meter Box Company.
 - c. Approved equivalent.
- E. Stainless Steel Couplings:
 - 1. All type 304 stainless steel middle ring, followers, nuts, bolts, and washers construction.
 - 2. Minimum length as required for joining cast iron pipe sizes as shown on plans.
 - 3. Minimum rated working pressure of 250 psi.
 - 4. Buna N rubber "O"-ring gaskets.
 - 5. Approved manufacturers:
 - a. Dresser Industries, Style 38.
 - b. Approved equivalent
- F. Transition Couplings:
 - 1. Long pattern, sleeve type, ductile iron couplings, meeting the requirements of ANSI/AWWA C110/A21.10 and rated for 250 psig.
 - 2. Epoxy or nylon coated inside and out.
 - 3. Where pipes of dissimilar metal are joined, ensure dielectric insulation to prevent galvanic corrosion.
 - 4. Install with stainless steel bolts.
 - 5. Provide polyethylene encasement.
 - 6. Approved manufacturers:

- a. Power Seal
- b. Ford
- c. Romac
- d. Approved equivalent

2.13 TRENCH INSULATION

A. Trench insulation shall be extruded rigid board material. The insulation shall have a thermal conductivity of not more than 0.28 BTU per hour per square foot per degree Fahrenheit per inch of thickness as tested in accordance with ASTM C177. The insulation shall not absorb moisture to an extent greater than 2.5 percent by volume as tested in accordance with ASTM D2127. The compression strength of the insulation shall be greater than 20 psi as tested in accordance with ASTM D1621. The density of the insulation shall be between 0.9 and 1.3 pounds per cubic feet as tested in accordance with ASTM D1622.

PART 3 - EXECUTION

3.01 GENERAL

- A. Contractor shall verify location of piping and piping systems as shown on the Drawings.
- B. Contractor shall be aware that it may be necessary to move a piping run a reasonable amount or shift it slightly up or down to avoid an existing obstruction or other piping runs. Contractor shall not receive additional compensation due to slight shift or movement of piping runs.
- C. Not all fittings may be shown on the Drawings, the fittings shown are meant to give a graphical representation only. Additional fittings required for differences in vertical and/or horizontal alignment may be required. Contractor shall not receive additional compensation due to additional fittings required to meet vertical and horizontal alignments.
- D. The Drawings show two (2) dimensional graphical representation of piping systems, Contractor shall note there may need to be additional pipe length due to the vertical elevation differences that may not be represented on the drawings.
- E. All buried piping with less than six (6) feet of cover shall be insulated. Trench insulation shall be provided above the pipe with a minimum thickness of four (4) inches as shown on the drawings for all piping.
- F. Contractor has ability to modify the inverts of the potable water to avoid pipe conflicts. The potable water lines have been set constant elevations throughout the site. Contractor shall have the ability to modify invert elevations as long as six (6) feet of cover has been maintained.
- G. All joints shall be properly restrained in accordance with these specifications.
- H. Contractor shall provide dewatering as necessary, piping shall not be laid in water or wet conditions.

- I. See Section 31 23 33 for all trench excavation and backfill requirements, and piping system bedding requirements.
- J. See Division 40 for all exposed process piping and valves.
- 3.02 PREPARATION AND STORAGE
 - A. Store pipe on-site on flat surface so barrel is evenly supported. Do not stack higher than 6 feet. Cover pipe with opaque material for extended storage.
 - B. Remove scale and dirt on inside and outside before assembly. Inspect for damage to pipe and other materials before installation.
- 3.03 INSTALLATION PIPE, VALVES, AND APPURTENANCES
 - A. The type, kind, and class of pipe to be used shall be as shown on the Drawings. All pipes shall be laid and to the required line and grades.
 - B. Install all pipe and appurtenances in strict accordance with manufacturer's recommendations.
 - C. All foreign material or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying.
 - D. Pipe materials shall be handled carefully. Damage to protective coatings, linings, and joint fittings shall be cause for rejection of the materials. Prior to installation each pipe section, fitting, or valve shall be thoroughly inspected by the Contractor to detect damage or defects. Contractor shall inform Engineer of such damage or defects. Any defective, damaged, or gravity piping which has had its grade or joint disturbed after layer shall be replaced.
 - E. Cut pipe in a neat and workmanlike manner without damaging the pipe. Cutting of pipe for connections or pipe run lengths or inserting of fittings and valves shall be done in accordance with pipe manufacturer recommendations. Rough edges shall be removed and where rubber gasket joints are used, the outer edge shall be beveled by grinding or filing to produce a smooth fit.
 - F. Trench preparation shall proceed in advance of pipe installation only so far as can be backfilled the same day, or as permitted by the Owners specifications.
 - G. Excavate, and backfill excavations and trenches in accordance with Section 31 23 33.
 - H. Keep trenches free from surface and ground water until pipe jointing is complete.
 - I. All fittings shall be set on cast in place or precast concrete blocks in order to prevent the weight from being transmitted to the pipe. Before concrete is placed around fittings and appurtenances, the appurtenance and pipe shall be wrapped with polyethylene to completely isolate the concrete from the water main construction.
 - J. Form and place concrete for thrust blocking at each bend, tee, or change of direction. Thrust blocks shall bear on undisturbed earth.
 - K. Securely close open ends of pipe and fittings when Work is not in progress.

- L. Pipe Installation:
 - 1. Install piping to lines, grades, and dimensions shown on Drawings.
 - 2. Take up and relay any pipe disturbed from its required grade or alignment.
 - 3. Install pipe to allow for expansion and contraction without stressing pipe.
 - 4. Install pipe such that maximum deflections from straight line or grade do not exceed manufacturer's specifications. Install bend fittings where maximum deflections are exceeded.
 - 5. Notify Engineer and Owner at least 48 hours in advance of service disruptions and connections.
- M. Prior to pipe placement the bedding conditions shall be such as to provide uniform and continuous support for the pipe. For belled pipe, bell holes shall be excavated as necessary to make the joint connections and provide proper support. Pipe shall not be laid in water or unsuitable bedding conditions. See Section 31 23 33 for bedding requirements.
- N. Piping shall be carefully lowered into laying position by the use of suitable restraining devices. The pipe shall not be dropped or dumped into the trench. All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are placed into position. Pipe joints shall be kept clean prior to and during installation. The joint surface shall be inspected prior to placement to ensure that there is no foreign matter, coating blisters, projections, rough edges, or damaged gaskets that may impact the integrity of the joint connection.
- O. As each length of pipe is placed in laying position the pipe shall be secured in place with approved backfill material and the appropriate compaction as specified in Section 31 23 33.
- P. Bell and spigot piping shall be laid with the bell ends facing upgrade and the laying shall start at the downgrade end and proceed upgrade, unless otherwise permitted by the Engineer.
- Q. When pipe laying is not in progress the open ends shall be closed by watertight plugs or other approved means. In the presence of water, the pipe end shall remain sealed until the trench has been properly drained or dewatered.
- R. At connections to existing piping, Contractor shall remove all dirt and debris that is allowed to enter the existing lines.
- S. Inspection: Do not cover pipe and fittings until all bedding, joints, and polyethylene wrap have been inspected.
- T. Replace any pipe, fittings, or appurtenances found defective after installation has been completed.
- U. PVC pipe used for force main and water main shall be installed in accordance with AWWA C605, AWWA Standard for Underground Installation of PVC Pressure Pipe and

Fittings for Water.

3.04 PIPE THRUST RESTRAINT

- A. Provide all crosses, tees, bends, caps, and other thrust points in the piping system with suitable means of overcoming thrust.
- B. Concrete reaction blocking and/or retainer glands or tie rods may be used subject to the Engineer's approval. All rods, nuts, bolts, and hardware shall be stainless steel. At tees, 90 degree bends, and dead ends both mechanical type joint restraint and concrete reaction blocking shall be required.
- C. Concrete reaction blocking shall be placed so that pipe and fitting joints are accessible for repair, and in such a manner as to provide bearing against undisturbed earth. Pressure testing shall not proceed until concrete reaction blocking has reached its design strength. High early strength concrete may be used.
- D. The following table is based upon the results of the Ductile Iron Pipe Research Association thrust restraint design program for a test pressure of 150 psig, backfill soil density of 90 pounds per cubic foot, and polyethylene wrapped pipe. The table shows the minimum length of pipe to be restrained for various types of fittings where joint retainer glands are used. The minimum concrete reaction block size is shown in parentheses under the minimum length.

Pipe Diameter	Dead End Tee	Wye
(inches)	Branch	45° Bends or less
	90° Bend	
4	26 LF	11 LF
4	(3.1 SF)	(2.0 SF)
6	26 LF	11 LF
0	(3.1 SF)	(2.0 SF)
8	34 LF	14 LF
0	(5.3 SF)	(3.0 SF)
10	42 LF	17 LF
10	(8.1 SF)	(4.4 SF)
12	50 LF	20 LF
12	(13.4 SF)	(6.6 SF)
14	58 LF	23 LF
14	(17.2 SF)	(9.2 SF)
16	64 LF	27 LF
10	(21.4 SF)	(11.6 SF)
18	71 LF	30 LF
10	(25.2 SF)	(15.2 SF)
20	79 LF	33 LF
20	(30.2 SF)	(18.1 SF)
24	93 LF	39 LF
24	(38.5 SF)	(26.1 SF)

30	112 LF	46 LF
50	(52.5 SF)	(34.5 SF)
26	132 LF	56 LF
36	(65.4 SF)	(40 SF)
42	167 LF	70 LF
42	(82.5 SF)	(49 SF)

3.05 POLYETHYLENE ENCASEMENT

- A. Where required all piping, fittings, valves, and appurtenances shall be fully encased in polyethylene film tubing.
- B. The polyethylene tubing shall be of appropriate size for the size of pipe being installed. Install polyethylene tubing prior to lowering pipe into trench.
- C. Tubing length shall be long enough to provide a minimum of one (1) foot overlap at all joints, fittings, and appurtenances. After completing the pipe jointing and positioning the tubing material, the overlap shall be secured into place with plastic adhesive tape wrapped circumferentially around the pipe at least three (3) full turns.
- D. The fit shall be snug over the pipe with no excess or bunched up material. Repair all rips, punctures, or other damage with taping and overlapping patching.

3.06 TESTING GRAVITY LINES

- A. Gravity lines, including service connections, shall be substantially watertight and shall be tested for excessive leakage upon completion and before connections are made to the service. Each test section of the sewer shall be subjected to exfiltration testing, either by hydrostatic or air test method as described below and at the Contractor's option. The requirements set forth for maximum leakage shall be met as a condition for acceptance of the gravity line section represented by the test.
- B. If the ground water level is greater than three feet above the pipe invert elevation of the upper manhole and the Engineer so approves, infiltration testing may be allowed in lieu of the exfiltration testing, in which case the allowable leakage shall be the same as would be allowed for the Hydrostatic Test.
- C. Testing shall be performed by the Contractor without any direct compensation being made therefore, and the Contractor shall provide necessary equipment and materials, including plugs and standpipes as required.
- D. Air Test Method
 - 1. Air testing shall conform to ASTM C 924 for concrete pipe and ASTM F 1417 for plastic pipe and ductile iron.
 - 2. The pipeline shall be sealed with plug whose sealing length is greater than the diameter of the pipe and constructed in such a nature that it will not require external blocking or bracing and maintain a seal against the line's test pressure.
 - 3. Wyes, tees, outlets or ends of laterals shall be suitably capped and braced to

withstand the internal pressures. Such caps or plugs shall be easily removable.

- 4. One plug shall be tapped for the air supply hose and the return air pressure hose. The air supply hose, connected from the compressor to the plug shall have a throttling valve, bleeding valve and shut off valve for control. The air pressure tap shall have a sensitive pressure gauge, 0 to 10 psi range, protected by a gauge cock and a pressure relief valve set at 10 psi.
- 5. In performing the test, air is added slowly to the pipeline until pressure inside the pipeline reaches 4.0 psi. If air is added too rapidly, the test accuracy will decrease because a change in temperature also has an effect on the change in pressure. When the air pressure inside the pipeline reaches 4.0 psig above external hydrostatic pressure, the supply air is stopped. A minimum two-minute time interval is allowed for the temperature difference to stabilize before the actual test is performed. If the air pressure drops below 3.5 psig during this time interval, more air will be supplied to the pipeline and throttled to maintain a pressure between 3.5 psig and 4.0 psig for a minimum of two minutes after which time the supply air will be shut off.
- 6. The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.0015 cfm per square foot (for PVC) or 0.003 cfm per square foot (for RCP) per internal pipe end area at an average pressure of 3.0 psig greater than any back pressure exerted by groundwater that may be over the pipe at the time of test.
- 7. The test shall be accomplished by determining the time in minutes for the pressure to decrease from 3.5 psig to 3.0 psig greater than the average groundwater pressure that may be over the pipe. That time shall not be less than the time shown on the given diameter in the following table:

Gravity Line Diameter	Minutes for DIP
(Inches)	
4	1.9
6	2.8
8	3.8
10	4.7
12	5.7
15	7.1
18	8.5
21	9.9
24	11.3
27	12.8
30	14.2
33	15.6
36	17.0
42	19.8

8. For pipe lengths exceeding 100 feet, the following table of times shall be used per every 100 feet of pipe. All other testing parameters and requirements shall remain:

Gravity Line Diameter (Inches)	Minutes for DIP
4	1.9
6	2.8
8	3.8
10	4.8
12	5.7
15	7.1
18	9.7
21	13.1
24	11.4
27	14.5
30	17.8
33	21.6
36	25.7
42	28.5

- 9. If the pipeline fails to meet the requirement of the test, the Contractor shall, at Contractor's own expense, determine the source of leakage and then repair or replace all defective material and workmanship.
- 10. In determining the pressure greater than the average groundwater, the groundwater height in feet above the pipeline must be measured.
- 11. When the water elevation has been established, the height in feet above the pipeline shall be divided by 2.31 and that pressure added to gauge pressure of test.

3.07 HYDROSTATIC TEST METHOD

- A. After bulkheading the test section, the pipe shall be subjected to a hydrostatic pressure produced by a head of water at a depth of three feet above the invert elevation of the gravity line at the manhole of the test section. In areas where ground water exists, this head of water shall be three feet above the existing water table.
- B. The water head shall be maintained for a period of one hour during which time it will be presumed that full absorption of the pipe body has taken place, and thereafter for an extended period of one hour the water head shall be maintained as the test period. During the one hour test period, the measured water loss within the test section, including service stubs, shall not exceed the Maximum Allowable Loss (in Gallons Per Hour per 100 Feet of Pipe) given below for the applicable Gravity Line Diameter.

Gravity Line Diameter (In Inches)	Maximum Allowable Loss* (In Gallons Per Hour Per 100 Feet)
6	0.5
8	0.6
10	0.8
12	1.0
15	1.2
18	1.4
21	1.7

24 & Larger	1.9
* Based on 100 Gallons Per Day Per Pipe Diameter Inch Per Mile	

C. If measurements indicate exfiltration within a test action section is not greater than the allowable maximum, the section will be accepted as passing the test.

3.08 TEST FAILURE AND REMEDY

- A. In the event of test failure on any test section, testing shall be continued until all leakage has been detected and corrected to meet the requirements. Repair work shall be subject to approval of the Engineer. Introduction of sealant substances by means of the test water will not be permitted.
- B. Unsatisfactory repairs or test results may result in an order to remove and replace pipe as the Engineer considers necessary for test conformance. All repair and replacement work shall be at the Contractor' expense.

3.09 TESTING PRESSURE MAINS

- A. Hydrostatic Testing of Pressure Mains
 - 1. After the pipe has been laid, including fittings and valves and blocking, all newlylaid pipe or any valved section thereof, unless directed otherwise by the Engineer, shall be subject to hydrostatic pressure of 150 pounds per square inch. The duration of each test shall be at least two hours.
 - 2. Each section of pipe to be tested shall be filled with water and all air expelled at the highest point. The required taps to expel air or to fill the water main shall be supplied and installed by the Contractor and shall be 3/4 inch and shall include an approved service saddle when required.
 - 3. The test apparatus shall be applied at the lowest elevation on the section to be tested. The apparatus shall be connected to the line at a service tap or special tap location.
 - 4. The pressure gauge shall be a standard pressure gauge. The dial shall register from 0 200 psi and have a dial size of 4 1/2 inches with 1 psi increments.
 - 5. The hydrostatic test, pressure requirement for an acceptable test shall be a maximum pressure drop of 2 psi during the last hour of the two hour pressure test. If this test requirement cannot be met, the Contractor shall investigate the cause, make corrections, and retest until the pressure drop requirement can be met at no cost to Owner.
- B. Operational Inspection
 - 1. Before substantial completion of the work and in the presence of the Engineer and the Contractor, representatives of the Owner shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are opened; that all hydrants operate and drain properly; that all curb boxes are plumb and centered; and that water is available at all curb stops.
- 3.10 DISINFECTION OF POTABLE WATER SYSTEM

A. Flush and disinfect system in accordance with Section 33 01 10.

3.11 POTABLE WATER SEPARATION

- A. Unless otherwise specified in Contract Documents, the potable water lines shall generally be placed with the minimum specified cover. However, a greater depth may be required to clear process piping, storm, and sanitary sewers and sewer services, and no additional compensation shall be provided for such adjustments.
- B. In locations where sewer is in direct conflict with existing water main and water services the water main and water services shall be lowered to provide at least 18 inches of vertical distance between the top of the water main or service and the bottom of the sanitary or relocated in accordance with the Drawings. No additional compensation will be made for lowering the water main.
- C. Water mains crossing above process piping, storm, or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer. When local conditions prevent a vertical separation as described, the following construction shall be used:
 - 1. Sewers passing over or under water mains shall be constructed of materials equal to water main standards of construction for a distance of at least 10 feet on either side of the water main.
 - 2. Water main passing under sewers shall, in addition, be protected by providing:
 - a. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main.
 - b. Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking of the water mains.
 - c. A length of water pipe shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.
 - 3. Water mains shall be laid at least 10 feet horizontally from any process piping, sanitary sewer, or storm sewer, whenever possible. When local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to a storm or sanitary sewer provided that:
 - a. The bottom of the water main is at least 18 inches above the top of the sewer.
 - b. Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water tightness prior to backfilling.
- D. No deviation shall be made from the required line or grade except with the consent of the Engineer.
- 3.12 FIELD QUALITY CONTROL
 - A. Section 01 45 00 Quality Assurance.

3.13 DATA FOR AS-BUILT RECORDS

A. Record stationing and/or ties of all fittings, valves, and other underground appurtenances installed on sheets provided for such purposes by the Engineer. Include invert or centerline elevations.

END OF SECTION 33 31 19

SECTION 33 38 33 INSULATED FLOATING COVER

PART 1 - GENERAL

1.01 SUMMARY

- A. The design, fabrication, supply, and installation of the modular insulated floating cover system to be placed on the *lagoon treatment cells and polishing reactor* and shall be as specified herein. The system shall be designed to meet all anticipated weather conditions for a wastewater treatment system to be located in Warm Springs, MT.
- B. The work shall include furnishing equipment, material and supplies to complete the work as specified herein.

1.02 REFERENCES

- A. The publications listed below form a part of the specification to the extent referenced.
 - 1. ASTM American Society for Testing and Materials
 - 2. ASTM D-6693 Tensile Properties of Plastics
 - 3. ASTM D-1004 Initial Tear Resistance of Plastic Film and Sheeting
 - 4. ASTM D-4218 Carbon Black in Olefin Plastics
 - 5. ASTM D-4833 Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
 - 6. ASTM D-5994 Measuring Nominal Thickness of Geotextiles and Geomembranes
 - 7. ASTM D-5596 Microscopic evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
 - 8. Geosynthetics Research Institute
 - 9. GM11 Accelerated Weathering of Geomembranes Using a Fluorescent UVA Device

1.03 QUALIFICATIONS

- A. The design of the modular insulated floating cover is patented and shall be supplied by Lemna Environmental Technologies, Inc., Vadnais Heights, Minnesota or pre-approved equal. Alternative equipment manufacturers who wish to be considered must submit to the Engineer material and construction specifications and submittal drawings, equipment operation and maintenance manual, CPA audited financial data from previous 12 months, list of all installations and the name/address/contact/telephone numbers of the owners of the last 10 U.S. installations. Above information is due no later than 15 days prior to the bid opening to allow engineer adequate time to perform due diligence.
- B. The modular insulated floating cover supplier shall be experienced in the manufacture, design, integration, and installation of similar covers as demonstrated by a minimum of 10 years' experience and a minimum of 25 installed similar modular insulated floating

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cover systems.

- C. The modular insulated floating cover supplier shall be experienced in the installation of multiple floating covers over wastewater that includes sewage and/or industrial waste, where the modular cover panels are linked/fastened to each other.
- D. The modular insulated floating cover supplier shall be experienced in the installation of multiple insulated covers over wastewater that includes sewage and/or industrial waste, where the modular cover panels are removably linked to each other.
- E. The modular insulated floating cover supplier shall be experienced in the manufacture, design, integration, and installation of similar covers when used in conjunction with hydraulic baffles, as demonstrated by a minimum of 10 years' experience and a minimum of 25 installed floating cover/hydraulic baffle systems.
- F. The modular insulated floating cover supplier shall be experienced in the manufacture, design, integration, and installation of similar modular insulated floating cover systems when used in conjunction with diffused aeration systems, as demonstrated by a minimum of 10 years' experience in the floating cover business and a minimum of 30 installed modular cover/diffused aeration systems.
- G. The modular insulated floating cover supplier shall be experienced in wastewater treatment processes and shall be prepared to demonstrate the effect on the client's process through documented analysis relating to hydraulic retention time, heat retention, odor control, algae control, solids settling, and biological contact.
- H. The modular insulated floating cover supplier shall have continuous documented water and wastewater treatment design and operations experience a minimum of 20 years.
- 1.04 SUBMITTALS
 - A. The modular insulated floating cover supplier shall furnish a submittal package to the engineer for approval prior to fabrication via the general contractor. The submittal package shall include a layout drawing; individual system component drawings; details of the integration of the modular insulated floating cover with other components, as specified herein; individual component cut-sheets; and product warranty.
 - B. The modular insulated floating cover supplier, shall conduct a survey of the design waterline (or high waterline). The cover supplier shall submit a fabrication layout for approval. Supplier shall verify fabrication dimensions using AutoCAD (.dwg files) or similar design software.

PART 2 - PRODUCTS

2.01 MODULAR INSULATED FLOATING COVER SYSTEM

- A. The modular insulated floating cover system shall consist of insulated cover panels, cable, fasteners, sand tubes, perimeter anchors, and pulling posts (where required).
- B. The modular insulated floating cover system shall not require a gas collection system. The cover system shall be installed so that gases are not trapped beneath the cover but are

allowed to escape vertically through the overlap spaces of adjacent cover panels.

- C. The modular insulated floating cover system shall consist of multiple cover panels placed over wastewater that includes sewage and/or industrial waste, where the modular cover panels are removably fastened/linked to each other.
- D. The modular insulated floating cover system shall not require a rainwater collection trench or water pumping equipment. The cover system shall be designed to allow rainwater to drain through the overlap spaces of adjacent cover panels. No water shall pool on top of the cover.
- E. The modular insulated cover shall allow for the liquid level within the basin to fluctuate, as specified by the engineer.
- F. The modular insulated floating cover shall be designed in such a manner to support snow loads typical of the intended installed environment. The cover shall perform well in cold environments and be able to withstand freeze/thaw conditions without damage to the cover or its components.
- G. The modular cover shall be designed in such a manner to withstand wind-loading conditions typical to the site environment. Supplier shall show evidence their design has been effective in performing successfully under similar wind conditions. In the event wind velocity reduction structures are required, cover supplier shall provide design options to engineer.
- H. The modular cover shall be capable of covering only a portion of the water surface (if required), with one edge floating freely. The modular cover shall allow for partially covered ponds to be further covered at a later date without any modification to the existing cover or additional expense other than the additional cover and installation labor required.
- I. In cover applications utilizing hydraulic baffles, the insulated cover shall be designed to allow for complete integration and attachment to the baffle(s). This integration shall prevent flow short-circuiting, baffle migration, and prevent damage to both the cover and baffle.
- J. In cover applications utilizing aeration, the cover and aeration equipment shall be designed to allow for complete integration. For diffused air systems, integration includes diffuser access panels that can be removed to allow access to submerged diffusers. The cover shall be designed to accommodate floating or submerged aeration laterals and feeder lines.
- K. The modular insulated floating cover shall consist of individual modular cover panels connected by either looped geomembrane fasteners inserted through factory-drilled openings or by wedge-welded seams.

2.02 COVER PANELS

A. The cover panels and cover shall be fabricated in such a manner that each section of the modular cover can be individually displaced or removably linked with fasteners, to allow access to the water surface.

- B. With the exception of field modifications, all fabrication and welding of the modular insulated floating cover panels shall be performed in a climate-controlled building. All straight welds on the sides of cover sections shall be double-fusion wedge welds. Corner and detail welds shall be extrusion welds.
- C. The modular insulated floating cover system shall consist of multiple panels placed over wastewater that includes sewage and/or industrial waste, where the panels are removably fastened/ linked to each other and each contains, but is not completely filled with, insulation material sealed inside it.
- D. Each modular panel shall be secured to all adjacent panels. The entire modular insulated cover shall be secured to the sides of the basin in such a manner that allows for removal and reinstallation of the insulated cover.
- E. Individual panels shall be independently buoyant, thereby requiring no additional support or buoyancy.
- F. The modular insulated floating cover shall be composed of panels fabricated from two sheets of 40 mil High Density Polyethylene (HDPE) geomembrane, which shall encapsulate insulation that provides a thermal barrier and flotation. The HDPE shall meet the standards for HDPE geomembrane in accordance with ASTM D6693, D1004, D4218, D4833, D5994 and D5596.
- G. The HDPE geomembrane of each panel shall have insulation sealed inside each panel by a weld. The panel is to be welded closed in such a manner that it provides a cavity in which to contain the insulation. The insulation shall be closed cell Expanded Polystyrene (EPS) with an R-rating at a minimum R-8. The insulation shall be rectangular panels.
- H. As required, walkway panels shall be provided. Walkway panels shall be constructed of 40mil textured HDPE and contain 3.9" of insulation. Walkway panels are designed to provide extra flotation to a worker needing access to in-basin equipment.
- I. Individual modular panels shall not exceed 7.5 feet (width) and 52 feet (length).

2.03 FASTENERS AND FASTENER STOPS

- A. Fasteners shall be fabricated of 30-mil XR-5 geomembrane with a honeycomb scrim and have a 10-year Ultraviolet resistance. Fasteners shall link adjacent panels together and each panel to anchor cables. Fasteners shall be fabricated in a manner that will allow cables to be threaded through the fastener loops on top of the panels.
- B. The panels shall overlap, and the fasteners shall allow adjacent panels to be removably linked together.
- C. The fasteners are placed through pairs of adjacent openings in panels.
- D. Fastener stops shall consist of an HDPE disk and shall prevent fasteners from being pulled through the fastener holes of the modular panels.

2.04 CABLE

A. Cable shall anchor the linked panels over the wastewater basin, and shall be attached to

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perimeter anchors.

- B. Cable shall be 1/8-inch diameter 7 x 19 stranded stainless steel, black PVC coated to 3/16 inch, and have a tensile strength of 1700 pounds.
- C. Stainless steel cable clamps shall secure the cabling to the anchoring system and where splices and loops are required.

2.05 SAND TUBES

- A. Pre-filled sand tubes shall be supplied to weight the cover perimeter and body against wind uplift. Perimeter sand tube locations shall have (2) HDPE straps welded to the modular cover, body sand tubes attached by fastener. The free ends of the HDPE straps shall be fastened to the sandtube.
- B. Sand tubes shall be 10-foot long HDPE sleeves filled with sand and shall weigh between 60 and 110 lbs. The sleeves shall be wedge welded along its length and across its ends to form an enclosed tube.

2.06 PERIMETER ANCHORS

A. Perimeter anchors shall be installed along the perimeter of the basin. The perimeter anchor shall be a 30" long carbon steel earth anchor. On the lower end of the earth anchor shall be welded a 4" diameter helical screw plate. The upper end of the earth anchor shall be looped to provide an attachment point for the cover anchor cable. The perimeter anchors shall be installed so that the entire anchor is below ground to avoid interference with vehicle or foot traffic on the pond berm as indicated on the drawings.

PART 3 - EXECUTION

3.01 GENERAL

- A. The installer of the cover system shall furnish all materials, tools, equipment and services necessary to fabricate and install a modular insulated floating cover system. Proper storage of the cover system shall be provided, prior to installation. No damaged panels shall be installed. The installer must demonstrate that the weather is conducive to the installation of the cover system.
- B. Only assembly and attachment of the modular panels shall be allowed on-site. To facilitate ease of installation and removal, modular panels shall not exceed 7.5 feet in width and 52 feet in length. The panels shall be installed in an overlapping relationship to adjacent panels.
- C. The modular insulated floating cover shall be capable of being installed in a basin at its high operating water depth. Modular panels shall be assembled and connected on shore and pulled into position in the basin.
- D. The modular insulated floating cover panels shall be filled with rectangular shaped sections of insulation.
- E. The modular insulated floating cover shall be anchored to shore using PVC coated stainless steel cable or approved alternative.

- F. Each section of cover shall be individually removably linked without affecting the structural integrity of the rest of the cover system.
- G. Where appropriate, multiple individual panels shall be welded together to facilitate installation and/or operation of the modular insulated floating cover.
- H. The modular insulated floating cover supplier shall provide installation supervision services as a part of overall cover supply.
- I. The modular insulated floating cover supplier shall provide technological wastewater treatment start-up services as a part of overall cover supply.
- J. The modular insulated floating cover supplier shall provide unloading, storage, and installation manual.
- K. The modular insulated floating cover supplier shall provide 2 hard copies and 1 electronic copy of an operation and maintenance manual.

PART 4 - WARRANTY

- 4.01 The modular insulated floating cover supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of ten (10) years from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective.
- 4.02 The modular insulated floating cover supplier shall be responsible for guaranteeing effluent quality according to the end user's requirements, as the modular insulated floating cover is an integral part of the overall treatment process.

END OF SECTION 33 38 33

DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40 05 60 SLIDE AND WEIR GATES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to install, ready for operation and field test stainless steel gates and appurtenances as shown on the Contract Drawings and as specified herein.
- B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 Standard for Fabricated Stainless Steel Slide Gates as modified herein. The allowable leakage rate for the stainless steel gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561.
- C. The equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer.
- D. Gates and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.
- E. Gates supplied under this section shall be Model GH-66 Stainless Steel Weir Gates as manufactured by Golden Harvest Inc. or engineer approved equal.
- 1.02 SUBMITTALS
 - A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements specified in Section.
 - 1. Complete description of all materials including the material thickness of all structural components of the frame and slide.
 - 2. Installation drawings showing all details of construction, details required for installation, dimensions and anchor bolt locations, general construction materials used in the gate & lift mechanism.
 - 3. Complete engineering design calculations in compliance with AWWA standards latest edition.
 - 4. Maximum bending stress and deflection of the slide under the maximum design head.
 - 5. The location of the company headquarters and the location of the principle manufacturing facility. Provide the name of the company that manufactures the equipment if the supplier utilizes an outside source.

1.03 QUALITY ASSURANCE

- A. Qualifications
 - 1. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gates for a minimum of 100 projects.
 - 2. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of AWS Sections D1.1, 1.2 and 1.6.
 - 3. The fully assembled gates shall be shop inspected, tested for operation and leakage, and adjusted before shipping. There shall be no assembling or adjusting on the job sites other than for the lifting mechanism.
 - 4. Approved manufacturers of the weir gates and slide gates are:
 - a. Rodney Hunt, Inc of Orange, MA,
 - b. Plasti-Fab, (Ershigs, Inc.) of Ridgefield, WA
 - c. Golden Harvest, Inc. of Burlington, WA
 - d. Whipps, Inc. of Athol, MA
 - e. Other manufacturers with pre-approval.

PART 2 - EQUIPMENT

2.01 GENERAL

- A. Gates shall be as specified herein and have the characteristics and dimensions shown on the Contract Drawings.
- B. Gate shall be designed in accordance with AWWA C561-14 Standards for fabricated slide gates.
- C. Slide gates will be the non-rising stem design as called out on the Project Drawings. Gates shall be either self-contained or non-self-contained of the rising stem or non-rising configuration as indicated on the gate schedule.
- D. Slide gates shall have a 2" square operating nut.
- E. All parts of the gate shall have a minimum thickness of 1/4 inch.
- F. Leakage shall not exceed 0.10 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.
 - 1. Weir and slide gates shall be substantially watertight under the design head conditions. Under the design seating head, the leakage shall not exceed 0.10 US gallons per minute per foot of seating perimeter. Under the design unseating head, leakage shall not exceed 0.10 US gallons per minute per foot of perimeter.
- G. All gate valves shall utilize self-adjusting seals. Due to the difficulty of accessing gates when they are in service, gates that utilize adjustable wedges, wedging devices or pressure pads are not acceptable.

- H. All structural components of the frame and slide <u>shall be fabricated of stainless steel</u> <u>having a minimum thickness of 1/4-inch</u> and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.
- I. All welds shall be full and continuous performed by welders with AWS certification.
- J. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale/picked & passivated. All iron and steel components shall be properly prepared and shop coated with a primer.
- 2.02 FRAME
 - A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of stainless steel plate with a minimum thickness of 1/4-inch.
 - 1. Frame design shall allow for embedded mounting, mounting directly to a wall with stainless steel anchor bolts and grout or mounting to a wall thimble with stainless steel mounting studs and a mastic gasket material. Mounting style shall be as shown on the Contract Drawings.
 - 2. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.
 - 3. Gussets shall be provided as necessary to support the guide members in an unseating head condition.
 - 4. Frame support of the gate:
 - a. For upward-opening slide gates, the frame shall extend to accommodate the *entire height* of the slide when the slide is in the fully opened position.
 - b. For downward-opening weir gates, the frame shall extend to accommodate at least ³/₄ of the gate height when in the fully opened position..
 - 5. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by a structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide.
 - 6. A rigid stainless steel invert member (flush bottom type) shall be provided across the bottom of the opening for upward-opening slide gates.
 - 7. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.
 - 8. A rigid stainless steel member shall be provided across the invert of the opening on downward-opening weir gates.
 - 9. The frame configuration shall be of the flush-bottom type and shall allow the replacement of the top and side seals without removing the gate frame from the wall or wall thimble.
- 2.03 SLIDE

- A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch
 - 1. The slide shall consist of stainless steel plate reinforced to limit its deflection to L/720 of the clear opening span or 1/32 inch, whichever is smaller, under the design maximum head.
 - 2. Reinforcing stiffeners shall be continuously welded (stitch welding will not be acceptable) to the slide and mounted horizontally. Vertical stiffeners shall be continuously welded on the outside of the horizontal stiffeners for additional reinforcement.
 - 3. The stem connector shall be constructed of two angles or plates. The stem connector shall be continuously welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.04 SEALS

- A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.
 - 1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.
 - 2. Slide Gates:
 - a. The seat/seals shall extend to accommodate at least 1-1/2 x the height of the slide when the slide is in the fully closed or fully opened position.
 - b. Guides shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.
 - 3. Weir Gates:
 - a. The seat/seals shall extend to accommodate the entire height of the weir when weir is in the fully closed or fully open position.
 - b. Guides shall be of such length as to retain and support at least three-quarters (3/4) of the vertical height of the weir in the fully open position.
 - 4. All slide and weir gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and it shall be held in place with stainless steel attachment hardware.
 - 5. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.
 - 6. All seals must be bolted or otherwise mechanically fastened to the frame or slide.
 - 7. The seals shall be mounted so as not to obstruct the water way opening.
 - 8. Gates that utilize rubber "J" seals or "P" seals are not acceptable.
 - 9. Seals shall be fully adjustable.

- 10. The seal system shall have been factory tested to confirm negligible wear (less than 0.01") and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 25,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.
- 11. When required for isolation of a pipe or structural opening, a horizontal top spigot and neoprene top seal shall be supplied.

2.05 STEM

- A. A threaded operating stem shall be utilized to connect the operating mechanism to the slide.
- B. On rising stem gates, the threaded portion shall engage the operating nut in the manual operator or motor actuator. On non-rising stem gates; the threaded portion shall engage the nut on the slide.
 - 1. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.
 - 2. The stem shall be constructed of solid stainless steel bar for the entire length, the metal having a tensile strength of not less than 90,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a tensile strength of 85,000 psi.
 - 3. The stem shall be threaded to allow full travel of the slide unless the travel distance is otherwise shown on the Contract Drawings.
 - 4. Maximum L/R ratio for the unsupported part of the stem shall not exceed 200.
 - 5. In compression, the stem shall be designed for a critical buckling load caused by a 40 lb effort on the crank or handwheel with a safety factor of 2, using the Euler column formula.
 - 6. For *upward-opening slide gates*, the stem shall be designed to withstand the tension load caused by the application of a 40 lb. effort on the crank or handwheel without exceeding 1/5 of the ultimate tensile strength of the stem material.
 - 7. For <u>downward-opening weir gates</u>, the operating stem shall be of stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb effort on the crank or handwheel.
 - 8. The threaded portion of the stem shall have threads of Acme type with a 16 microinch finish or better.
 - 9. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be threaded and bolted to the stems.
 - 10. Stems shall be provided with adjustable stop collars to prevent over-closing or overopening of the gate.
 - 11. Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

- 12. Stem Cover
 - a. Rising stem gates shall be provided with a clear polycarbonate stem cover. The stem cover shall have a cap and condensation vents and a clear mylar position indicating tape. The tape shall be field applied to the stem cover after the gate has been installed and positioned.

2.06 STEM GUIDES

- A. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.
 - 1. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.
 - 2. Adjustable in two directions.

2.07 WALL THIMBLES

- A. Wall thimbles shall be provided when shown on the Contract Drawings.
 - 1. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be mounted.
 - 2. Wall thimbles shall be fabricated stainless steel construction of adequate section to withstand all operational and reasonable installation stresses.
 - 3. Wall thimbles shall be constructed of 1/4-inch minimum thickness stainless steel and the front face shall have a minimum thickness of 1/4–inch.
 - 4. The fabrication process shall ensure that the wall thimble is square and plumb and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.
 - 5. The face of the wall thimble shall only be machined if recommended by the gate manufacturer. If the wall thimble is to be machined, the front face shall have a minimum thickness of 1/4-inch after machining.
 - 6. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.
 - 7. Studs and nuts shall be stainless steel. Water stop may be stitch welded.
 - 8. A suitable gasket or mastic shall be provided to seal between the gate frame and the wall thimble.

2.08 MATERIAL OF CONSTRUCTION

Frame Assembly and Retainers:	Stainless Steel, Type 304L, ASTM A240
Slide and Stiffeners:	Stainless Steel, Type 304L, ASTM A240
Stem:	Stainless Steel, Type 304, ASTM A276
Fasteners, Nuts and Bolts:	Stainless Steel, Type 304, ASTM A276

Invert Seal (Upward Opening Gates Only):	Neoprene ASTM D-2000 or EPDM	
Seat/Seals and Facing:	Ultra-High Molecular Weight Polyethylene ASTM D4020	
Lift Nuts:	Bronze ASTM B584	
Pedestals and Wall Brackets:	Stainless Steel, Type 304L, ASTM A276	
Operator Housing:	Cast aluminum or ductile iron	

2.09 MANUAL OPERATORS

- A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual crank-operated gearbox. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self-contained gates.
 - 1. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40 lb effort when the gate is in the closed position and experiencing the maximum operating head.
 - 2. Operators of the types listed in the schedule shall be provided by the gate manufacturer. Each manual operator shall be designed to operate the gate under the maximum specified seating and unseating heads by using a maximum effort of 40 lb on the crank or handwheel, and shall be able to withstand, without damage, an effort of 80 lb.
 - 3. An arrow with the word "OPEN" shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.
 - 4. Weir gates operated by a 2" operating nut shall open in the counterclockwise direction and close in the clockwise direction.
 - 5. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.
 - a. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating stem.
 - b. Handwheel operators shall be equipped with roller bearings above and below the operating nut.
 - c. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.
 - d. Operating handwheels shall be removable and shall have a minimum diameter of 15 inches.
 - 6. Crank-operated gearboxes shall be fully enclosed and shall have cast aluminum or ductile iron housing.
 - a. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required.
 - b. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem.

- c. Gearboxes shall be provided when required to maintain the operating force below 40 lb.
- d. All bearings and gears shall be totally enclosed in a weather tight housing.
- e. Operator housing shall be cast steel or cast iron.
- f. The operating shaft shall be fitted with a 2 inch square operating nut and removable crank.
- g. The crank shall be fitted with a corrosion-resistant rotating handle.
- h. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts.
- i. Gears shall be steel with machined cut teeth designed for smooth operation.
- j. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings.
- k. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.
- 1. The crank shall be cast aluminum or cast iron with a revolving nylon grip.
- m. The crank shall be removable.
- 7. Pedestals (where required or specified) shall be constructed of stainless steel. Aluminum pedestals are not acceptable.
 - a. The pedestal height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36 in above the operating floor.
 - b. Wall brackets shall be used to support floor stands where shown on the Drawings and shall be constructed of stainless steel.
 - c. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 40 lb effort on the crank or handwheel.
 - d. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the ENGINEER. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.
 - e. The yoke, to support the operating bench stand, shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame.
 - f. Self-contained gates shall be provided with a yoke to support the operating bench stand. The yoke shall be formed by two structural members welded at the top of the guides to provide a one piece rigid frame. The maximum deflection of the yoke shall be L/360 of the gate's span.

- g. Non-self contained gates shall be provided with pedestal mounted lifts. Pedestal shall be mild steel that is prepped per SSPC-05 and provided with industrial grade powder coating. Stainless steel pedestals and/or wall brackets shall be supplied where specified in the gate schedule.
- 8. Rising-stem slide gate operators shall be equipped with polycarbonate plastic stem covers.
 - a. The top of the stem cover shall be closed.
 - b. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.
 - c. Stem covers shall be complete with indicator markings to indicate gate position.
 - d. When shown on the Contract Drawings, provide 2-inch square nut, mounted in a floor box, with a non-rising stem.
 - e. The square nut shall be constructed of stainless steel.
 - f. The floor box shall be constructed of stainless steel or cast iron and shall be set in the concrete floor above the gate as shown.
 - g. Provide one aluminum or stainless steel T-handle wrench for operation.

2.10 ANCHOR BOLTS

- A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates and appurtenances.
 - 1. Quantity and location shall be determined by the gate manufacturer.
 - 2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.
 - 3. Anchor bolts shall have a minimum diameter of 1/2-inch

PART 3 - EXECUTION

- 3.01 INSTALLATION
 - A. Installation of the gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.
 - B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the gates.
 - C. The gate assemblies shall be installed in a true vertical plane, square and plumb.
 - D. The CONTRACTOR shall fill the void in between the gate frame and the wall with nonshrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.
 - E. The CONTRACTOR shall add a mastic gasket between the gate frame and wall thimble

SLIDE AND WEIR GATES

(when applicable) in accordance with the manufacturer's recommendations.

3.02 FIELD TESTING

A. After installation, all gates shall be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured, and shall not exceed the maximum operating effort specified above. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the CONTRACTOR, at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowable leakage.

END OF SECTION 40 05 60

SECTION 40 27 00 PROCESS PIPING - GENERAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
 - 1. Pipe, fittings, wall pipes, and connections associated with interior Work.
- B. Related section include:
 - 1. Section 01 10 00 Summary of Work
 - 2. Section 01 33 00 Submittal Procedures
 - 3. Section 01 40 00 Quality Control
 - 4. Section 01 60 00 Product Requirements
 - 5. Section 09 90 02 High Performance Painting and Coating
 - 6. Section 40 27 05 Process Piping Support Systems
 - 7. Section 40 27 10 Process Piping Specialties
 - 8. Section 40 27 20 Process Valves
 - 9. Section 40 42 13 Process Piping Insulation
 - 10. Section 40 71 13 Magnetic Flow Meter

1.02 REFERENCES

- A. Reference Standards include:
 - 1. American National Standards Institute (ANSI)
 - 2. American Society of Mechanical Engineers (ASME)
 - 3. American Society for Testing Materials (ASTM)
 - 4. American Water Works Association (AWWA)
 - 5. American Welding Society (AWS)
 - 6. National Sanitation Foundation (NSF)
 - 7. ANSI/AWWA C104/A21.4: Cement-Mortar Lining for Gray-Iron and Ductile-Iron Pipe and Fittings for water.
 - 8. ANSI/AWWA C105/A21.5: Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for water and other liquids.
 - 9. ANSI/AWWA C110/A21.10: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water.
 - 10. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe

and Fittings.

- 11. ANSI/AWWA C115/A21.15: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
- 12. ANSI/AWWA C150/A21.50: Thickness Design of Ductile-Iron Pipe.
- 13. ANSI/AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand Lined Molds for water or other liquids.
- 14. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.
- 15. ASME B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- 16. ASME B16.26: Cast Copper Alloy Fittings for Flared Copper Tubes.
- 17. ASTM B 88: Seamless Copper Water Tube.
- 18. ASTM D-1784: Rigid Poly(Vinyl Chloride) Compounds and Chlorinated
- 19. Poly(Vinyl Chloride) Compounds.
- 20. ASTM D-1785: Poly(Vinyl Chloride) (PVC) Plastic Pipe, schedules 40, 80, 120.
- 21. ASTM D-2464: Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 22. ASTM D-2467: Socket Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- 23. ASTM D-2564: Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- 24. ASTM D-2855: Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- 25. AWWA C600: Installation of Ductile-Iron Water Mains and Their Appurtenances.
- 26. AWWA C606: Grooved and shouldered type joints.
- 27. AWWA C651: Standard for Disinfecting Water Mains.
- 28. AWWA C653: Disinfection of Water Treatment Plants.
- 29. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. through 12 In., for Water.
- 30. AWWA C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In., for Water Transmission and Distribution.
- 31. NSF Standards No. 60 and 61 National Sanitation Foundation.

1.03 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Conform to ANSI/AWS D.1.1.
- B. Employ certified welders.
- C. Piping modifications subject to Engineer's review. No additional compensation allowed

for modifications required to suit equipment furnished by Contractor.

1.04 SUBMITTALS

- A. Submit Shop Drawings in accordance with Section 01 33 00 Submittal Procedures for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, and Joint Data.
- B. Submit Affidavit of Compliance for ductile iron pipe and fittings.
- C. Submit design calculations for structural design of pipe thickness where pipe class or thickness is not specifically called out.
- D. Submit detailed piping layout drawings showing piping and connections to equipment and appurtenances.
- 1.05 COATING AND IDENTIFICATION SYSTEMS
 - A. All material and equipment in this section shall be factory primed. Primer shall be compatible with finish coats of paint provided under Section 09 90 02 High Performance Painting and Coating.
 - B. The Contractor shall refinish and restore to the original appearance all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.
 - C. Finish painting of all materials and equipment in this Section shall be the responsibility of the Contractor, and shall be as described Section 09 90 02 High Performance Painting and Coating, unless otherwise specifically indicated.
 - D. All *interior* ductile iron pipe (DIP) shall be either:
 - 1. Installed with no asphaltic varnish coating (only red primer) and coated in accordance with System 2 of Section 09 90 02 of these specifications;
 - 2. Installed with asphaltic varnish coating (properly cleaned) and coated in accordance with 09 90 02 D.1.f of these specifications.

1.06 REGULATORY REQUIREMENTS

A. All Products that may come into contact with water intended for use in a Public Water System shall meet ANSI/NSF International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

PART 2 - PRODUCTS

- 2.01 PIPE SCHEDULE
 - A. Process Piping:
 - 1. Ductile Iron.
 - 2. Stainless Steel.
 - 3. PVC.

- B. Other Piping:
 - 1. CPVC (for all interior potable and non-potable plumbing).
 - 2. HDPE.
 - 3. Copper (*for non-potable water pump gallery, plant air to UV, interior/exterior potable water bibs*).
 - 4. Steel Pipe.
 - 5. PE Jacketed, PE Insulated Steel Pipe (for interior blower discharge)
 - 6. As otherwise shown on Drawings or specified in other Sections.

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. Approved Manufacturers:
 - 1. American Cast Iron Pipe Company.
 - 2. U.S. Pipe.
 - 3. Or approved equivalent.
- B. General
 - 1. Minimum Pressure Class (Pounds per Square Inch PSI):
 - a. Interior and exterior exposed, flanged:
 - i. 12-inch diameter and smaller: 350 PSI.
 - ii. 14-inch diameter and larger: 250 PSI.
 - 2. Onsite inspection of all materials by Contractor.
 - 3. Pipe coating:
 - a. Buried and submerged: bituminous coating (asphalt coating).
 - b. Interior and exposed: prime coat.
 - 4. Bolts and nuts:
 - a. Buried exposed and submerged: stainless steel.
 - b. Interior and exposed: stainless steel.
 - 5. Pipe lining:
 - a. All pipelines except air lines: cement-mortar.
 - b. Ductile iron pipe for air lines shall be unlined.
 - 6. Submit design calculation for structural design of pipe thickness where pipe thickness or class is not specifically called out.
 - 7. Pipe and fittings to match face and drill of valves.
 - 8. All flanges shall be full-faced flanges.

- 9. All materials to be new and unused.
- 10. Pipe and fitting material: ductile iron.
- C. Pipe: ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.
- D. Flanged Pipe: ANSI/AWWA C115/A21.15.
 - 1. Minimum Class: Class 53.
- E. Fittings:
 - 1. Flanged fittings:
 - a. Conform to ANSI/AWWA C110/A21.10.
 - b. Full face gaskets, bolts, and nuts: AWWA C110, Appendix A.
 - c. Material: ductile iron.
 - 2. Reducers: all reducers shall be concentric pattern unless noted otherwise on the Project Drawings.
- F. Based Fittings:
 - 1. Conform to ANSI/AWWA-C110/A21.10.
 - 2. All side-based and flange-based fittings must be fully faced and drilled.
- G. Coatings and Linings:
 - 1. Asphaltic: ANSI/AWWA C110/A21.10 and ANSI/AWWA C151/A21.51.
 - 2. Cement lining: ANSI/AWWA C104/A21.4.
 - 3. Prime coat: per Section 09 90 02 Mechanical Painting and Coating.
- H. Joints Pipe and Fittings:
 - 1. Flanged: ANSI/AWWA C110/A21.10 and ANSI/AWWA C115/A21.15.
 - 2. Provide type of joint as indicated on Project Drawings.
 - 3. Use of grooved and shouldered joints is acceptable where approved by Engineer.
 - a. Conform to AWWA C606.
 - 4. The Engineer will only accept Uni-Flanges or approved equivalent at locations that receive prior approval.
- I. Wall sleeves: wall sleeve shall be provided where ductile iron pipe passes through concrete walls and no thrust restraint is required. Wall sleeves shall be utilized unless a wall pipe is used. Wall sleeves shall be Schedule 40 PVC or galvanized carbon steel as specified on the project drawings. Wall sleeves shall be as manufactured by Metraflex or approved equal.
- J. Wall Pipe and Wall Collar: All wall pipes and collars shall be Class 53 ductile iron with the collar continuously welded around the entire circumference and shall be rated a minimum of 250 psi. All wall pipes and collars shall be fabricated such that they are

suitable in all thrust restraint applications where there is a concrete penetration. Wall pipes and collars shall be as manufactured by U.S. Pipe or approved equal.

K. Sleeve Seals: All pipes passing through wall sleeves unrestrained where indicated on the Drawings will be provided with a sleeve seal similar to the Model C Link-Seal® Modular Seal or pre-approved equal.

2.03 STAINLESS STEEL PIPE

- A. ASTM A-312 stainless steel pipe, Schedule 40, Type 304 with stainless steel drilled flanges, rated for 175 psi minimum, sizes 2-inch through 6-inch. Schedule 80, Type 304 stainless steel with stainless steel drilled flanges, sizes 8-inch through 12-inch.
 - 1. Onsite inspection by Contractor of all materials.
 - 2. Bolts and nuts: stainless steel.
 - 3. Pipe and fittings to match face and drill of valves.
 - 4. All materials to be new and unused.
- B. Stainless Steel Pipe for (*if applicable*)
 - 1. ASTM A-312 stainless steel pipe, Schedule 10, Type 304L
 - 2. Size: As indicated on Construction Drawings and pipe schedule.
 - 3. Joints: 304L stainless steel welding neck flanges conforming to ANSI B16.5.
 - 4. Pressure: Rated for 175 psi minimum at 150°F.
 - 5. Pipe shall be electric fusion welded.

2.04 PVC PIPE AND FITTINGS

- A. PVC pipe and fittings furnished shall be of the type as specified below for each particular use or type of installation.
- B. Pressure Piping (4-inches diameter through 12-inches diameter)
 - 1. PVC pressure pipe in sizes 4 12 inches in diameter shall conform to all applicable requirements of ANSI/AWWA C900 or C909 as applicable or indicated in the drawings. Pipe utilized for potable water shall be NSF certified for use in the transport of potable water.
 - 2. The pipe and fittings shall meet cast iron pipe equivalent outside diameters and shall be minimum Class 150 (DR18) or Class 200 (DR14) pipe as indicated on the drawings, and shall meet the requirements of Table 2 of AWWA C900 or C909 as applicable.
 - 3. Flanges for connecting plain end PVC pipe to equipment shall be Uni- flange series 900, ROMAC, or equal.
 - 4. Pipe, fittings, and valves shall be installed in compliance with manufacturer's recommendations.
- C. Pressure Piping (less than 4-inches in diameter) and Non Pressure Piping

- 1. Schedule 80, unless specified otherwise, conforming to ASTM D-1785.
- 2. Materials: ASTM D-1784, Type 1, Grade 1.
- 3. Pipe Coating:
 - a. Buried and submerged: None
 - b. Exposed and Interior: Painted as Specified in Section 09 90 02 Mechanical Painting and Coating.
- 4. Fittings: ASTM D-2467, socket type; or ASTM D-2467, flange type; or ASTM D-2464, threaded type; as required or as indicated on Drawings.
- 5. Solvent Cement: ASTM D-2564, Primer (ASTM F656) and PVC Solvent Cement.
- 6. Polyvinyl chloride fittings shall be limited to a 3-inch diameter or less.

2.05 CPVC PIPE AND FITTINGS

- A. Pipe, fittings, and valves shall be manufactured from a CPVC compound which meets the requirements of class 23447-B, Type 4, Grade 1 in accordance with ASTM D1784. Compound from which the pipe is produced shall have a design stress rating of 2,000 psi at 23 degrees C, listed by the Plastic Pipe Institute (PPI).
- B. Fittings and valves shall meet the requirements of ASTM F439 (schedule 80 socket) or ASTM F437 (schedule 80 threaded).
- C. All socket type connections shall be joined with CPVC solvent cement conforming to the requirements of ASTM F493.
- D. All CPVC shall be Schedule 80.
- E. Approved Manufacturers:
 - 1. Georg Fischer.
 - 2. Hayward.
 - 3. Asahi/America.
 - 4. Spear.
- 2.06 HIGH DENSITY POLYETHYLENE (HDPE) PIPE
 - A. All high density polyethylene pipe shall be DR 11, unless specified otherwise, conforming to ANSI D-2239.
 - B. All HDPE pipe to have standard ductile iron pipe size (DIPS) dimensions.
 - C. All pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious faults. The physical appearance of the pipe having deformities such as concentrated ridges, discoloration, excessive spot roughness, pitting, varying wall thickness, etc., shall constitute sufficient basis for rejection.
 - D. Ductile Iron Fittings:
 - 1. All ductile iron fittings connecting to polyethylene pipe are required to include

stainless steel sleeve inserts inside the pipe and PE electrofusion MJ adapters as manufactured by Central Plastics Company or approved equivalent.

- 2. PE electrofusion fittings may be substituted for ductile iron fittings at no additional cost to Owner. Fitting and piping shall be heat fused in accordance with ASTM D2657. Butt fusion fittings shall conform to ASTM D3261.
- 3. Push-on or mechanical rubber gasket joints conforming to the compression gasket ring requirements of ANSI/AWWA C111/A21/11 and ASTM D3139, and as shown on Drawings.
- 4. Provide stainless steel nuts, bolts, and glands.
- 2.07 COPPER TUBE AND FITTINGS
 - A. Copper pipe to be used for pipe sizes less than 4 inch diameter.
 - B. Dielectric unions shall be used between copper water tube and dissimilar metal piping.
 - C. Hard Copper Tube: ASTM B88, Types L and M (ASTM B88M, Types B and C), water tube, drawn temper. Type K for underground services.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper alloy or ASME B16.22, wrought-copper, solder joint fittings.
 - 2. Bronze Flanges: ASME B16.24, Class 300, with solder joint end.
 - 3. Copper Unions: MSS SP-123, cast-copper alloy, hexagonal stock body, with ball and socket, metal to metal seating surfaces and solder joint or threaded ends.
 - 4. Copper, Grooved End Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.
 - a. Copper Tubing, Keyed Couplings: Copper tube dimensions and design similar to AWWA C606. Included ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
 - 5. Aboveground Water Piping: Use the following piping materials for each size range:
 - a. NPS 1-1/2 (DN 40) and Smaller: Hard copper tube, Type L (Type B); and soldered joints.
 - b. NPS 2 (DN 50): Hard copper tube, Type L (Type B); and soldered joints.
 - c. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B); and soldered joints.
 - 6. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - a. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 - 7. Soldered Joints: Use ASTM B 813, water-fusible, lead-free flux; ASTM B 32, lead-

free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

2.08 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2" (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade A, Schedule 80, galvanized steel, threaded ends per ASME/ANSI B1.20.1.
- B. Steel Pipe, NPS 2-1/2" through NPS 12" (DN 65 through DN 300): ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.
- C. Steel Pipe, NPS Greater than 12": ERW standard wall, thickness of 0.375 inch, continuous spiral welded conforming to ASTM A-53 standards.
 - 1. On-Site inspection by Contractor of all materials.
 - 2. Pipe Coating:
 - a. Epoxy Lining: NSF International Standards 60 and 61.
 - b. Exposed: Shop Prime Coated and finish coat as specified in Section 09 90 02 Mechanical Painting and Coating.
 - 3. Flanges: ASME B16.5, Class 150-lb. slip on flanges, double welded.
 - 4. Bolts and Nuts: Stainless steel.
 - 5. Pipe and fittings to match face and drill of valves.
 - 6. All materials to be new and unused.
 - 7. Mechanical couplings: Dresser Style 38 or approved equal.
 - 8. Unions: Fed Spec. WW-U-531, Class 2, Type A (black) for ungalvanized pipe.
 - 9. Threaded fittings: ASME B16.4, Class 125.
- D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- E. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
- F. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- G. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.

- H. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).
- I. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- J. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
- K. PIPE INSULATION AND JACKET
 - 1. Blower exhaust piping and fittings within the Blower Building shall be insulated with a minimum 1" thick layer of fiberglass insulation;
 - 2. Pipe and fittings insulation shall be protected by an aluminum jacket specifically sized for the application. Jacket shall include 3-mil polyfilm moisture barrier heat laminated to the interior surface. Product shall be ITW Aluminum jacket from General Insulation Company, Inc.

2.09 PIPE CORROSION PROTECTION

- A. Coatings: See Section 09 90 02 High Performance Painting and Coating, for details of coating requirements.
- B. Heat Shrink Wrap:
- C. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.
- D. Manufacturer and Product: Raychem; WPC or TPS, or equal.
- 2.10 FLANGE INSULATING GASKET KITS
 - A. Approved Manufacturer:
 - 1. Advance Products & Systems.
 - 2. Approved Equivalent.
 - B. Size: per diameter of flange.
 - C. Pressure rating: meet minimum pressure rating of attached piping.
 - D. Provide to meet either full-faced or raised faced portion of flange.
 - 1. Full-Faced Gasket
 - a. Type E gaskets.
 - b. Precision cut bolt holes.
 - c. Material: plain face or Neoprene face phenolic.
 - 2. Raised Face Portion
 - a. Type F gaskets.

- b. Inside diameter of the bolt hole circle should be slightly smaller than the outside diameter of the gasket, assuring an exact, automatic positioning of the gasket.
- c. Material: plain face or Neoprene face phenolic.
- E. Provide insulating sleeve and washer with the single insulation sets.
 - 1. Material: high density polyethylene (HDPE), phenolic, and Mylar.
 - 2. Provide with each set a 1/8" thick S.A.E. electro-plated steel washer.

2.11 COUPLINGS, TAPS, AND MISCELLANEOUS JOINTS

- A. Tapping saddles and tapping sleeves shall be Mueller, or equal.
- B. Provide pipe repair clamps where indicated on the Drawings. Pipe repair clamps shall be suitable for potable water service with all type 304 stainless steel bolts and hardware. Contractor shall verify pipe outside diameter and necessary length before placing clamp. Pipe repair clamps shall be Mueller Series 510 XTRA-RANGE Full Seal type, or equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Make necessary field measurements to determine pipe laying lengths; fabricate pipe; deliver pipe to site; store pipe with ends capped to prevent contamination and damage to interior; prepare pipe for installation; work pipe into place without forcing or springing.
- B. Do not store or ship small diameter pipe inside larger diameter pipe.
- C. Ream pipe and tube ends. Remove burrs. Repair lining at pipe cuts.
- D. Remove scale and dirt, inside and outside, before assembly.
- E. Remove welding slag or foreign material from pipe and fitting materials.
- F. Remove temporary preservative coatings from valves, fittings, and appurtenances prior to installation.
- G. Clean, repair, or replace equipment malfunctioning due to presence of foreign material left in piping during installation or entering piping after installation due to Contractor's work at no cost to Owner.

3.02 DUCTILE IRON PIPE AND FITTINGS

- A. Joints:
 - 1. Interior submerged: flanged.
 - 2. Interior exposed: flanged, grooved and shouldered if approved by Engineer, except where indicated otherwise on the Project Drawings.
- B. Flanged Joints:
 - 1. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

- 2. Care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges when bolting flanged joints.
- 3. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be gradually tightened and at a uniform rate, to ensure uniform compression of the gasket.
- 4. Special care shall be taken when connecting piping to pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire surface of the flanges is obtained before any bolts are installed in the flanges.
- C. Penetrations:
 - 1. Install pipe straight through concrete walls or floors.
 - 2. Provide wall sleeves where ductile iron pipe passes through concrete walls and floors, unless specified otherwise on Project Drawings.
 - 3. Install wall pipes or sleeves as shown on Project Drawings.
 - 4. Install embedded wall flange in center of wall or floor and grout in place when embedded wall pipe flange shown on Project Drawings.
 - 5. Fabricate wall pipes to dimensions required.
- D. Support pipe at fittings with rods; anchor and support in accordance with Section 40 27 15 – Process Piping Support Systems
- E. Pipe and fittings to match face and drill of valves and appurtenances.
- 3.03 THREADED JOINTS
 - A. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.
 - B. Threaded joints in plastic piping shall be made with Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

3.04 COMPRESSION JOINTS

- A. Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past fingertight, or as recommended by the fitting manufacturer, to produce a leaktight, torque- free connection.
- 3.05 SOLVENT WELDED JOINTS

- A. All joint preparation, cutting, and jointing procedures shall comply with the pipe manufacturer's recommendations and ASTM D2855. Pipe ends shall be beveled or chambered to the dimensions recommended by the manufacturer. Newly assembled joints shall be suitably blocked or restrained to prevent movement during the setting time recommended by the manufacturer. Pressure testing of solvent welded piping systems shall not be performed until the applicable curing time, as set forth in Table X2.1 of ASTM D2855, has elapsed.
- 3.06 PVC PIPE
 - A. Form solvent joints in PVC pipe and fittings to ANSI/ASTM D2855. Solvent joints are to be used only where threaded or flanged connections are inappropriate.
 - B. 2-inch and larger: make connections to equipment and supply lines with flanges, unless otherwise specified.
 - C. Under 2-inches: make connections to equipment and supply lines with solvent joints, unless otherwise specified.
- 3.07 DISSIMILAR PIPE CONNECTIONS
 - A. Provide non-conducting connections or flange insulating gasket kits wherever jointing dissimilar metals in open systems.
- 3.08 VENTS AND DRAINS
 - A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines as shown.
- 3.09 INSULATION
 - A. See Section 40 42 13 Process Piping Insulation.
- 3.10 TESTING
 - A. Hydrostatically test each entire line in accordance with AWWA C600-99.
- 3.11 DISINFECTION
 - A. Disinfect all potable water lines in accordance with Section 33 13 00 Disinfection of Water Systems.
- 3.12 FIELD PREPARATION AND PAINTING
 - A. All material and equipment in this section shall be factory primed, excluding PVC and copper, and field finish coated. Factory coatings shall be compatible with materials provided under Section 09 90 02 High Performance Painting and Coating.
- 3.13 LEAKAGE
 - A. See Section 40 42 80 Process Piping Leakage Testing.
 - B. All joints shall be watertight and free from leaks. All leaks shall be repaired by Contractor in a timely manner and at no expense to the Owner.

C. All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed and replaced with new and acceptable materials, and the affected portion of the piping retested by and at the expense of the Contractor.

END OF SECTION 40 27 00

SECTION 40 27 05 PROCESS PIPING SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Pipe and equipment hangers, supports, and associated anchors.
 - 2. Sleeves and seals.
- B. Related Sections include:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 05 50 00 Metal Fabrications.
 - 3. Section 09 90 02 High Performance Painting and Coating.
 - 4. Section 40 27 00 Process Piping General.
 - 5. Section 40 27 10 Process Piping Specialties

1.02 REFERENCES

- A. Reference Standards include:
 - 1. ANSI B 31.10: Pipe Supports.
 - 2. ASTM A36: Structural Steel.
 - 3. ASTM A325: High Strength Bolts for Structural Steel Joints.

1.03 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01 33 00. Indicate name of manufacturer, materials, standard dimensions, references, maximum loadings, and thrust restraints for all pipe support systems.
- B. Provide a list of materials and corresponding suppliers.
- C. Provide pipe support location and details with piping layout drawings for piping systems 4-inches and larger.
- D. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.

1.04 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Conform to ANSI/AWS D.1.1.
- B. Employ certified welders as necessary to complete Work.
- 1.05 FIELD MEASUREMENTS
 - A. The Drawings indicate required pipe sizes and the general arrangement for major piping.

PROCESS PIPING SUPPORT SYSTEMS

Locations shall be verified in the field by the Contractor. Valves, fittings, and appurtenances shall be of such dimensions to allow for the installation of this piping and supports substantially as shown on the Drawings. In the event it should become necessary to change the location of any of the work due to interference with other work, Contractor shall consult with the Engineer prior to making any changes and all such changes shall be made at no additional cost to the Owner.

- B. Prior to roughing in any facilities or installation of piping and equipment, consult all related drawings including general, mechanical, electrical, etc., and inform self of materials, locations of structures, pipes, ducts, electrical conduits, etc., which may impact the installation of supports.
- C. Discrepancies discovered before or after work has started, shall be brought to the attention of the Engineer immediately, and the Engineer reserves the right to require minor changes in the work to eliminate such discrepancies.

PART 2 - PRODUCTS

2.01 PIPE HANGER SUPPORTS

- A. In certain locations, pipe supports, anchors and expansion joints have been indicated on the Drawings, but no attempt has been made to indicate every restraint, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.
- B. Concrete and fabricated steel supports shall be as indicated on the Drawings, as specified in other Sections, or, in the absence of such requirements, as permitted by the Engineer.
- C. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.
- D. Materials
 - 1. Unless otherwise specified, all pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69. Materials of construction for fabricated steel supports are covered in the structural and miscellaneous metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.
 - 2. Unless otherwise specified or indicated on the Drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with galvanized finish or be fabricated of stainless steel.
 - 3. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.
 - 4. Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.

- 5. Unless otherwise acceptable to the Engineer, the use of supports that rely on stressed thermoplastic components to support the pipe will not be acceptable.
- 6. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.
- 7. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to existing concrete and masonry.
- 8. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints.
- E. Manufacturer and Type:
 - 1. Anvil International, Catalog PH-5.10, or approved equivalent.
 - a. Light welded steel bracket: Figure 194.
 - b. Medium welded steel bracket: Figure 195
 - c. Heavy welded steel bracket: Figure 199
 - d. Concrete Inserts: Figure 281.
 - e. Offset Pipe Clamp: Figure 103.
 - f. Adjustable Clevis Hanger: Figure 260.
 - g. Stainless Steel Hanger Rods.

2.02 FLOOR PIPE SUPPORTS

- A. Approved Manufacturer and Type:
 - 1. Anvil International, adjustable pipe saddle support: Figure 264.
 - 2. Standon Model S92 Saddle Support.
 - 3. PHD Manufacturing Inc., adjustable pipe saddle support. Figure 875
 - 4. Or Approved Equivalent.
- B. Minimum vertical adjustment: 4¹/₂ inch.
- C. Provide complete with riser pipe and flange bolts for floor mounting.
- D. Provide precast concrete or grout base a minimum of 1" above floor.
- E. Provide as per recommended spacing, at minimum. Contractor shall install a minimum of one floor pipe support per pump discharge piping prior to the header piping.

PROCESS PIPING SUPPORT SYSTEMS

- F. Contractor may also be required to construct concrete saddle pipe supports for floor piping as indicated on the Drawings. Contractor to provide all materials, formwork, and labor to construct as detailed on Drawings.
- 2.03 WALL SUPPORTS
 - A. Steel brackets shall conform to MSS Type 31 for light duty, MSS Type 32 for heavy duty, and MSS Type 33 for heavy duty. Brackets shall be sized accordingly for full size and weight of piping system. All mounting hardware shall be stainless steel.
 - B. Submerged piping shall be supported with Type 316 stainless steel hangers or steel bracket supports coated with two coats of bitumastic paint.
- 2.04 VERTICAL PIPE SUPPORTS
 - A. Two bolt riser clamps shall be MSS SP 69 Type 8 galvanized or plastic coated.
 - B. Four bolt riser clamps shall be MSS SP 69 Type 42 galvanized or plastic coated.
- 2.05 SADDLES AND SHIELDS
 - A. Protection saddles shall be MSS SP 69 Type 39.
 - B. Protection shields shall be MSS SP 69 Type 40.
 - C. Wood insulation saddle shall be Elcen Metal Products Company, or equal.
- 2.06 PREFABRICATED OR FABRICATED PIPE SUPPORTS
 - A. Pre-engineered support systems constructed of steel products factory fabricated by firms regularly engaged in the manufacture of these items shall be used for this work. Steel pipe support systems shall be blasted to a white clean condition after fabrication and hot-dip galvanized in accordance with ASTM 123, unless support is specified to be fabricated of stainless steel.
 - B. Free-standing pipe connections to equipment shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams. Frames shall be anchored to the structure.
 - C. Exterior, free-standing overhead piping shall be supported by fabricated pipe stands, made of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
 - D. Special pipe supports for vertical and horizontal movement shall be as detailed on the drawings. Supports shall be fabricated by firms regularly engaged in the manufacture of these items.
- 2.07 SLEEVES AND SEALS
 - A. Wall pipes shall connect piping to concrete structure. Wall pipes shall be ductile iron meeting the requirements of AWWA C115. Provide wall pipes where indicated on Drawings.
 - B. Wall pipes shall be provided at all instances where piping penetrates concrete walls, floors, or foundations for the buildings and the polishing reactor.

- C. Wall sleeves shall be ductile iron meeting the requirements of AWWA C151. Sleeves shall have cast waterstop collar. Cast waterstop collar shall have an outside diameter a minimum of four inches greater than the outside diameter of the wall sleeve.
- D. Approved Manufacturers:
 - 1. Sleeves for pipes through walls and floors:
 - a. Ductile Iron Water-Stop wall pipe.
 - b. Or Approved Equivalent.
 - 2. Bolted rubber annular seal:
 - a. Link Seal manufactured by Thunderline Corp.
 - b. Or Approved Equivalent.

2.08 ANCHORS

- A. Hollow Concrete Block and Brick Anchors:
 - 1. Acceptable Manufacturer and Type:
 - a. HIT S 12/A Combi Fastener manufactured by Hilti Corporation.
 - b. Approved Equivalent.
 - 2. Accessories: HY20 Adhesive with screen tube insert.
- B. Use Type 316 stainless steel epoxy adhesive anchor bolts, Hilti 150 injection adhesive anchors, or equal, for building or structure attachments. Provide continuous concrete inserts, Unistrut P3200 series, or equal, where applicable.
- C. Mechanical anchor and powder-actuated drive-pin fasteners shall be used only with prior approval from the ENGINEER.
- 2.09 FABRICATION
 - A. Size sleeves large enough to allow for installation of annular seal.
 - B. Design hangers to support piping without disconnection of pipe.
- 2.10 FINISH
 - A. Factory coat steel hangers and supports as specified in Section 09 90 02 Mechanical Painting and Coating.
 - B. Touch up finish on exposed steel hangers and supports in accordance with Section 09 90 02 Mechanical Painting and Coating.

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. Contractor shall verify location of piping and piping systems as shown on the Drawings.
 - B. Pipes shall be attached to structural members when possible. When necessary to frame structural members between existing members, such members shall be provided by the

PROCESS PIPING SUPPORT SYSTEMS

Contractor at no additional cost to OWNER. Structural members shall be in accordance with the building code and the guidelines of the AISC.

- C. Install hangers, supports, clamps, and attachments as required to properly support piping in all operating conditions, including thrust, water hammer and surge conditions. Supports shall allow for free expansion and contraction of the piping, and shall prevent stress on equipment. Hangers shall have a means of vertical adjustment after installation. Hangers shall be designed so that movement of the supported pipe cannot cause them to disengage. Hanger rods shall be subject to tensile loading, only.
- D. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports on the Drawings shall not relieve the Contractor of the responsibility of providing supports as required.
- E. Connections to structural framing shall not induction twisting, torsion, or later bending in the framing members. Provide supplementary steel as required.
- F. Adjust support and hanger sizes to account for pipe insulation.
- G. Meters, valves, equipment, and other point load items shall be independently supported to prevent pipe stress. Piping shall support no meters, valves, equipment or other point load items.
- H. Space supports within maximum piping span length indicated in MSS SP-69, as indicated on the Drawings, or as recommended by the pipe manufacturer, whichever spacing is less. Install additional supports at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.
- I. Supports, hangers, anchors, and guides shall be designed and provided to prevent excess heat transfer to the structure or equipment, where applicable.
- J. Risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping, when possible.
- K. Do not support piping with wire, either temporarily or permanently. Do not support piping from other piping.
- L. Piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the support or the effects of the support.
- M. Embedded pipe supports or inserts shall be in place prior to placement of cast-in- place concrete. Continuous inserts shall be furnished with end caps and cardboard closure strips. Locate and space building attachments so that the total load and the point loads due to the pipe hanger and supports do not exceed the design capacity of the supporting structure.
- N. Where it is necessary to anchor supports to hardened concrete or completed masonry use stainless steel adhesive anchors.
- O. For precast concrete slabs, drill through concrete slab from below and provide stainless steel through bolts with square steel plates and stainless steel bolts. Plate shall bear directly upon the top surface of the precast concrete slab. All toppings or insulation as

required shall be applied after installation of all support plate assemblies.

- P. Attach to structural steel with beam clamps.
- Q. Mechanical anchor and powder-actuated drive-pin fasteners shall be installed in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Non-adhesive anchors shall be only used with prior approval from the ENGINEER.
- R. Piping shall be supported at least one and one-half inch out from the face of walls and at least three inches below ceilings, unless otherwise noted.
- S. Pedestal supports shall be used where indicated on the drawings or when piping is installed at or near the floor level, and shall consist of galvanized floor flange, pipe, and saddle. Provide stainless steel anchor bolts. All pedestal supports shall be adjustable, and place up off of the floor with minimum 1-inch grout.

3.02 INSERTS

- A. Provide and install inserts for placement in concrete formwork.
- B. Provide and install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams and walls.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.

3.03 PIPE HANGERS AND SUPPORTS

	MAX HANGER/	MIN HANGER/SUPPORT
PIPE SIZE	SUPPORT SPACING	ROD DIAMETER
$\frac{1}{2}$ to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0''	3/8"
2-1/2 to 3 inch	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"
8 to 12 inch	10'-0''	7/8"
14 to 18 inch	10'-0"	1"
20 to 30 inch	10'-0"	1-1/2"
30 to 36 inch	10'-0"	1-3/4"
PVC (All Sizes)	5'-0"	1/2"

A. Support horizontal piping as follows:

- B. Install supports free standing or suspended to provide minimum ¹/₂ inch space between support and adjacent Work.
- C. Place a hanger/support within 12 inches of each horizontal fitting and on each side of valves.
- D. Use hangers with 1¹/₂-inch minimum vertical adjustment.
- E. Support riser piping independently of connected horizontal piping.

3.04 THRUST ANCHORS AND GUIDES

- A. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and shall be sufficiently rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.
- B. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead end of pipelines. The design of all anchors shall be subject to approval by ENGINEER. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.
- C. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with the recommendations of the National Association of Expansion Joint Manufacturers.

3.05 INSERTS AND ANCHORS

- A. Furnish and install inserts or anchors for placement in concrete.
- B. Furnish and install inserts or anchors for suspending hangers from reinforced. concrete slabs and sides of reinforced concrete beams and walls.
- C. Utilize support assemblies designed for the appropriate loads. Contractor shall verify design conditions of each piping system.
- D. Mechanical anchor and powder-actuated drive-pin fasteners shall be installed in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Non-adhesive anchors shall be only used with prior approval from the ENGINEER.
- 3.06 SLEEVES
 - A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
 - B. Extend sleeves through floor three inches above finished floor level.
 - C. Where piping penetrates floor, ceiling, or wall, close off space between pipe and sleeve with link seal.
 - D. Wall sleeves and wall pipes shall be securely supported by form work to prevent contact with reinforcing steel and tie wires. Sleeves shall be set in formwork prior to pouring concrete.
 - E. For precast concrete panels openings shall be provided of such size to allow at least three inches clearance around the outside of the sleeve. After installation of sleeve, grout shall be tamped into place making a watertight joint.

3.07 COATING

- A. Prime coat non-galvanized steel or non-stainless steel hangers and supports.
- B. Finish coat all hangers and supports, except galvanized and stainless steel hangers and supports, under provisions of Section 09 90 02 Mechanical Painting and Coating.

END OF SECTION 40 27 05

PROCESS PIPING SUPPORT SYSTEMS

SECTION 40 27 10 PROCESS PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
 - a. Couplings.
 - b. Flanged Coupling Adapters.
 - c. Quick Connect Couplings
 - d. Buried Flange Adapters.
 - e. Mechanical Joint Restraint Gland.
 - f. Filler Flanges.
 - g. Rubber Expansion Joints.
 - h. Flexible PVC Wire Reinforced Hose.
 - i. Wye Strainers.
 - j. Filters
 - k. Basket Strainers
 - 1. Spray Nozzle Eductors
 - m. Fire Hose
 - n. Fire Hose Spray Nozzle
 - o. Rubber Garden Hose
- B. Related Sections include:
 - 1. Section 01 10 00 Summary of Work.
 - 2. Section 09 90 02 High Performance Painting and Coating.
 - 3. Section 40 27 00 Process Piping General.
 - 4. Section 40 27 05 Process Piping Support Systems.
 - 5. Section 40 27 20 Process Valves.
- 1.02 SUBMITTALS
 - A. Shop Drawings and Product Data: Submit, Under Provisions of Section 01 33 00, on all materials and products specified in this Section.
 - B. Provide a list of materials and corresponding suppliers.

PROCESS PIPING SPECIALTIES

C. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.

PART 2 - PRODUCTS

- 2.01 SPECIALTIES CONNECTIONS
 - A. Provide pipe specialties suitable to connect to adjoining pipes as specified for pipe fittings. Diameter to match adjacent and adjoining piping.
- 2.02 WORKING PRESSURE
 - A. Working pressure of pipe specialties to be equal to working pressure of connecting pipes, unless specified otherwise.

2.03 APPROVED MANUFACTURERS

- A. Mechanical Couplings
 - 1. Manufacturer and Type:
 - a. Dresser "Style 38".
 - b. Smith-Blair "441 or 411 Flexible Coupling".
 - c. Romac "Style 501" Coupling.
 - d. Or Equal.
- B. Quick Connect Couplings
 - 1. Manufacturer and type:
 - a. OPW, Kamlock.
 - b. Ryan Herco, 1300 series.
 - c. Or Equal.
- C. Flanged Coupling Adapters
 - 1. Manufacturer and type:
 - a. MegaFlange Series 2100 by EBAA Iron, Inc.
 - b. Smith Blair 912
 - c. Or Equal.
- D. Tapping Saddles and Tapping Sleeves
 - 1. Mueller
 - 2. Or Equal.
- E. Pipe Repair Clamps
 - 1. Mueller Series 510
 - 2. Or Equal.

- F. Rubber Expansion Joints
 - 1. Series 230, Style 231 with limit rods and compression sleeves by Proco Products, Inc.
 - 2. Invincible Style 501 with control rod assembly by Mercer Rubber Co.
 - 3. Or equal
- G. Flexible PVC Wire Reinforcement Hose
 - 1. Material: PVC Hose Heavy Duty.
 - 2. Reinforcement: Coated or Encased Spiral Wire.
 - 3. Strength: Capable of holding 100 pounds without elongation.
 - 4. Finish: Interior shall be smooth.
 - 5. Size: As shown on the drawings.
 - 6. Use: As shown on Drawings.
 - 7. Manufacturer:
 - a. Titan Hose.
 - b. Or Equal.
- H. Wye Strainers, Water Service, 2 inches and Smaller:
 - 1. Type: Bronze body, Y-pattern, 200 psi nonshock rated, with screwed gasketed bronze cap.
 - 2. Screen: Heavy-gauge Type 304 stainless steel or monel, 20-mesh.
 - 3. Manufacturer:
 - a. Armstrong International, Inc., Model F.
 - b. Mueller Steam Specialty, Model 351M.
 - c. Or Equal.
- I. Filters *(if applicable)*
 - 1. Type: Cartridge filter housing and disposable filter cartridges
 - 2. Inlet Liquid Pressure: 50-80 PSI
 - 3. Flow Rate: 20-150 GPM
 - 4. Usage: Effluent reuse filter
 - 5. Cartridge Pore Size: 150 micron
 - 6. Spare parts: provide spare disposable filter cartridges
 - 7. Manufacturer:
 - a. Hayward

- b. Dayton
- c. Eaton
- d. Or equal
- J. Basket Strainers
 - 1. Type: Basket Strainer
 - 2. Inlet Liquid Pressure: 50-80 PSI
 - 3. Flow Rate: 20-150 GPM
 - 4. Screen: Type 304 stainless steel or monel, 80-mesh.
 - 5. Usage: Effluent reuse strainer
 - 6. Spare Parts: provide 2 baskets for each strainer
 - 7. Manufacturer:
 - a. Hayward
 - b. Eaton
 - c. Or equal
- K. Spray Nozzle Eductors, Chlorine Injection (if applicable)
 - 1. Type: Polypropylene
 - 2. Inlet Connection: Pipe thread inlet 1.5 inches
 - 3. Orifice Diameter: 9/16 inches
 - 4. Inlet Liquid Pressure: 40 PSI
 - 5. Inlet Flow Rate: 66 GPM
 - 6. Entrained Flow Rate: $264 \pm 10\%$ GPM
 - 7. Circulation Rate: $330 \pm 10\%$ GPM
 - 8. Manufacturer:
 - a. Spraying Systems Co.
 - b. Or equal
- L. Fire Hose (if applicable)
 - 1. Type: Rubber covered lay flat
 - 2. Size: 1.5 inches
 - 3. Length: 50 ft
 - 4. Bowl Size:1-13/16 inches
 - 5. Inlet Liquid Pressure: 80 PSI

- 6. Quantity: 4
- 7. Manufacturer:
 - a. Fire Hose Direct.
 - b. Or equal
- M. Fire Hose Spray Nozzle (if applicable)
 - 1. Type: Assault fire hose nozzle with pistol grip
 - 2. Inlet Connection: Pipe thread inlet 1.5 inches
 - 3. Inlet Liquid Pressure: 80 PSI
 - 4. Quantity: 1
 - 5. Manufacturer:
 - a. Akron Brass Co.
 - b. Or equal
- N. Rubber Garden Hose
 - 1. Type: Commercial/Industrial rubber hose
 - 2. Size: 5/8 inches
 - 3. Length: 50 ft
 - 4. Quantity: 1
 - 5. Manufacturer:
 - a. Apex Commercial Model 8695-50
 - b. Or equal

PART 3 - EXECUTION

- 3.01 INSTALLATION
 - A. Install in accordance with manufacturer's recommendations.
 - B. Install equipment in locations shown on the Drawings.
- 3.02 MECHANICAL COUPLINGS
 - A. A space of at least ¹/₄-inch, but not more than 1-inch, shall be left between the pipe ends.
 - B. Pipe and coupling surfaces in contact with gaskets shall be clean and free of dirt and other foreign matter during assembly.
 - C. All assembly bolts shall be gradually tightened and at a uniform rate, so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe.
 - D. The interior surfaces of the middle rings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in

accordance with ANSI/AWWA C210. The remaining components shall be cleaned and shop primed with universal primer.

- E. Repair and damaged areas of shop coatings on the pipe and coupling to the satisfaction of the Engineer.
- F. Provide steel tie-bolts, diametrically opposite, which extend across the joint from lugs welded to the pipe on either side of the joint to provide restraint.
- 3.03 FLANGED COUPLING ADAPTERS
 - A. After the pipe is in place and bolted tight, the proper locations of holes for anchor studs or lock pins shall be determined and the pipe shall be field-drilled.
 - B. The inner surfaces of the couplings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining surfaces, except the flange mating surfaces, shall be cleaned and shop primed with universal primer.
- 3.04 FILLER FLANGES
 - A. Ductile iron conforming to the requirements of AWWA C115, maximum 250 psi working pressure.
 - B. Match filler flange to adjoining pipe working pressure class.
- 3.05 RUBBER EXPANSION JOINTS
 - A. Install expansion joints and control rod units per manufacturer's recommendation.

END OF SECTION 40 27 10

SECTION 40 27 20 PROCESS VALVES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Furnishing and installation of the following (where applicable), in accordance with the provisions of the Contract Documents.
 - a. Actuators.
 - b. Plug Valves.
 - c. Check Valves.
 - d. Duckbill Check Valves.
 - e. Butterfly Valves.
 - f. Ball Valves.
 - g. Gate Valves.
 - h. Globe Valves.
 - i. Mud Valves.
 - j. Air Release Valves.
 - k. Pressure Reducing Valve.
 - 1. Wye Strainers.
 - m. Corporation Stops.
 - n. Telescoping Valves
- B. Related Sections include:
 - 1. Section 01 33 00 Submittal Procedures
 - 2. Section 01 40 00 Quality Control
 - 3. Section 01 60 00 Product Requirements
 - 4. Section 01 77 00 Closeout Procedures
 - 5. Section 01 78 23 Operations and Maintenance Data
 - 6. Section 09 90 02 High Performance Painting and Coating
 - 7. Section 22 13 29.16 Submersible Sewage Pump Station
 - 8. Section 40 27 00 Process Piping General
 - 9. Section 40 27 15 Process Piping Support Systems
 - 10. Division 26 Electrical
- 1.02 REFERENCES
 - A. Reference Standards include:
 - 1. AWWA C504: Rubber-Seated Butterfly Valves.
 - 2. AWWA C509: Resilient-Seated Gate Valves for Waterworks Service, 2 inches through 24 inches NPS.
 - 3. AWWA C512: Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

PROCESS VALVES

- 4. AWWA C540: Power-Actuating Devices for Valves and Sluice Gates.
- 5. AWWA C550: Protective Epoxy Interior Coatings for Valves and Hydrants.
- 6. AWWA C800: Underground Service Line Valves and Fittings.

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit in accordance with Section 01 33 00, detailed specifications, drawings, and data covering all materials, parts, devices, equipment, and other accessories forming part of equipment for the complete operational system. Include name of Manufacturer, references, joint data, maximum loadings and thrust restraints.
- B. Operations and Maintenance Data: Submit in accordance with Section 01 78 23 on all parts, devices, equipment and other accessories forming each complete operational system. Include a complete write-up of how the system is to operate and how to make adjustments.

1.04 REGULATORY REQUIREMENTS

A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- B. Unless otherwise indicated, use valves suitable for 150 psi minimum working pressure.

2.02 VALVE CONNECTIONS

- A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use full port size valves.
- B. Thread pipe sizes 1-1/2 inches and smaller unless indicated otherwise.
- C. Flange pipe sizes 2 inches and larger unless indicated otherwise.

2.03 ACTUATORS

- A. Manual Geared Actuators:
 - 1. Type: Gear with cast iron housing. Provide chain-wheel on all valves with centerline located 6 feet and higher. Provide hand-wheel on all others requiring a manual operator.
 - 2. Equip with adjustable open and closed position stops.

PROCESS VALVES

- 3. Provide manual gear/hand wheel actuator on all valves unless indicated otherwise on the Drawings or the valve schedule. The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body shall have cast thereon the word "OPEN" and an arrow indicating the direction to open.
- 4. Provide riser stem and floor mounted base as indicated on the Drawings.
- 5. Provide position indicator.
- 6. Hand wheels:
 - a. Hand wheels shall be cast iron.
 - b. Maximum wheel diameter shall be 12 inches.
 - c. Maximum hand wheel pull shall be 80 pounds.
- 7. Chain wheels:
 - a. Chain wheels shall be galvanized, shrouded pocket hand wheels.
 - b. Provide shearidized chains.
 - c. Maximum wheel diameter shall be 12 inches.
 - d. Bolt to hand wheel type chain wheels will not be acceptable.
 - e. Maximum chain wheel pull shall be 80 pounds.
 - f. Each chain wheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be looped to extend within 4 feet of the floor below the valve.
- 8. Hand Levers:
 - a. Provide hand levers where indicated on the Drawings, or in these specifications.
 - b. Hand levers shall be directly connected to the shaft and rotate 90 degrees from full closed to full open.
 - c. Levers shall be provided with a locking device to assure positive position in full open, full closed and a minimum of five intermediate positions around the 90 degrees of rotation. Indication of valve position shall be provided.
 - d. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.
- 9. Manual Nut Operators:
 - a. Provide 2-inch AWWA-certified operating nut where indicated on the Drawings, or in these specifications.
- 10. The housing of traveling-nut type actuators shall be fitted with a removable cover

PROCESS VALVES

which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

- 11. Manufacturers:
 - a. Pratt.
 - b. DeZurik.
 - c. Clow
- B. Electric Motor Actuators:
 - . See Section 40 05 57 for electric actuator requirements.
- 2.04 PLUG VALVES
 - A. Type of Valve: Eccentric plug valve.
 - B. Body: Flanged, ASTM A126, Class B cast iron body. Bolted bonnet. Flanged valve shall be fully faced and drilled in accordance with ANSI B16.1, Class 125.
 - 1. Exterior Coating: Red oxide primer. Finish coat per Section 09 90 02.
 - 2. Interior Coating: Epoxy suitable for potable water service or fully neoprene rubber lined.
 - C. Minimum Valve Classification:
 - 1. 12 Inch and Smaller: 175 psi, C.W.P., non-shock working pressure rating.
 - 2. When plug valve is in full open position, plug geometry and body waterway contours shall provide port area equal to 80 percent of the adjacent pipe nominal diameter and no cavities where debris can collect.
 - D. Resilient Plug Facing: Neoprene. Provide dead-tight shutoff pressure in either direction.
 - E. Seat: One piece welded nickel, or AISI 304L Stainless Steel.
 - F. Stem Seal Packing: Nitrile-butadiene (Buna) filled PTFE U-ring seal or meet AWWA C504.
 - G. Bearings: Stainless steel, permanently lubricated radial bearings. Non- adjustable thrust bearings.
 - H. Manual Actuators:
 - 1. Type: Hand wheel, or gear with cast iron housing.
 - 2. Provide chain wheel on all valves located with centerline 6 feet and higher.

- 3. Equip with adjustable open memory stop.
- 4. Provide position indicator.
- I. Manufacturers:
 - 1. DeZurik.
 - 2. Pratt
 - 3. Milliken.
 - 4. Clow.
 - 5. GA Industries.
- 2.05 CHECK VALVES
 - A. Check Valves:
 - 1. Manufacturer and Type:
 - a. Series 100SR Rubber Flapper Swing Check Valve by Apco.
 - b. Surgebuster Swing Flex check Valve by Val-Matic.
 - c. Milliken Flex Check.
 - d. Crispin.
 - e. GA Industries.
 - 2. Design: Full body, flanged type, with removable cover for removal of rubber flap disc without removal of valve from process line.
 - a. Body and Cover: Cast Iron.
 - b. Disc: Buna-N w/steel and fabric reinforcement.
 - c. Interior and Exterior coating shall be fusion bonded epoxy.
 - d. Exterior Hardware: Stainless steel bolts, nuts, and washers.
 - 3. The valve shall have full flow equal to the nominal pipe diameter at any point, through the valve. Disc stroke shall be 35 degrees. Top access port shall be full size.
 - 4. Provide a disc accelerator or spring return for rapid closure.
 - 5. Provide a screw type backflow actuator to allow opening of the valve during no flow conditions.
 - 6. Refer to Drawings and Valve Schedule for installation locations and sizes.

2.06 BUTTERFLY VALVES – SERVICE TYPE: LIQUID

- A. Standard: AWWA C-504, Standard for Rubber Seated Butterfly Valves.
- B. Type of Body: Flanged short body. Flanged valves shall be fully faced and drilled in accordance with ANSI Standard B16.1, Class 125.
- C. Minimum Valve Classification: 150B.

- D. Shaft: One piece Type 304 stainless steel and supported on Teflon coated stainless steel or inert nylon bearings.
- E. Shaft Seal: Self-adjusting Chevron "V"-type.
- F. Body: ASTM A126, Class B cast iron. Body wall thickness shall meet AWWA C504. Coated or plated disks are not acceptable.
- G. Seats: Acrylonitrile-butadiene material. One-piece construction and attached to valve body or disc.
- H. Disc: One piece design. ASTM A126, stainless steel. Shaft shall pass through disc. Disc shall be retained by stainless steel pins or bolts that shall extend through the full diameter of the shaft. Disc stops within the flow stream shall be rejected.
- I. Approved Manufacturer:
 - 1. Pratt.
 - 2. DeZurik.
 - 3. Milliken.
 - 4. American R/D.
 - 5. GA Industries.
- 2.07 BUTTERFLY VALVES SERVICE TYPE: AIR
 - A. Low Pressure Air Service Butterfly Valve (2" to 48")
 - 1. Service:
 - a. Low Pressure Air (<20 psi)
 - b. Temperatures to 250 degrees F
 - c. Modulating or Open/Close function
 - 2. Features:
 - a. General:
 - i. High Performance Butterfly Valve
 - ii. Pressure Rating: ANSI Class 150 (285 psi), drop tight
 - b. Body:
 - i. Full lug style, designed to fit between ANSI B 16.5 Class 150 flanges, suitable for dead-end service in either direction.
 - ii. Carbon steel (ASTM A216 WCB) with baked on epoxy powder coating.
 - c. Disc:
 - i. 316 stainless steel (ASTM A351-CF8M)
 - ii. Provide valve with double-offset disc design with 2-piece stem to provide uninterrupted 360-degree seating.

- d. Shaft:
 - i. Two-piece.
 - ii. 17-4 stainless steel.
- e. Seat:
 - i. Valve seat shall be retained in the valve body and replaceable without removing disc or stem.
 - ii. RTFE/stainless steel
- 3. Manufacturers and Products:
 - a. Henry Pratt Company: Series 400
 - b. Tyco/Keystone; Figure F362, Trim Code 123
 - c. Or equal

2.08 BALL VALVES

- A. Manual ball valves for use with metallic pipe systems:
 - 1. Manufacturer and type: Series B-6000 ball valve as manufactured by Watts Regulator Company, or approved equivalent.
 - a. Body: Bronze.
 - b. Ball: AISI Stainless Steel.
 - c. Stem: AISI Stainless Steel.
 - d. Valve Seats: Durafill.
 - e. Connection: Threaded.
- B. Manual ball valves for use with PVC pipe systems:
 - 1. Manufacturer and type:
 - a. Watts Regulator Company.
 - b. Hayward.
 - c. Spears.
 - d. George Fisher Inc (GF).
 - 2. Material: PVC.
 - 3. Seats: Teflon.
 - 4. Seals: Viton "O" rings.
 - 5. Stem: Blow out proof.
 - 6. Connector: True union.

2.09 GATE VALVES

- A. Approved Manufacturer:
 - 1. DeZurik.
 - 2. Mueller.
 - 3. Clow
 - 4. Approved Equivalent.
- B. Gate valves 2-inches to 48-inches in diameter shall be resilient wedge type gate valves rated for 250 psi working pressure with all ferrous components ductile iron in accordance with ASTM A536. Gate valves 3-inches to 36-inches in diameter shall be in full compliance with the requirements of AWWA C515.
- C. Manufacturer shall provide an affidavit stating that the valve and materials conform to the applicable AWWA requirement and test specified under the respective standard have been performed and met. Valves shall be NSF 61 certified.
- D. The wedge shall be cast or ductile iron encapsulated with polyurethane rubber. The polyurethane shall be permanently bonded to the wedge.
- E. The interior of the body and bonnet shall be coated with a fused epoxy coating meeting the requirements of AWWA C550.
- F. Valves shall be non-rising stem with a 2-inch square operating nut, unless noted otherwise. All valves shall open right unless noted otherwise.
- G. Stems shall be cast bronze with integral thrust collars. The stuffing box shall be the P-ring seal type with a triple O-ring seal. The rings shall be replaceable with the valve fully open at full rated working pressure.
- H. There shall be two (2) low torque thrust washers or bearings located above and below the integral stem collar. The stem nut shall be separate and shall be of solid bronze or copper alloy.
- I. Markings shall be cast on the bonnet or body of each valve and shall show the manufacturer's name, year valve casting was made, size of valve, the letters and numbers "C515", and the designated working water pressure.
- J. Valves shall be equipped with indicators to show the position of the gate in relation to the water way.
- K. Valves shall be suitable for exposed service. All nuts, bolts, and hardware shall be stainless steel.
 - 1. Provide geared operators, unless noted otherwise. Gears shall be steel, housed in a heavy-duty cast iron grease case.
- 2.10 AIR RELEASE VALVES (ARV)
 - A. Air release valves shall allow entrained air in pipelines to escape through an air release orifice. After releasing entrained air, the orifice shall close by a needle mounted upon a compound lever mechanism actuated by a float. The orifice shall remain closed until

more air accumulates and the cycle is repeated.

- B. Valves for sewage or sludge shall contain flushing and drain connections.
- C. Acceptable Manufacturers:
 - 1. Water Valves:
 - a. Apco
 - b. Crispin
 - c. Val-Matic
 - d. GA Industries.
 - 2. Sewage or Sludge Valves
 - a. Apco
 - b. Crispin
 - c. Val-Matic
 - d. GA Industries.

2.11 PRESSURE REDUCING VALVE

- A. Valve Operation: Valve shall automatically reduce higher inlet pressure to a steady lower pressure downstream regardless of changing flow rate or varying inlet pressure. The valve shall be pilot operated capable of holding pressure to a predetermined limit. The main valve and pilot valve shall close drip-tight if the downstream pressure exceeds the pressure setting of the control pilot. A check feature shall be provided. Should a pressure reversal occur, the downstream pressure shall be admitted in the main valve cover chamber closing the valve to prevent return flow.
- B. Refer to Valve Schedule in the Drawings for installation locations and sizes.
- C. Adjustment Range: 15 to 150 psi.
- D. Temperature Range: Water to 180 degrees F.
- E. Main Valve Materials:
 - 1. Body and Cover: Cast Iron; 125-pound flanges.
 - 2. Disk Retainer & Diaphragm Washer: Cast Iron.
 - 3. Trim (Disc guide, seat, and cover bearing): Bronze.
 - 4. Disc: Buna N Rubber.
 - 5. Diaphragm: Nylon reinforced Buna N.
 - 6. Stem, Nut, and Spring: Stainless Steel.
- F. Pilot System Materials:
 - 1. Pilot Control: Bronze.

- 2. Trim: Stainless Steel Type 303.
- 3. Rubber: Buna N Synthetic Rubber.
- G. Acceptable Manufacturer:
 - 1. Cla-Val.
 - 2. Singer Valve Company.
 - 3. Ross Valve.
 - 4. GA Industries
 - 5. Or Equal
- 2.12 PRESSURE REDUCING VALVE CHEMICAL FEED TYPE
 - A. Operation: Valve shall automatically reduce higher inlet pressure to a steady lower pressure downstream regardless of changing flow rate or varying inlet pressure.
 - B. Material: all thermoplastic diaphragm Pressure Relief Valve for protecting against overpressure in chemical feed systems. Valves shall be capable of reducing pressure to the following range with adjustable spring: 10 - 150 psi
 - 1. BODY: PVC, CPVC, PP, or PVDF
 - 2. DOME: Molded NORYL[™]
 - 3. Adjustment screw with slot.
 - 4. 304 stainless steel bolting
 - 5. PTFE/EPDM Diagram
 - 6. FNTP Threads
 - C. MANUFACTURERS;
 - 1. Hayward Flow Control
 - 2. Or Equal
- 2.13 CORPORATION STOPS
 - A. Bronze, Brass, or Stainless steel construction, inlet and outlet openings same size as the valve.
 - B. AWWA ball valve type.
 - C. Insta-tite or compression connections.
 - D. Meet or exceed the ANSI/AWWA C800 standards, 150 psi.
 - E. Approved Manufacturers:
 - 1. A.Y. McDonald Manufacturing.
 - 2. Mueller
 - 3. Fork Meter Box

4. Or Approved Equivalent.

2.14 TELESCOPING VALVES

- A. The manufacturer shall have experience 10 years manufacturing telescoping valves and shall show evidence of satisfactory operation in at least 5 installations. The manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirement of the latest edition ASME, Section IX. The manufacturer must also be an ISO 9001 certified company.
- B. General Design
 - 1. Slip Tube
 - a. Slip tube material shall be type 304 or 316 stainless steel;
 - b. The slip tube may be supplied square on top or with a V-notch for estimating flow.
 - c. Cone weirs and/or Scum baffles shall be stainless steel (304 or 316) when required.
 - 2. Grease Fitting
 - a. When required, slip tubes shall be equipped with a grease fitting to allow the operator to apply grease to the slip tube from the operator level. The fitting shall be used when flange is often exposed to dry air, or in a dry application completely.
 - 3. Flange
 - a. The slip tube gasket shall be BUNA-N and replaceable without removal of the slip tube assembly from the riser pipe, lift rod or actuator. The gasket retainer shall be stainless steel and the flange shall be cast iron, unless otherwise specified.
 - 4. Safety Lock Operators (operator for MSH wastewater project can be either rising or non-rising stem rack & pinion or screw type);
 - a. Rack & Pinion
 - i. The operator shall be rising stem, rack and pinion type, with a worm gear operator and bronze bearings. For safety and efficiency, the operator shall be self-locking, eliminating the need for additional locking devices. A clear acrylic rack cover with a calibrated Mylar strip position indicator shall be provided.
 - b. Screw Type Rising Stem
 - i. The operator shall be screw type with a stainless steel acme thread screw. A clear acryic rack cover with a calibrated Mylar strip position indicator shall be provided.
 - c. Non-Rising Stem

- i. The operator shall be a non-rising stem style with a hand wheel and linear position indicator, calibrated in 1/4" increments, incorporated in the stainless steel floor stand. A stainless steel traveling torque tube and stainless steel anti-rotation plate shall be incorporated to prevent the slip tube from rotating. All fasteners are to be 304 stainless steel.
- d. The telescoping valve shall be machined, assembled, and tested in the USA for quality assurance.

Manufacturer shall show proof of ISO 9001 certification.

- e. Where required, the manufacturer shall provide valve operating stems, stem guides, and operators as specified in the valve schedule or plans.
- f. Telescoping Valve and accessories shall be manufactured by Troy Valve or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted (does not apply to plug valves).
- B. Install valves in the locations and configurations shown on Drawings.
- C. Provide adequate structural support of installed valves as required.
- D. Install valves per manufacturer's recommendations.
- E. Install telescoping valves plumb and in accordance with manufacturer's guidelines.
- 3.02 STARTING AND ADJUSTING
 - A. Furnish Owner and Engineer with a written report prepared by equipment supplier certifying that equipment:
 - 1. Has been properly installed.
 - 2. Is in accurate alignment.
 - 3. Is free from an undue stress imposed by connecting piping, anchor bolts, etc.
 - 4. Has been operated through at least two complete open/close cycles.
 - 5. Checked for leakage
- 3.03 CLASSROOM AND DEMONSTRATION TRAINING
 - A. Provide minimum two (2) hours classroom and demonstration training on the proper operation and maintenance of equipment. Training to be completed after completion of starting and adjusting.
- 3.04 PAINTING
 - A. All material and equipment in this section shall be factory primed. Primer shall be compatible with finish coats of paint provided under Section 09 90 02 Mechanical

Painting and Coating.

B. Finish painting of all materials and equipment in this Section that are not concealed shall be the responsibility of the General Contractor, and shall be as described in Section 09 90 02 – High Performance Painting and Coating, unless otherwise specifically indicated. The Contractor shall, however, refinish and restore to the original appearance, all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.

END OF SECTION 40 27 20

SECTION 40 27 60 PROCESS IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Pipe markers.
 - 2. Equipment, valve, gate, flow meter, and instrument markers.
 - 3. The methods and materials specified herein apply to all piping and equipment in Divisions 40 and Division 46.
- B. Related Sections include:
 - 1. Section 01 33 00 Submittals.
 - 2. Section 09 90 02 High Performance Painting and Coating.
 - 3. Division 46 Equipment.
 - 4. Division 23 HVAC
 - 5. Division 26 Electrical
- 1.02 REFERENCES
 - A. Reference Standards include:
 - 1. Ten States Standards 2.14 Piping Color Code.
 - 2. ANSI A13.1 1981: Schemes for Identification of Piping Systems.
- 1.03 SUBMITTALS
 - A. Submit color schedule under provisions of Section 01 33 00.
 - B. Submit location drawing and shop drawings on markers under provisions of Section 01 33 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Pipe Marker Manufacturers:
 - 1. W.H. Brady Co.
 - 2. Seton Nameplate Corp.
 - 3. Chemelex Div., Raychem Corp.
 - 4. Koibi Industries, Inc.
 - 5. John P. Nissen Jr. Co.

- 6. Zippertubing Co.
- 7. Emedco.

2.02 PIPE MARKERS

- A. All pipes, regardless of material, shall receive pipe markers.
- B. All process and drainage piping within the Grit Building, Main Process Building, and Blower Building regardless of content, shall have labels every ten feet with a minimum of two labels in each room, closet, or pipe-chase.
- C. Pipe Size ³/₄ inch through 6 inch Diameter:
 - 1. One piece, snap around and completely encircle pipe with substantial overlap and permanent tension to grip pipe firmly without adhesives.
 - 2. Provide with flow arrows every 10'.
 - 3. Clearly indicate pipe size and service code on line.
 - a. Example: 4-WAS
 - 4. Size of Legend Letters and Numbers:

Outside Diameter of Pipe or Pipe Covering	Size of Legend Letters and Numerals
3/4" to 1-1/4"	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"

- 5. Comply with ANSI Standard A13.1 1996.
- 6. Material: Pre-formed acrylic/vinyl plastic.
- 7. Working printed in a "repeat and reverse" pattern.
- 8. Adhesive markers will not be allowed.
- D. Pipe Size 8 inch Diameter and Larger:
 - 1. After process pipe has been finish coated per Section 09 90 02 Mechanical Painting and Coating, apply pipe name with painted on stenciling.
 - 2. Clearly indicate pipe size and service code in stencil.
 - a. Example: 8-RAS
 - 3. Provide each label with flow arrow adjacent to text.
 - 4. Size of Legend Letters and Numbers:

Outside Diameter of Pipe	Size of Legend
or Pipe Covering	Letters and Numerals
8" to 10"	2"
Over 10"	3"

- 5. Paint on each pipe at 120 or 180 degree intervals based on pipe size and location. Arrange so labeling of similar pipe runs are spaced and oriented the same. Coordinate label placement with Owner and Engineer.
- 6. Stack stencil wording were applicable. Center flow arrow between words in vertical direction.
- 7. Coordinate and maintain consistent spacing and stencil locations from filter to filter, between flanges, and within plant walls and penetrations for neat appearance.
- 8. Stencil paint color to be selected by Engineer to provide required contrast between process pipe coating and stencil identification.
- 9. All sticker or wrap pipe labels shall meet the minimum quality requirements as those manufactured by ComplianceSigns of Chadwick, Illinois.

2.03 CONTROL DEVICE MARKERS

- A. After process pipe, equipment, valves, flow meters, and other appurtenances have been finish coated per Section 09 90 02 Mechanical Painting and Coating, apply metal nametag for all pieces of equipment, valves, gates, flow meters, and instruments.
 - 1. Metal tag shall include the full tag including building following the examples below:

a.	Equipment:	AGS-BLW#1
b.	Valves / Gates:	WAS-AGS#1
c.	Instrument:	UVI-FE1

- B. Material: Stainless Steel.
- C. Size: 3 inch diameter, round shape, 0.025-inch thickness
- D. Provide with holes for hanging.
- E. Stamp tag with appropriate name or number. See the equipment schedule, valve schedule, and instrument schedule in the construction drawings for equipment, valves, flow meters, gates, and instruments.
- F. Provide metal tags as required. Contractor shall verify number of valves, flow meters, equipment, and instruments requiring tags.

2.04 RFID TAGS

A. All equipment, valves, gates, flow meters, and instruments shall also receive RFID tags which shall allow operators to look up asset information in the field and linked to the facility asset management system. Contractor shall provide tags and coordinate integration with facility asset management system.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. All process piping 1/2" or greater shall be scheduled for painting and identification. Marker colors shall be yellow with black lettering unless indicated otherwise.
- B. Pipe Markers:
 - 1. Install on all piping systems at the following locations or at Engineer's direction:
 - a. Adjacent to each valve.
 - b. Each branch and riser at take-off.
 - c. At each pipe passage through wall or floor.
 - d. At not more than 20 feet spacing on straight pipe runs.
 - e. At each change in direction.
 - 2. Provide number and copy indicated in schedule below.
- C. Painting:
 - 1. Finish painting of all materials and equipment shall be the responsibility of the General Contractor, and shall be as described in Section 09 90 02 High Performance Painting and Coating.
 - 2. Colors: As indicated in schedule below and coordinated with Engineer.
 - a. Owner and Engineer reserve the right to change color selections during shop drawing review based on available color chart options. Where applicable, Contractor shall field verify and match existing pipe colors.
 - 3. All PVC carrier piping shall be painted according to chemical tubing carried.
 - 4. Provide 2-inch bands at 30 inch intervals where banding is required. Provide 2-inch width with straight edges and neat appearance. Contractor also has the option to use colored electric tape for identification banding in lieu of painting bands.
- D. Control Device Markers
 - 1. Attach with a corrosion resistant material.
 - 2. Attach at all process valves, flow meters, equipment, pressure transducers, and ultrasonic level transducers.

3.02 PIPE COLOR CODE SCHEDULE

Wastewater and Chemical Lines:

Type of Line	Color	Tnemec Color / Band Color
Raw Influent (INF)	Dark Grey	34GR Deep Space
Treated/Settled Wastewater (TWW)	Light Grey	38GR Dove Grey
Potable (POT)	Dark Blue	11SF Safety Blue
Plant Water/Non-Potable (NPW)	Violet	16SF Rec Water Purple

Fire Protection	Red	06SF Safety Red
Plant Effluent (EFF)	Clay	07RD Terra Cotta
Chlorine (CL)	Yellow	02SF Safety Yellow
Polymer	Orange with Green Band	04SF Safety Orange 09SF Safety Green

Gas Lines:

Natural Gas (GAS/G)	Red	28RD Monterrey Tile

Other:

•	Compressed Air (AIR)	Dark Green	91GN Balsam
•	Fire Protection	Red	06SF Safety Red
•	Hoists/Trolleys	Yellow	02SF Safety Yellow

Contractor shall confirm all color selections for piping with Engineer.

END OF SECTION 40 27 60

SECTION 40 42 13 INSULATION FOR EXPOSED PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies thermal and sound insulation for exposed piping, related equipment and appurtenant surfaces.
- B. Related Sections: Not used.
- C. Performance Requirements:
 - 1. Temperature Classes:
 - a. Insulation for exposed piping and equipment is classified for the following temperature ranges: low, medium; high, and very high.
 - b. Low temperature class insulation shall be suitable for an operating temperature range of -100 to +100 degrees F.
 - c. Medium temperature class insulation shall be suitable for an operating temperature range of 100 to 800 degrees F.
 - d. High temperature class insulation shall be suitable for an operating temperature range of 800 to 1200 degrees F.
 - e. Very high temperature class insulation shall be suitable for an operating temperature range of 1200 to 1800 degrees F.
 - 2. Service Classes:
 - a. Insulation of exposed piping is provided for one or more of the following services: condensate control (CC), personal protection (PP), freeze protection (FP), and energy conservation (EC). All piping systems listed in the Insulation Thickness Schedule at the end of this section shall be insulated for the insulation service class listed in the schedule.
 - b. Pipe insulation for CC shall be provided for all piping and appurtenances that are designated as system CC and are 3 inches and smaller.
 - c. Pipe insulation for PP shall be provided on all equipment and piping appurtenances
 - i. on the blower discharge piping that is within 8 feet of a floor slab, stair landing, or other type of accessible walkway and are contained within the facility structure where the equipment is located.
 - d. Pipe insulation for EC shall be provided on all piping and pipe appurtenances that are designated as EC.

1.02 QUALITY ASSURANCE

A. Referenced Standards: This Section incorporates by reference the latest revisions of the following documents. They are part of this Section. In case of conflict between the requirements of this Section and the listed documents, the Contractor shall point out the conflict to the Project Representative; lacking a definitive answer otherwise, the requirements of the Contract Specifications shall prevail.

Reference	Title
ASTM 8209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C552	Cellular Glass Thermal Insulation
ASTM E96	Water Vapor Transmission of Materials
FEDSPEC L-P-535E Chloride)	Plastic Sheet (Sheeting) "Plastic Strip" Poly (Vinyl and Poly (Vinyl Chloride-Vinyl Acetate), Rigid
FEDSPEC HH-1-558B(3)	Insulation, Blocks, Boards, Blankets, Felt Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)

1.03 SUBMITTALS

- A. Procedures: Section 01 33 00.
- B. Items to be Submitted for this Specification:
 - 1. Manufacturer's descriptive literature, including insulation and jacket thickness, heat transfer coefficient, and methods of installation.
 - 2. Samples of each insulation material type and thickness along with typical jackets and covers for fittings, valves and appurtenances. Provide a 6 inch long, full diameter segment for each insulation sample.
 - 3. Certification of jacket ratings for water vapor transmission and puncture and stiffness as specified.

1.04 WARRANTY

A. For the work of this Section, provide all warranties as described in the General Conditions,

Section 01 70 00, and provide all normal commercial warranties available as described in the General Conditions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Piping insulation shall be tubular type or the flexible blanket type.

- B. Insulation for valves, strainers, fittings, expansion joints, flanges and other connections shall be segmented sections, molded, or blanket type coverings of the specified type and thickness of pipe insulation, or the flexible blanket type.
- C. Equipment insulation shall be flexible blanket type or rigid board type cut to fit the surface.

2.02 INSULATION

- A. General:
 - 1. Low temperature class insulation shall be of the unicellular elastomeric thermal, cellular glass, or fiberglass type.
 - 2. Medium temperature class insulation shall be of the cellular glass or fiberglass type.
 - 3. High temperature class and very high temperature class insulation shall be of the calcium silicate type or the flexible blanket type. Piping and equipment subjected to vibration (such as engine exhaust) shall be insulated with flexible blanket type.
- B. Unicellular Elastomeric Thermal Type: Unicellular elastomeric thermal type insulation shall conform to the requirements of ASTM C534, Type I.
- C. Cellular Glass Type: Cellular glass type insulation shall conform to the requirements of ASTM C552, Type II.
- D. Fiberglass Type: Fiberglass type insulation shall conform to the requirements of FEDSPEC HH-15588.
 - 1. Shall be in compliance with ASTM C547, ASTM C1136, ASTM C795.
 - 2. Shall be equal to or exceed the qualities of Owens-Corning SSL II
- E. Calcium Silicate Type: Calcium silicate type insulation shall conform to the requirements of ASTM C533, Type II, Class C.
- F. Flexible Blanket Type:
 - 1. High Temperature Class:
 - a. High temperature insulation shall be removable 1- or 2-inch-thick blanket-type insulation designed for continuous 1200 degree F service.
 - b. The blanket shall be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.
 - c. Blanket shall be custom fitted to not restrict access to any instrumentation or equipment.
 - d. Insulation shall not compact or shake down in vibrating service.
 - e. Blanket insulation shall consist of a noncombustible silica cloth jacket and nonasbestos white ceramic fiber insulation.
 - f. Acceptable manufacturer:

- i. Thermazip Hi-Temp blanket Style 2000-60-3000 by Accessible Products Company.
- ii. Hitco AIM.

iii. Advanced Thermal Products.

iv. SEI Temp-Set 1200.

v. Approved equal.

- 2. Very High Temperature Class:
 - a. Very high temperature insulation shall be removable 1- or 2-inch-thick blanket-type insulation designed for continuous 1800 degree F service.
 - b. The blanket shall be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.
 - c. Blanket shall be custom-fitted to not restrict access to any instrumentation or equipment.
 - d. Insulation shall not compact or shake down in vibrating service.
 - e. Blanket insulation shall consist of a noncombustible silica cloth jacket and high purity alumina and silica nonasbestos white ceramic fiber insulation.
 - f. Acceptable manufacturer:
 - i. Thermazip Hi-Temp blanket Style 2000-61-3000 by Accessible Products Company.
- G. Mandrel-Wound Pipe Section Type:
 - 1. Shall comply with the properties outlined in ASTM C547
 - 2. The insulative and durability properties shall equate to or exceed those of:
 - a. Rockwool ProRox PS 960 or;
- H. <u>The Sch.40 steel blower discharge piping shall be insulated with either mandrel-wound</u> <u>as outlined in 2.02.G or Fiberglass as outlined in 2.02.D above</u>.
- 2.03 INSULATION JACKETS
 - A. Laminated Jackets: Laminated jackets shall consist of aluminum and white kraft paper. Jackets shall have a perm rating for water vapor transmission of not more than 0.02 in accordance with procedure A of ASTM E96.
 - B. Aluminum Jackets:
 - 1. Aluminum jackets shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Jackets shall be 0.016 inch thick.
 - 2. Sheet metal screws shall be aluminum or stainless steel.
 - 3. Jackets shall be secured with 0.020 by 3/4-inch Type 304 stainless steel expansion

bands.

2.04 INSULATION COVERS

- A. Polyvinyl Chloride (PVC) Covers: Polyvinyl chloride covers shall be one piece, premolded polyvinyl chloride conforming to FEDSPEC L-P-535E, Composition A, Type II, Grade E4.
- B. Aluminum Covers: Aluminum covers shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Covers shall be 0.016 inch thick. <u>All insulated aeration blower</u> <u>discharge piping in the Blower Building shall be provided with aluminum covers.</u>
- C. Soft Covers: Soft covers shall be of the reusable type with TFE-coated fiberglass covers and liner.
- 2.05 SHIELDS
 - A. Unless otherwise indicated, thermal pipe hanger shields shall be provided at pipe supports. Thermal hanger shields shall be as specified in Section 40 27 05.
- 2.06 FLASHING
 - A. Flashing shall include aluminum caps, sealant and reinforcing. Aluminum caps shall be 20 gage thick and shall be cut to completely cover the insulation. Sealants shall be as recommended by the insulation manufacturer.
 - B. Reinforcement in flashing heated up to 370 degrees F shall be nylon fabric. Reinforcement in flashing for hotter surfaces shall be wire mesh or as recommended by the insulation manufacturer.
- 2.07 ADHESIVES
 - A. Adhesive products used for the work of this Section shall conform to the manufacturer's specifications for each particular pipe insulation system.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Apply insulation over clean, dry surfaces. Double layer ·insulation, where specified or required to achieve the specified surface temperature, shall be provided with staggered section joints.
- B. Pipe Supports and Shields: Unless otherwise indicated, the Contractor shall supply thermal pipe hanger shields and install them during pipe support installation. Where thermal pipe hanger shields are used, apply the following to all butt joints:
 - 1. On hot pipe systems, apply 3-inch-wide vapor barrier tape or band over the butt joints.
 - 2. On cold water, chilled water, or refrigerant piping, apply a wet coat of vapor barrier lap cement on all butt joints and seal the joints with a minimum 3-inch-Wide vapor barrier tape or band.

- C. Protection: Protect insulation and jackets from crushing, denting, and similar damage during construction. Vapor barriers shall not be penetrated or otherwise damaged. Remove any insulation, jacket, and vapor barriers damaged during construction and install new material.
- D. Piping Insulation:
 - 1. General
 - a. Pipe:
 - Insulate piping continuously along its entire length including all in-line devices such as valves, fittings, flanges, couplings, strainers and other piping appurtenances. Unless otherwise indicated, provide piping insulation with laminated jackets as specified within this Section. Insulation shall be butted firmly together and jacket laps and joint strips provided with lap adhesive. Install jackets with their seams located on the underside of pipe.
 - ii. Do not use PVC covers specified in this Section with medium-, high-, or very high- temperature class insulation. Removable flexible blanket-type insulation need not be jacketed.
 - b. Fittings, Connections, Flanges and Valves: Provide fitting, connection, flange and valve insulation with covers as specified within this Section. Secure insulation in place with 20-gage wire and a coat of insulating cement'. Covers shall overlap the adjoining pipe insulation and jackets. Install covers with their seams located on the underside of fittings and valves.
 - 2. Low Temperature Class:
 - a. Pipe: Seal off ends of insulation with a vapor barrier coating.
 - b. Fittings, Connections, Flanges and Valves:
 - i. Except where soft covers are specified, provide insulation for pipe sizes 2 inches and less with rigid PVC covers as specified within this Section. Seal covers at edges with vapor barrier adhesive. Secure the ends of covers with vinyl tape. The tape shall overlap the jacket and the cover at least 1 inch. Do not penetrate vapor barrier.
 - ii. Except where soft covers are specified, provide insulation for pipes 2-1/2 inches and larger with rigid aluminum covers as specified within this Section. Mechanically secure covers using corrosion-resistant tacks pushed into the overlapping throat joint.
 - 3. Medium, High, and Very High Temperature Class:
 - a. Pipe: Except for flexible blanket type insulation, seal ends of insulation with end joint strips and use waterproof adhesive to hold them in place.
 - b. Fittings, Connections, Flanges and Valves: Except where soft covers are

specified, provide rigid insulation with rigid aluminum covers as specified within this Section. Mechanically secure covers using corrosion-resistant tacks pushed into the overlapping throat joint.

- 4. Outdoor Piping:
 - a. Pipe: Provide rigid insulation with aluminum jackets as specified within this Section. Design flexible blanket-type insulation for outdoor, weatherexposed service. Where piping emerges from soil without concrete or asphalt overtop, extend the insulation a minimum of 12 inches below the finished ground level. Where piping emerges from concrete or asphalt, extend the insulation to within 1 inch of the finished surface. Do not push insulation into contact with the finished concrete or asphalt surface.
 - b. Insulation Over Heat Tracing: Provide heat tracing in specified locations where indicated on the drawings (if applicable), in particular on back flow preventer valves for potable and fire water services that are located in insulated fiberglass vaults. Do not install insulation over the top of any piping that is heat traced inside these vaults. For all other piping, install insulation over the top of heat tracing according to the specifications of the heat trace tape and insulation manufacturers.
 - c. Fittings, Connections, Flanges and Valves: Provide rigid insulation with rigid aluminum covers as specified within this Section. Design flexible blanket type insulation for outdoor, weather- exposed service.
- E. Mechanical Equipment Insulation:
 - 1. General:
 - a. Unless otherwise specified, fit insulation to the contours of equipment and secure it with 1/2-inch by 0.015-inch galvanized steel bands. Weld pins or stick clips with washers may be used for flat surfaces and spaced a maximum 18 inches apart. Stagger joints and fill voids with insulating cement. Unless otherwise specified, provide insulation with laminated jackets as specified within this Section.
 - b. Unless specifically specified to be uninsulated, insulate all equipment connected to insulated piping.
 - 2. Outdoor Equipment: Provided insulation with a coat of weatherproof mastic and a layer of open- weave glass cloth embedded into a wet tack coat. Overlap seams at least 2 inches. Provide a finish coat of weatherproof mastic. The total coating thickness shall be a minimum of 1/8 inch.
 - 3. Low Temperature Class:
 - a. Where joints, breaks, and punctures occur in the insulation, seal them in facing with fire- retardant vapor barrier adhesive reinforced with 4-inch tape.

- b. Provide insulation with a layer of open-weave glass cloth embedded into a wet coat of fire- retardant adhesive. Overlap seams at least 2 inches. Provide a finish coat of fire-retardant adhesive.
- 4. Medium Temperature Class: Cover joints and cement them in place with 4inch-wide strips of the same material as the laminated jackets as specified within this Section.
- 5. High and Very High Temperature Class: Cover high and very high temperature equipment with custom-fitted removable blanket-type insulation or hinged sleeve insulation with protective jacketing. Secure blanket-type insulation with stainless steel wire lacing and hooks. Overlap ends of blanket segments to prevent gaps and voids when the piping and equipment are heated. Secure blankets snugly under nuts and bolt heads to assure complete coverage during operation and to prevent vibration-induced gaps or voids. Secure blankets in strict accordance with the manufacturer's instructions.
- F. Flashing:
 - 1. Provide flashing at jacket penetrations and terminations. Provide clearance for flashing between insulation system and piping supports.
 - 2. Trowel a heavy tack coat of sealant over the insulation, extending it over the jacket edge 1 inch and over the pipe or protrusion 2 inches. Stretch reinforcement over the tack coat after clipping to fit over pipe and jacket. Strap clipped reinforcing with a continuous band of reinforcing to prevent curling. Then trowel sealant over the reinforcement to a minimum thickness of 1/8 inch.
 - 3. Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation. Hold cap in place with a jacket strap.

3.02 INSULATION THICKNESS SCHEDULE

- A. The insulation dimensional tolerances shall comply with the specified standards. Equipment insulation shall match thickness of attached piping. The minimum insulation thicknesses, exclusive of jacket, shall be as shown in the schedule at the end of this section.
- 3.03 TESTING
 - A. In addition to any testing herein, perform all testing for this product or system consistent with the requirements of Section 01660, the applicable codes, and the manufacturers' current quality assurance program.

Insulation Thickness Schedule

Piping Service	Service Type	Temperature Class	8" Pipe
Blower Discharge Piping	PP	High	1" thick insulation

END OF SECTION 40 42 13

SECTION 40 42 80 PROCESS PIPING LEAKAGE TESTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Performing of the following, as indicated, in accordance with the provision of the Contract Documents:
 - a. Leakage testing of process piping.
- B. Related Sections include:
 - 1. Section 01 33 00 Submittals.
 - 2. Section 01 40 00 Quality Control.
 - 3. Section 01 60 00 Product Requirements.
 - 4. Section 01 75 00 Starting and Adjusting.
 - 5. Section 01 77 00 Closeout Procedures.
 - 6. Section 01 78 23 Operations and Maintenance Data.
 - 7. Section 40 27 00 Process Piping General.
 - 8. Section 40 27 05 Process Piping Support Systems.
 - 9. Section 40 27 20 Process Valves.
- 1.02 SUBMITTALS
 - A. Informational Submittals:
 - 1. Testing Plan: Submit prior to testing and include at least the information that follows.
 - a. Testing dates.
 - b. Piping systems and section(s) to be tested.
 - c. Test type.
 - d. Method of isolation.
 - e. Calculation of maximum allowable leakage for piping section(s) to be tested.
 - 2. Certifications of Calibration: Testing equipment.
 - 3. Certified test report.
- 1.03 REFERENCES
 - A. The following is a list of standards which may be referenced in this section:

PROCESS PIPING LEAKAGE TESTING

- 1. Chlorine Institute (2001 L Street N.W., Washington D.C. 28036): Pamphlet 6, Piping Systems for Dry Chlorine.
- 2. AWWA C600-99.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Notify Engineer in writing 5 days in advance of testing. Perform testing in presence of Engineer.
 - B. Hydrostatically test in accordance with AWWA C600-99.
 - C. Pressure Piping:
 - 1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
 - 2. Wait 5 days minimum after concrete thrust blocking is installed to perform pressure tests. If high-early strength cement is used for thrust blocking, wait may be reduced to 2 days.
 - 3. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
 - 4. Chemical Piping: Test, dry, and clean in accordance with requirements of Chlorine Institute Pamphlet 6.
 - 5. New Piping Connected to Existing Piping:
 - a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Engineer.
 - b. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Engineer.
 - 6. Items that do not require testing include: Piping between wetwells and wet well isolation valves, Equipment seal drains, tank overflows to atmospheric vented drains and tank atmospheric vents.
 - 7. Test Pressure: As specified in specifications or as specified by equipment manufacturer.
 - D. Test section may be filled with water and allowed to stand under low pressure prior to testing.
 - E. Gravity Piping:
 - 1. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
 - 2. Determine groundwater level at time of testing by exploratory holes or other method

PROCESS PIPING LEAKAGE TESTING

acceptable to Engineer.

- 3. Pipe 42 Inches Diameter and Larger: Joint testing device may be used to isolate and test individual joints.
- 3.02 HYDROSTATIC TEST FOR PRESSURE PIPING
 - A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.
 - B. Exposed Piping:
 - 1. Perform testing on installed piping prior to application of insulation.
 - 2. Maximum Filling Velocity: 0.25 foot per second, applied over full area of pipe.
 - 3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
 - 4. Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
 - 5. Examine joints and connections for leakage.
 - 6. Correct visible leakage and retest as specified.
 - 7. Empty pipe of water prior to final cleaning or disinfection.
- 3.03 HYDROSTATIC TEST FOR GRAVITY PIPING
 - A. Testing Equipment Accuracy: Plus or minus 1/2 -gallon water leakage under specified conditions.
 - B. Maximum Allowable Leakage: 0.16 gallons per hour per inch diameter per 100 feet. Include service connection footage in test section, subjected to minimum head specified.
 - C. Gravity Sanitary and Roof Drain Piping: Test with 15 feet of water to include highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 15 feet in height, test systems in 15-foot vertical sections as piping is installed.
 - D. Exfiltration Test:
 - 1. Hydrostatic Head:
 - a. At least 6 feet above maximum estimated groundwater level in section being tested.
 - b. No less than 6 feet above inside top of highest section of pipe in test section, including service connections.
 - 2. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 30 feet of water column.
 - E. Infiltration Test:
 - 1. Groundwater Level: At least 6 feet above inside top of highest section of pipe in test section, including service connections.

- F. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.
- G. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.
- 3.04 PNEUMATIC TEST FOR PRESSURE PIPING
 - A. Do not perform on:
 - 1. PVC or CPVC pipe.
 - 2. Piping larger than 18 inches.
 - 3. Buried and other non-exposed piping.
 - B. Fluid: Oil-free, dry air.
 - C. Procedure:
 - 1. Apply preliminary pneumatic test pressure of 25 psig maximum to piping system prior to final leak testing, to locate visible leaks. Apply soap bubble mixture to joints and connections; examine for leakage.
 - 2. Correct visible leaks and repeat preliminary test until visible leaks are corrected.
 - 3. Gradually increase pressure in system to half of specified test pressure. Thereafter, increase pressure in steps of approximately one-tenth of specified test pressure until required test pressure is reached.
 - 4. Maintain pneumatic test pressure continuously for minimum of
 - 5. 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
 - 6. Correct visible leakage and retest as specified.
 - D. Allowable Leakage: Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.
 - E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to assure no explosive mixtures will be present in system during filling process.

3.05 PNEUMATIC TEST FOR GRAVITY PIPING

- A. Equipment:
 - 1. Calibrate gauges with standardized test gauge provided by Contractor at start of each testing day. Engineer will witness calibration.
 - 2. Install gauges, air piping manifolds, and valves at ground surface.
 - 3. Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 6 psi or less.
 - 4. Restrain plugs used to close sewer lines to prevent blowoff.
- B. Procedure:

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- 1. Require that no person enter manhole where pipe is under pressure.
- 2. Slowly introduce air into pipe section until internal air pressure reaches 4 psi greater than average back pressure of groundwater submerging pipe.
- 3. Allow 2 minutes minimum for air temperature to stabilize.
- C. Allowable Leakage: Test section will be considered defective when time required for pressure to decrease from 3.5 to 2.5 psi greater than average back pressure of groundwater submerging pipe is less than that computed utilizing values from following table:

А	В	С	D	E	F
Pipe Diameter (Inches)	Time per Foot up to Length in Col C (Seconds)	Test Length (Feet)	any Length Between Col C	Length at Which Time in Col F Applies (Feet)	Time per Foot for Total Length (Seconds)
4	0.18	636	1:54	1,114	0.10
6	0.40	424	2:50	743	0.23
8	0.71	318	3:47	557	0.41
10	1.11	255	4:43	446	0.63
12	1.60	212	5:40	371	0.91
15	2.50	170	7:05	297	1.42
18	3.62	141	8:30	248	2.06
21	4.92	121	9:55	212	2.81
24	6.42	106	11:20	187	3.67
EXAMPLE: 15-inch diameter pipe: For 150 feet, $T = 2.50 \text{ sec}$ (Col B) x 150 ft = 375 sec = 6:15 For 250 feet, $T = 7:05$ (Col D) For 500 feet, $T = 1.42 \text{ sec}$ (Col F) x 500 ft = 710 sec = 11:50 *Based on 0.003 cfm per square foot with a minimum significant loss of 2 cfm and a maximum					

*Based on 0.003 cfm per square foot with a minimum significant loss of 2 cfm and a maxiloss of 3.5 cfm.

- D. Piping with groundwater infiltration rate greater than allowable leakage rate for exfiltration will be considered defective even if pipe previously passed a pressure test.
- E. Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.
- 3.06 FIELD QUALITY CONTROL
 - A. Test Report Documentation:
 - 1. Test date.
 - 2. Description and identification of piping tested.
 - 3. Test fluid.

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- 4. Test pressure.
- 5. Remarks, including:
 - a. Leaks (type, location).
 - b. Repair/replacement performed to remedy excessive leakage.
- 6. Signed by Contractor and Owner's Representative to represent that test has been satisfactorily completed.

END OF SECTION 40 42 80

SECTION 40 63 00 PROCESS CONTROL SYSTEM EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section covers process instruments and transmitters to be installed for system monitoring, including but not limited to: float switches; pressure gauges, pressure transmitters and related enclosures.
- B. Items specified in this section shall include all materials, equipment, and work required for implementation of completely operable instruments. Instruments shall include primary elements for process variable measurements, analog and discrete outputs, and display and control elements (where specified).
- C. The Contractor shall conduct all calibration adjustments, troubleshooting, and startup to assure instruments are properly operating and interfaced with other equipment. (See Special Provisions for system testing and startup requirements.)
- D. Instruments specified in this section are subject to the requirements of Section 01 60 00 Product Requirements.

1.02 SUBMITTALS

- A. In addition to the requirements of Section 01 60 00, the following documentation shall also be provided for this equipment and accompany other required submittals:
 - 1. Electrical drawings including circuit schematics, interconnection diagrams, and all information necessary for connection of electrical power and input/output circuits.
 - 2. Panel elementary diagrams of pre-wired panels, including identification of all switched analog signals and all auxiliary devices such as relays, alarms, fuses, and lights.
 - 3. Interconnecting wiring diagrams to tie instruments to Owner's telemetry system where shown on the Drawings, including all component and panel terminal board identification numbers and external wire numbers. This diagram shall include all intermediate terminations between field elements and panels (e.g., terminal junction boxes, motor control centers, etc.).
 - 4. Hydraulic characteristics and requirements for all flow-, pressure-, or level-related devices.
 - 5. Any special options included for each instrument.
 - 6. Submittal information for each instrument shall bear the component name and instrument tag number designation shown in the P&ID Drawings, where applicable.
 - 7. Manufacturer's ratings for each instrument, including:
 - a. Certified accuracy and precision (including repeatability).

- b. Scale range.
- c. Environmental tolerance (temperature, humidity, electrical induction isolation, and chemical resistance).
- d. UL, ANSI, or other ratings.
- 8. Dimensional drawings and ratings for all instrument panels and enclosures.
- 9. Specifications, ratings, and power requirements for any heating or ventilating devices installed in instrument enclosures.
- B. Spare Parts:
 - 1. The Contractor shall provide a list of the manufacturer's recommended spare parts and quantities to sustain equipment provided under this section. Unit and total costs for the recommended parts inventory shall be included.
- C. Operating and Maintenance Manuals: Manufacturer's O & M manuals shall be provided for each electrified instrument per Section 01 60 00 Product Requirements.
- D. Record Drawings: The Contractor shall provide one set of record drawings in both hard copy and electronic format for any field-wired interconnects between instruments or controllers.

1.03 RESPONSIBILITY FOR COMPLETE SYSTEM

- A. Unit Responsibility for Process Instruments:
 - 1. Unit responsibility for the Process Instruments shall be provided by the Contractor.
 - 2. See Filter Specifications for specific requirements for non-potable water control and pump manufacturer's control panel.
- B. The Contractor shall be responsible for coordination of the work to ensure that:
 - 1. All components provided under this section are properly installed.
 - 2. The proper type, size, and number of control wires with their conduits are provided and installed.
 - 3. Proper electric power and control circuits are provided for all components and systems.
 - 4. Instrumentation cable, power conductors, and conduits, and the installation thereof shall be provided and installed to meet the requirements of Division 26 Electrical.

PART 2 - MATERIALS

- 2.01 GENERAL
 - A. Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
- 2.02 EQUIPMENT SPECIFICATIONS

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- A. Unless superseded by other specifications herein or the manufacturer's standard ratings for a referenced instrument brand and model, all instruments shall be capable of the following minimum accuracy and precision:
 - 1. Accuracy: plus-or-minus 1.0% of full scale
 - 2. Precision: plus-or-minus 0.5% of full scale
- B. Environmental Conditions: Unless otherwise noted, equipment shall be suitable for the following environmental conditions:
 - 1. Temperature 32 °to 120° F
 - 2. Relative Humidity 10 to 90 percent
 - 3. Enclosure RatingNEMA Type 1/2 (panel-mounted instruments);
NEMA 4X (outdoor electrical panels)
NEMA 7 (Class I, Div. 1 *in* Lift Station & Screen Room)
 - 4. Classification Non-Hazardous (except for <u>in</u> Lift Station & Screen Room)
 - 5. Process Water Temperature 32° to 100° F
- C. Wiring:
 - 1. All electrical wiring shall be in accordance with the applicable requirements of Section 16 Electrical. Instrumentation cable and power conductors shall meet the requirements stated therein.
 - 2. Wiring for signal circuits and 24VDC shall not be smaller than No. 18 AWG, and be separated at least 18 inches from any 120 VAC power wiring.
 - 3. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks. All wires shall be color coded, and be identified by permanent plastic number tags placed within 2 inches of each termination.
 - 4. Wiring run in panels shall be run in covered wiring duct identified by permanent plastic number tags within two inches of entering and leaving the duct. Wiring duct shall be covered, constructed of plastic and be of a snap-in slot type design.
- D. Terminal Blocks:
 - 1. Terminal blocks shall be one-piece molded plastic blocks with screw type terminals and barriers rated for 300 volts. Terminals shall be double sided and supplied with removable covers to prevent accidental contact with live circuits. Terminals shall be numbered and have permanent, legible identification, clearly visible with the protective cover removed.
 - 2. Wires shall be terminated at the terminal blocks of one of the following ways:
 - a. Crimp type, pre-insulated, forked-tongue lugs for screw post terminals.
 - b. Bared wire ends for clamp-type terminals.

3. Lugs shall be of the appropriate size for the terminal block screws and for the number and size of the wires terminated.

2.03 INSTRUMENT SPECIFICATIONS

- A. Float Switches and Level Alarm Panels
 - 1. Where shown on the Drawings, high and/or low level alarm panels with float switches and accessories shall be installed in the screen channel and lift station wetwell. Level alarm panels shall be self-contained units, including float switches by the panel manufacturer.
 - Level alarm panels shall be NEMA 4X non-metallic enclosures with 85 db alarm buzzer and red alarm beacon. Units shall be UL listed. Separate test and silence buttons shall be provided, and alarms shall reset automatically. Panels shall have a 5A, 120V auxiliary alarm contact. Units shall operate on 120 VAC, and shall have a two-year limited warranty.
 - 3. Float switches for alarm panels shall be hermetically sealed, stainless steel mercury switch floats with 16' *(for lift station)* water and oil resistant cables and narrow angle NO or NC contacts, as required for the application.
 - 4. Floats shall be furnished with zinc-plated cast iron cord weights by the float manufacturer.
 - 5. Low Level alarm panels shall include (6) auxiliary contacts to be wired through 24VDC "pump enable" circuits from/to pump VFDs to prevent pumping if a low level condition exists (raw influent pumps).
 - 6. High Level alarm panels shall include a single pair of auxiliary contacts to be wired to the building alarm dialer.
 - 7. Both high and low level alarm panels shall include a red beacon mounted atop the panels and an alarm horn with "silencing" feature.
 - 8. Level alarm and float switch systems shall be Conery Manufacturing model 10A500-(6)C3 for low level alarm/pump enable panels and model Observer 400 for high level alarm panels, all with 'C10' cord weights, '1FB' float brackets, and 'G1' cord grips, or equal.
- B. Pressure Gauges
 - 1. Pressure Gages:
 - a. Shall be Bourdon tube actuated pressure gauges. Gauges shall be metal cased and silicone (DC200) liquid filled. Gauges shall be stem mounted with minimum 2 1/2-inch dial size, unless otherwise noted. Gauge shall be ANSI Grade 2A: accuracy of plus or minus 1/2 percent of span.
 - b. The sensing element shall be phosphor-bronze, unless otherwise noted.
 - c. Pressure gauges for all but clean water or NPW applications shall be furnished with diaphragm seals, and pressure gauges with integral diaphragm seals are

acceptable. Diaphragm seals are to be compatible with municipal wastewater or specific chemicals according to their installed location. Diaphragm seals shall be Ashcroft capsule type, or approved equal.

- d. All pressure gauge assemblies shall include an isolation valve between the pressure gauge (or diaphragm seal) and the carrier pipe. Isolation valves for wastewater shall be bronze body ball valves with standard or full port Teflon seats, and shall be rated for min. 600 psi water pressure. Isolation valves for chemical service shall be PVDF body ball valves rated for 230 psi pressure.
- e. Units shall be Ashcroft 'Duragauge', Robert Shaw 'Acragauge', Marshall, or equal.
- C. NPW Pump Pressure Controller:
 - 1. The control system for the NPW pumps shall be as described in Section 43 23 31 VERTICAL CENTRIFUGAL PUMP
- D. Lift Station Level Sensing Transducer:
 - 1. The level sensing transducer for the lift station pumps shall be as described in Section 43 25 00 SUBMERSIBLE LIFT STATION

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. Coordinate process instrument electrical interface, installation and startup of all process instruments.
 - B. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instructions, and these Contract Documents, follow Engineer's decision, at no additional cost to Owner. Keep copy of manufacturers' instructions on the jobsite available for review at all times.
- 3.02 ELECTRICAL POWER AND SIGNAL WIRING
 - A. Control and signal wiring external to the control panels and all power wiring shall conform to the requirements of Division 26 Electrical.
 - B. B. Control and signal wiring in control panels shall be restrained by plastic ties or ducts. Hinge wiring shall be secured at each end so that any bending or twisting will be around the axis of the wire, and the bend area shall be protected with a sleeve.
 - C. Arrange wiring neatly, cut to proper length, and remove surplus wire. Provide abrasion protection for wire bundles passing through holes or across metal edges.
 - D. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.
- 3.03 SPECIAL REQUIREMENTS FOR FLOAT SWITCHES
 - A. Manufacturer's cables for float switches shall be supported and routed as shown on the Drawings, with slack cable provided in handholes or hatchways to facilitate float switch removal and replacement.

- B. Cables shall be completely stress relieved. Support points and tie-off's shall be fully cushioned to prevent cable damage, and in full accordance with manufacturer's installation recommendations.
- C. Cabling from probes shall be protected with neoprene grommets where entering conduit ends, sleeves, panels, or any sharp-edged openings in order to protect the cable.

3.04 CONTRACTOR TESTING

- A. Calibrate, condition, and test all instruments in accordance with manufacturers' recommendations prior to demonstrating instruments and placing in service.
- B. Provide testing and functional demonstration of all monitoring and control functions as described in manufacturers' submittals and the construction drawings.
- C. See Special Provisions for system demonstration and testing requirements.

END OF SECTION 40 63 00

SECTION 40 68 26 REMOTE MONITORING SYSTEM

PART 1 - GENERAL

1.01 INTENT OF SPECIFICATION

- A. The contractor shall furnish; install and place into operation an integrated cellular remote dialer monitoring system for the monitoring and control of the Owner's wastewater supply facilities as described herein. All individual equipment elements are to be assembled, wired and tested prior to installation.
- B. The wastewater supply facilities control and monitoring system is described hereafter as the "Remote Dialer", "Monitoring System", "Remote Monitoring System", or "Alarm Dialer" is made up of components, some of which are described by specific manufacturers. The naming of a manufacturer in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment of equal quality. Rather, the intent is to establish a standard of performance and quality for the material used, and to indicate a principle of operation desired. The contractors bid shall be based on the use of equipment that satisfies the quality standards of those manufacturers noted herein.
- C. Contractors are cautioned to pre-qualify the Monitoring System in order to verify it meets the specified intent of this specification with regard to reliability, efficiency, ease of operation and functional capability.

1.02 SUMMARY

- A. It is the intention that this specification shall cover supplying, installing and integrating a monitoring system that will enable the Owner to monitor or be notified from a web-based application *and* provide local alarms for the following wastewater treatment system conditions:
 - 1. Monitoring:
 - a. Rotary screen run status;
 - b. Lift station pump(s) run status;
 - c. Lift station level;
 - d. UV disinfection system run status;
 - e. UV dosing level;
 - f. Blower(s) run status;
 - g. Non-potable pump(s) run status;
 - h. Cellular signal strength for remote dialer notification system
 - 2. Alarm Notifications (web-based):
 - a. Rotary screen fault;
 - b. Rotary screen high level;

- c. Lift station pump(s) fault;
- d. Lift station high level;
- e. Line power failure;
- f. Generator start failure;
- g. UV disinfection system priority fault;
- h. Blower(s) fault;
- i. NPW pump(s) fault;
- j. Monitoring system primary power fail;
- k. Monitoring system backup battery low power;
- 1. Notifications shall be configured to automatically deliver a voice message, email and/or text message to a list of individuals specified by the Owner.
- 3. Local Alarms:
 - a. Single visual red strobe light on exterior of: Screen/Lift Station Building; Blower Building;
 - b. Single audio horn on exterior of: Screen/Lift Station Building; Blower Building
- B. It is the intention of this specification to disallow non-standard, "one of a kind", experimental, unproven or unique combinations of equipment.

1.03 RESPONSIBILITY FOR COMPLETE SYSTEM

- A. The Contractor shall be responsible for and shall provide for the design, supply, delivery, installation, calibration and adjustment, software configuration, testing and startup, owner training, warranty and routine future field services support, of a complete coordinated Monitoring System, which shall perform the specified functions outlined in 1.02.A above.
- B. The Owner and the Engineer will review Monitoring System technical information as submitted by the Contractor for software; operating system, database, control strategies and the user interface, i.e. report and log formats, graphics, trends, alarming, etc. for complete compliance with these specifications.
- C. The Contractor shall provide the Owner with all services and hardware to ensure that proper communications are established, which are to be monitored, provide notifications and local alarms.

1.04 DRAWINGS

- A. Shop Drawing Submittal: Shop Drawings shall be submitted for approval for all equipment herein specified. A Description of Operation shall be provided detailing the operation of the complete system, including the various control loops, systems power equipment and alarm handling.
- B. Operation And Maintenance (O&M) Manuals shall be provided in accordance with "Final Documentation" requirements outlined in Part 3 of these contract documents.
- 1.05 PRE-SUBMITTAL PROPOSAL

REMOTE MONITORING SYSTEM

A. The right is reserved to reject any and all pre-submittal proposals, to waive any informality, irregularity, mistake, error or omission in any pre-submittal proposals received and to accept the pre-submittal proposal, as determined by the Engineer or Owner, deemed most favorable to the Owner.

PART 2 - PRODUCTS

2.01 SCOPE OVERVIEW

- A. The Monitoring System shall consist of the required components and equipment in accordance with the following:
 - 1. Wireless industrial alarm notification and remote monitoring system. Each unit has an activated 4G cellular modem, backup battery, antenna, and mounting hardware which allows the system to communicate data to the remote Cattron (previously known as Antx) Remote IQ website. All monitoring systems shall be manufactured in the United States by Cattron or Engineer-approved equal. Commissioning and Training to be provided by Cattron or authorized representative.
 - 2. Number of units required:
 - a. Building #1: Screening Building
 - b. Building #2: Blower/UV Building
 - 3. Plan Cost for plan shall be locked in at the time of startup for 3 years and billed annually (costs shall be equal year to year with no increases) with the option to opt out at any time with no additional penalty costs to the Owner. The Owner shall have the right to upgrade/downgrade the plan at anytime during the 3 year period to a price point provided to the Owner at the time of startup for the remaining portion of the 3 years. The upgrade/downgrade costs shall be prorated for the remaining portion of the annual billing cycle.
 - a. Building #1: Standard Yearly Cell Plan
 - b. Building #2: Standard Yearly Cell Plan

2.02 FUNCTIONALITY

- A. The wastewater facilities remote monitoring, reporting and alarm notification system shall be comprised of a hosted, Web-based user-interface which communicates to remotely monitored stations via a readily available commercial cellular network. The system shall contain:
 - 1. Hardware located at each remote station that continually monitors equipment activity, fault conditions, liquid levels and computed volumetric inflow and outflow and reports this information on a periodic and exception basis to a Web-based user-interface using a secure protocol over the cellular network.
 - 2. A Web-based application that is configured to present all fault conditions, operating conditions, computed values in tabular, graphical, map and report formats. The application will provide alarm notification to designated personnel based on alarms

detected by the remote hardware and by computations performed by the Web-based system.

B. The system shall be fully integrated between the hardware and Web application providing complete programming capability of the hardware from the hardware installed at each station and from the Web application. The Web application shall be automatically updated whenever any configuration changes are made to the hardware.

2.03 SYSTEM TECHNICAL DESCRIPTION

A. Station Hardware:

User Interface

The station hardware shall include a user interface for operations viewing and configuration. The keypad/display shall allow the user to view the status of any/all pumps being monitored, computed or historic conditions, current and historic faults and configuration of operational parameters.

a. Status – The user shall be able to select any of the monitored conditions to be included in an automatic scrolling display that presents the current value and status of the condition on, to be provide by digital inputs.

SCREENING BUILDING			
Equipment	Input/Output	Alarm	
Rotary Screen	Input – Digital	Running/Off	
Rotary Screen	Input – Digital	Fault	
Rotary Screen	Input – Digital	High Level Alarm	
Lift Station Pump #1	Input – Digital	Running/Off	
Lift Station Pump #1	Input – Digital	Fault	
Lift Station Pump #2	Input – Digital	Running/Off	
Lift Station Pump #2	Input – Digital	Fault	
Lift Station	Input – Analog	Transducer Level Sensor	
Lift Station	Input – Digital	High Level Alarm (Floats)	
Generator	Input – Digital	Failure to Start	
Generator ATS	Input – Digital	Line Power Failure	
Cellular Remote Dialer	Local	Cellular Signal Strength	
Cellular Remote Dialer	Local	Primary Power to	
		Monitoring System	
Cellular Remote Dialer	Local	Low Backup Battery	
Remote Dialer	Output	Local Alarm – Visual	
Remote Dialer	Output	Local Alarm – Audio	

b. The following parameters shall be available for the user to select:

*Any Digital Channels being monitored

BLOWER/UV BUILDING			
Equipment	Input/Output	Alarm	
UV Disinfection	Input – Digital	Running/Off	
UV Disinfection	Input – Digital	UV High Priority Fault	
UV Disinfection	Input – Analog	UV Dose	
Blower #1	Input – Digital	Running/Off	
Blower #1	Input – Digital	Fault	
Blower #2	Input – Digital	Running/Off	
Blower #2	Input – Digital	Fault	
Non-Potable Pump #1	Input – Digital	Running/Off	
Non-Potable Pump #1	Input – Digital	Fault	
Non-Potable Pump #2	Input – Digital	Running/Off	
Non-Potable Pump #2	Input – Digital	Fault	
Cellular Remote Dialer	Local	Cellular Signal Strength	
Callular Parata Dialar	Local	Primary Power to	
Cellular Remote Dialer	Local	Monitoring System	
Cellular Remote Dialer	Local	Low Backup Battery	
Remote Dialer	Output	Local Alarm – Visual	
Remote Dialer	Output	Local Alarm – Audio	

*Any Digital Channels being monitored

- c. The user shall be able to stop the display on any parameter of interest and request additional information about that particular parameter. Information shall include:
 - i. For each digital input:
 - the number of cycles for the current day
 - the total run-time in the non-normal state for the current day
 - alarm limits for number of cycles in a day
 - alarm limits for the total run-time in a day
 - ii. For each analog input:
 - high alarm limit
 - low alarm limit
 - rate of change limits

iii. For computed inflow/outflow channels:

- total inflow and outflow for the day
- inflow rate
- outflow for last pump cycle

iv. For computed pump running channels:

- pump run times for individual and combined lift station pumps;
- pump run times for individual and combined NPW pumps
- v. For flow channels:
 - instantaneous flow;
 - total flow for the day or total accumulated flow;
 - user-specified preset to match installed flow meter
- d. The display shall automatically cycle through all of the parameters that the user has selected showing the current status and value of each. The status shall include:
 - i. Normal or in alarm
 - ii. Acknowledged or not
 - iii. Reason in alarm
 - Excessive number of cycles on any pump
 - Run-time too long on any pump
 - Level to high or low
 - Outflow volume too high
 - Input changed state
 - Analog value too low
 - Analog value too high
 - Inflow rate too high
 - Loss of analog signal
- 2. Alarms
 - a. Any monitored parameter that exceeds the normal operating conditions as defined by the user, shall enter into an alarm state.
 - b. The local display shall automatically display all parameters that are in the alarm state. When all alarm states have returned to normal, the display shall automatically revert to the user-configured scrolling display or to the main menu if no scrolling display has been configured.
 - c. A unique event shall be created for each alarm state. Each event shall be stored locally for viewing in a chronological order. Each event may also be automatically transmitted to the Aquavx web-service based on a user-specified configuration.
 - d. The system shall contain a store and forward buffer capable of saving hundreds of events for later transmission if immediate cellular transmission is not possible

due to cellular coverage issues. The system shall automatically try to reestablish cellular connection on a continuous basis.

- 3. Update Rate
 - a. Digital inputs/outputs are reported on any change of state, analog and pulsing inputs on a delta change. Any alarm exceptions shall be reported immediately. End of Day comprehensive summaries shall be reported at midnight. The user shall have the ability to request a status or End of Day report on demand from the keypad.
- 4. Local Programming
 - a. The user shall be able to program the entire system from the integral keypad and display.
 - b. Programming parameters for each monitored condition shall include:
 - c. Channel Name
 - d. Status only or report on alarms
 - e. Delay until considered in alarm
 - f. Report on return to normal state
 - g. Relay to control when in/out of alarm
 - i. For pump monitoring:
 - Daily run-time alarm limit;
 - Daily cycle alarm limit;
 - Time difference between lift station pumps or NPW pumps too long;
 - Cycle difference between lift station pumps or NPW pumps too many
 - ii. For inflow/outflow monitoring:
 - High outflow volume alarm limit
 - High inflow rate alarm limit

iii. For digital monitoring:

- Alarm on change from open/close
- Alarm on change from close/open

iv. For analog monitoring:

- High and low alarm limits
- Loss of signal alarm limits
- Total flow too much for a day
- v. For system monitoring:

- Loss of primary power
- Loss of Modbus communication
- Low backup battery power
- h. The user shall be able to specify parameters allowing the monitoring unit to compute volumetric outflow volume and inflow rate for a single, duplex or triplex pump station.
- 5. History
 - a. The monitoring system shall include a History screen allowing the user to review the following:
 - i. Date and time of alarms
 - Into alarm conditions
 - Out of alarm conditions
 - Acknowledgements
 - E-mail, text and voice callouts
 - ii. Date and time of system events
 - Relay controls
 - Parameter changes
 - Communication with the web-service
- 6. Control
 - a. The remote monitoring system shall include internal physical relay and Modbus relay control capability from the following:
 - i. Digital input exceeding a run-time or cycle limit
 - ii. Digital input changing state a pre-defined number of time
 - iii. Analog input exceeding a low or high limit
 - iv. Loss of analog input signal
 - v. Too high output volume
 - vi. Too high input flow rate
 - vii. Loss of power
 - viii. Loss of Modbus communication
 - ix. User request from the keypad
- 7. Operator On-site
 - a. The monitoring system shall include an operator on-site login/logout function.

- i. The login function shall allow an authorized person to acknowledge that they are on-site.
- ii. An automatic message shall be sent to the web-based service to record that the authorized person is on-site.
- iii. The logout function shall allow an authorized person to acknowledge that they have left the site.
- iv. An automatic message shall be sent to the web-based service to record that the authorized person has left the site.
- v. Man-Down detection an alarm message shall be able to activate a local alarm and send a message to the web-based service when a timer has expired after an operator has logged in but has not logged out.
- 8. Security
 - a. The monitoring system shall include a user-configurable access code that must be entered prior to any programming or control operations.

Physical

The monitoring system shall consist of the following:

- 1. Hardware shall be available in a NEMA 4X or Panel/Flush mount configuration:
 - a. NEMA 4X hinged enclosure: 10"W x 12"H x 6"D, weight 6.0 lbs.
 - b. Panel/Flush mount: 8.3"W x 6.3"H x 3.6"D, weight 2.0 lbs.
- 2. I/O:
 - a. 10 digital/pulse inputs, 0-5Hz, dry contact, open-collector or closure to ground.
 - b. 4 analog inputs, 0-20ma, 4-20ma or 0-5, 1-5VDC
 - c. 2 relays 0.5A@125VAC (Outputs for audio and visual alarm)
 - d. 20 Modbus RTU read coil/input status digital channels
 - e. 30 Modbus RTU read holding/register analog channels
 - f. 8 Modbus RTU write coil relay channels
 - g. Removable terminal blocks, #14-22 AWG
- 3. User Interface: 2x20 line LCD backlight display, 20 key keypad
- 4. Serial Port: Modbus RTU Slave/Master or Local Programming
- 5. Cellular: Quad-band LTE/4G Verizon. FCC, PTCRB, UL and ATT LTE/4G certified.
 - a. Dual-band LTE/4G Verizon certified. FCC, UL certified
 - b. Antenna: Attached, 3dBi. External OMNI available.
- 6. Operating Temperature: -20 F to 158 F.

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- 7. Operating Humidity: 0% to 90% @ 140 F.
- 8. Power: 115 VAC 10%, 60 Hz; 10 watts, UL rated power supply included.
- 9. 12-hour battery backup, included.
- 10. Surge protection on power and inputs

Warranty

Two year warranty shall be standard with the purchase of a new unit.

- B. Web-based system:
 - 1. User Interface
 - a. The web-based system user interface shall allow authorized personnel the ability to view current and historic conditions for any or all remote monitoring systems. The interface shall allow on-demand polling of information from a remote monitoring system as well as updating new configurations settings to a remote monitoring system.
 - 2. Security and Support
 - a. Any user of the web-based system shall have to provide a valid username and password to gain access to any current or historical information based on their user profile and security levels.
 - i. The system shall provide access to any and all functions based on the predefined settings for each individual user. User's access shall be able to be restricted to a single screen, any combination of screens, and any combination of remote monitoring systems.
 - ii. 128 bit encryption between the client and the web server shall be used
 - iii. An unlimited number of user access levels shall be supported
 - iv. The system shall be backed by a 99.5% uptime system level agreement
 - v. The system shall be hosted in a tier 4 data center
 - vi. The vendor shall provide 24 x 7 x 365 support options
 - vii. The system shall include four years of online data storage
 - viii. The system shall have acknowledgment of receipt of all incoming messages
 - ix. An unlimited number of users at no additional cost shall be provided
 - 3. Remote Monitor System and Computed Data
 - a. The system shall receive data from Remote Monitoring Systems, perform additional computations on the received field data and store both types of data in secure databases for later presentation and reporting.
 - b. Computations shall include summations, counts, pump run-time and cycle

comparisons, including:

- i. Pump run-time differentials between lift station pumps and between NPW pumps. If the run-times differential exceeds that limit, an alarm is created, and user-defined notifications are performed.
- ii. Pump cycle differentials between lift station pumps and between NPW pumps, allowing the user to specify a number of cycles that the pump cycle count must be within. If the cycle differential exceeds that limit, an alarm is created and user-defined notifications are performed.
- 4. Viewing
 - a. The system shall support viewing the most recent received field data from any remote monitoring system. Information viewed may be all data received or a portion of that data that is of particular interest. The web-site shall be viewable from at least Internet Explorer, Firefox, Chrome, Safari, Opera.
 - b. The system shall be viewable on smart mobile devices including iPhones, iPads, Tablets and Android-operating system phones.
 - i. The system shall allow users to poll a device to get current data for viewing
 - ii. The system shall allow users to determine their home page view
 - iii. The system shall be able to calculate differential run-times for stations with multiple pumps and shall be able to alert users when pumps run for disproportionate numbers of cycles or hours
 - c. Data shall be able to be viewed in tabular format, on a map or in graphical format.
 - i. Tabular viewing
 - The system shall provide and interactive method of selecting which available data is to be included in tabular formatted screens.
 - ii. Map viewing
 - The system shall support viewing any subset of the remote monitoring systems on an interactive map. Users shall be able to select a remote monitoring system and view additional information and data about that system.

iii. Graphical viewing

- The system shall support interactive graphical display allowing the user to select the specific data and time frame for that data to view on a chart. Chart formats shall include line, bars and points.
- 5. Mapping and Reporting
 - a. The system shall support ad hoc and scheduled reports.
 - i. Reports shall be delivered automatically at daily, weekly and monthly

intervals.

- ii. An alarm history report containing the date/time of alarm, date/time of alarm clearing and date/time of acknowledgement shall be available on demand or via schedule.
- iii. The system shall provide a report that shows daily inflow, outflow, run time, and number of cycles.
- iv. The system shall provide the ability to view the location of all monitored units on a map and access sub-menus specific to a site in order to view status of each and all inputs monitored at one or more sites.
- v. The values of all analog inputs are reported in engineering units.
- vi. Custom reports may be emailed or exported to an Excel file or PDF.
- vii. All events are time and date stamped and encrypted. Events and data are stored online for 4 years on the hosted server.
- viii. The system shall provide that status of all units on a map and allow users to drill down to each unit.
- ix. The system shall record all e-mails, text messages and voice notifications and responses for subsequent reporting.
- x. The system shall provide interactive mapping allowing zooming, panning, and display of road names.
- 6. Alarm Notification
 - a. The system shall issue alerts via email, text, and voice, configurable for each alarm to a user defined list of users. All alarm notifications, clearing of alarms and acknowledging of alarms shall be stored in the system and reported as needed by the user.
 - b. The following methods of generating alarms shall be provided:
 - i. Run time on a pump exceeds a user-specified time limit in a day
 - ii. Number of cycles on a pump exceeds a user-specified limit in a day
 - Difference between pump run-times at a station exceeds a user-specified percent in a day. System shall support differences between any 2 or any 3 pumps.
 - Difference between pump cycles at a station exceeds a user-specified amount in a day. System shall support differences between any 2 or any 3 pumps.
 - v. Inflow and/or outflow exceeds a user-specified limit
 - vi. Any analog monitored condition exceeds a low or high threshold limit
 - vii. Any digital monitored condition exceeds a run-time or cycle count limit in

a day

- viii. Any digital changing state
- ix. Loss of communication between the remote monitoring system and Modbus devices connected to the remote system
- x. Loss of primary power on the remote monitoring system
- xi. Loss of communication between the remote monitoring system and the web-system
- xii. Alarm notifications to be delivered via voice messaging (up to 8 call out numbers), text and or emails or a combination of the three. All notifications are delivered in a sequential order as specified by the user.
- xiii. Acknowledgement of alarms may be performed via voice, text or email.
- xiv. Ability to program a delay time for re-notification of alarms if one or more acknowledged alarms are still in an alarm state after a specified period of time.
- xv. For each site, the user may define whether they want to receive notifications on current alarms and/or cleared alarms
- 7. Graphing
 - a. User shall have the ability to generate graphs and charts that display historic data.
 - i. Charts shall display run-times and flow rates either separately on individual graphs or both incorporated into one graph.
 - ii. The user shall be able to select any monitored or calculated data to be graphed over any timeframe.
 - iii. Charts shall be able to be printed directly from viewing
 - iv. Data being displayed on the chart shall be able to be exported or emailed.
 - v. User shall be able to zoom and/or pan to any portion of the data.
- 8. Update Rates and On-Demand Requests
 - a. The system shall report all digital inputs and output changes as they occur. All analog changes will be reported when a delta value has been exceeded. All alarm exceptions shall be reporting immediately. The user shall have the ability to immediately request a status report or issue control commands to properly configure remote hardware.

PART 3 - EXECUTION

- 3.01 GENERAL
 - A. Coordinate all work with the Owner/Engineer to avoid conflicts, errors, delays and unnecessary interference with operation of the system during installation, testing, cutover

and startup.

3.02 EXAMINATION

- A. Prior to installation of the work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- B. Verify that work may be completed in strict accordance with the original design and with the manufacturer's recommendations as approved by the Owner/Engineer.
- C. Do not proceed until unsatisfactory conditions are corrected.
- 3.03 FIELD SERVICE, WARRANTIES AND GUARANTEE SUPPORT
 - A. On-Site Supervision: The System Manufacturing Supplier shall provide experienced personnel to supervise, perform, and coordinate the installation, adjustment, testing, and startup of the monitoring system. The personnel shall be present on-site as required to effect a complete and operating system.
 - B. Start-Up Services: The System Manufacturing Supplier shall provide the services of factory trained qualified representative, for one- (1) trip with a minimum of four- (4) working days, including travel and living expenses, for the purpose of inspecting the installation and providing monitoring system start up and commissioning services.
 - C. Field Test: All system components shall be checked to verify that they have been installed properly and that all terminations have been made correctly.
 - 1. Witnessed field tests shall be performed on the complete system during start-up.
 - 2. The Contractor shall notify the Owner at least one (1) week prior to the commencement date of the field tests.
 - 3. Field Test Acceptance: The field test described above shall be witnessed and signed off by the Owner upon satisfactory completion.
 - D. WARRANTIES AND GUARANTEE: The System Manufacturing Supplier of the equipment shall guarantee for 12 months from the date of final acceptance, not to exceed eighteen- (18) months from date of shipment, that all equipment will be free from defects in design and workmanship.
 - 1. Warranties and guarantees by the suppliers of various components in lieu of a single source responsibility by the System Manufacturing Supplier will not be accepted. The System Manufacturing Supplier shall be solely responsible for the guarantee of the complete Monitoring System and all its components.
 - 2. In the event components fail to perform as specified or is proved defective in service during the guarantee period, the System Manufacturing Supplier shall provide a replacement without cost or obligation to the owner.

3.04 INSTALLATION

A. The Contractor shall install the work of this section in strict accordance with the System Manufacturing Suppliers recommendations as approved by the Owner/Engineer.

REMOTE MONITORING SYSTEM

- B. Contractor shall provide experienced personnel to supervise, perform, and coordinate the installation, adjustment, testing, and startup of the Monitoring System. The personnel shall be present on-site as required to effect a complete and operating system.
- C. The contractor, in conjunction with the System Manufacturing Supplier shall provide a warranty for no less than 12 months after the date of Substantial Completion, that the Monitoring System shall be free from defects in system installation. All system deficiencies identified within that 12-month period that adversely affect system functionality in any manner shall be corrected by the Contractor at no extra cost to the Owner.
- 3.05 TRAINING
 - A. The System Manufacturing Supplier shall be capable of providing standard on-site training on all aspects of the Monitoring System.
 - B. The System Manufacturing Supplier representative shall instruct the OWNER'S operating personnel, at a time designated by the OWNER, as to the proper method of operation and recommended maintenance procedures.
 - C. The training program shall educate operators, maintenance, engineering, and management personnel with the required levels of system familiarity to provide a common working knowledge concerning all significant aspects of the system being supplied.
 - D. The on-site training program shall consist of one half day at a minimum.
 - E. At least two weeks prior to the requested start of the program, the proposed dates of training shall be submitted to the Owner and the Engineer for approval.
 - F. The System Manufacturing Supplier shall provide all instructional course material, equipment and manuals to conduct the training program. OWNER shall provide facilities for the training.
 - G. The scheduling of the instruction shall be at the convenience of the OWNER and may not coincide with the start-up inspection.

3.06 FINAL DOCUMENTATION

- A. Operation And Maintenance Manuals (O&M): The System Manufacturing Supplier shall provide two (2) complete sets of hard-covered ring bound loose-leaf O&M manuals and one electronic copy on flash drive. In addition to "as-built" system drawings as described in Part 1 of this specification, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section.
- B. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing and maintenance of each component and/or instrument.
- 3.07 DEFINITION OF ACCEPTANCE
 - A. System acceptance shall be defined as that point in time when the following requirements

have been fulfilled:

- 1. All O&M documentation has been submitted, reviewed and approved.
- 2. The complete Monitoring System and instrumentation have successfully completed all testing requirements specified herein and have successfully been started up.
- 3. All OWNER's staff personnel training programs have been completed.
- B. Owner/Engineer sign a document indicating the completed Monitoring System has formally been accepted

END OF SECTION 40 68 26

SECTION 40 71 13 MAGNETIC FLOW METER AND TRANSMITTER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This specification includes the installation of an electromagnetic flow meter and transmitter suitable for fixed-site measurement of bi-directional flow in a full pipe. The flow meter shall consist of a flow tube and a flow transmitter, which shall indicate, totalize and transmit flow. The flow tube shall use a spool piece configuration with field-interchangeable sensors containing coils and electrodes. The flow velocity measured in the flow meter is converted through a microprocessor into a flow measurement recorded in conventional English units. Both instantaneous and cumulative flow will be recorded. The system will not lose memory and recorded flows if the power is interrupted. The transmitters will send a 4 to 20 mA signal to the UV controller, composite sampler, and a digital signal to the non-potable water pumps (provided by others) located in the blower/UV building and will send a 4 to 20 mA signal to the composite sampler (provided by others) in the screening building. The following schedule shows the size of the meters, location and cable length.

Schedule for Plant Flow Meters

Location	<u>Size</u>	<u>Cable Length (ft)</u>
Forcemain	4"	25 ft
Effluent Line	10"	25 ft
NPW Pumps (x2)	2.0"	25 ft

1.03 SUBMITTALS

- A. Submit Product Materials lists of items proposed to be provided under this section.
- B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
- C. Shop drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this section with the work of adjacent trades.
- D. Manufacturer's recommended installation procedures which, when approved, will become the basis for accepting or rejecting actual installation procedures used on the work.
- E. Operations manuals for each part or piece of equipment, suitable to instruct the operator in the use, calibration and programming of the flow measuring equipment. Four hard copies and one electronic copy of the manual will be required.

PART 2 - PRODUCTS

2.01 METER

- A. Shall be a velocity sensing electromagnetic type flanged tube meter with sealed housing for 150 PSI working pressure (UM06). The meter sizes shall be as described in the schedule in the previous section 1.0 above, based on use of Ultra MagTM MODEL UM06. The meters shall be equipped with a 9 digit digital totalizer reading in units of gpm and shall be accurate within 0.5% of actual flow. The meter assembly shall operate within a range of 0.2 FPS to 32 FPS and be constructed as follows: Meter Tube (Sensor) shall be fabricated stainless steel pipe and use 150 lb. AWWA Class "D" flat face steel flanges (UM06). The internal and external of the meter tube shall be blasted and lined with a NSF approved fusion bonded epoxy UltraLinerTM, applied by the fluidized bed method. Meter tubes shall have a constant nominal inside diameter offering no obstruction to the flow. Electrodes shall be 316 stainless steel.
- B. Other meter manufacturers will be considered if general compliance with these specifications can be documented and no specific changes in plant piping are required to address a different type of meter or meter with different hydraulic installation requirements.
- C. Certifications
 - 1. CE Certified (Converter only)
 - 2. Listed by CSA to 61010-1: Certified by CSA to UL 61010-1 and CSA C22.2 No.61010-1-04
 - 3. ISO 9001:2015 certified quality management system
- 2.02 MAG SHIELD
 - A. Shall be welded to the tube providing a completely sealed environment for all coils, electrode connections and wiring harness capable of NEMA 6P/IP68 operation.

2.03 SIGNAL CONVERTER

A. Shall be pulsed DC coil excitation type with auto zeroing. The converter shall indicate direction of flow and provide a flow rate indication and a totalization of flow volume for both forward and reverse directions. Both forward and reverse totalizers shall be electronically resettable. The flow meter converter shall be microprocessor based with a keypad for instrument set up and LCD displays for totalized flow, flow rate engineering units and velocity. The converter shall power the flow sensing element and provide galvanically isolated dual 4-20mA outputs, and 2 digital volumetric pulse output. It shall be possible, in the test mode, to easily set the converter outputs to any desired value within the range. The 4-20mA scaling, time constants, pipe size, flow proportional output, engineering units and test mode values shall be easily set via the keypad and display. Four separate fully programmable alarm outputs shall be provided to indicate empty pipe, forward/reverse polarity (normally open/close), analog over-range, fault

conditions, high/low flow rates, percent of range and pulse cutoff. The converter shall periodically perform self-diagnostics and display and resulting error messages. All set up and data and totalizer values may be protected by a password. The flow transmitter shall operate on 120 VAC, 50/60 Hz line power. Typical power consumption shall be 10 W, including the sensors.

- B. The transmitter/converter shall utilize the digital signals to relay a signal to the nonpotable water pumps to shut down when a low flow setpoint is occurring and turn back on when the flow rates increase.
- C. The converter shall be integrally mounted or remotely mounted up to 500 feet from the sensor, and shall be supplied in a rugged, watertight, dust-tight, corrosion resistant (NEMA 4X and IP67) cast aluminum, epoxy painted enclosure suitable for conduit connections. The enclosure shall include a polycarbonate window for viewing the LCD without opening the enclosure. Calibration will be completed at the manufacturer's location in accordance with customer supplied application-based requirements.

2.04 GROUNDING RINGS

- A. Shall be 316 stainless steel and shall be supplied with the meter tube. For best performance grounding rings must be used.
- 2.05 POWER AND SIGNAL ISOLATION
 - A. The power supplied between the converter and the meter tube (sensor) and signal between the meter tube and the converter shall be isolated and placed in separate submersible cables.
- 2.06 SERVICE & SUPPORT
 - A. Supplier must have flow calibration laboratories and personnel to perform testing and certify calibration. Personnel must also provide instruction or training as required assuring meters are supported and maintained throughout the guarantee period. Classroom Training on the equipment shall follow the requirements in Division 1.

2.07 VOLUMETRIC TESTING

- A. Testing of all meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated. The test facility must be rigorously traceable to an accuracy of $\pm 0.15\%$ with the National Institute of Standards and Technology. If desired, the test shall be witnessed by the customer or their selected agent. A copy of the certified accuracy test record must be furnished at no charge to the customer.
- 2.08 ONE MANUFACTURER
 - A. Shall make all meter sizes and styles required for this contract. The meters shall be manufactured and tested in the United States.

PART 3 - EXECUTION

3.01 INSTALLATION/WORKMANSHIP

- A. The meter tube, sensor and transmitter will be installed in accordance with the manufacturer's specifications.
- B. Installation will be made similar to placing a short length of flanged end pipe in the line. The meter can be installed vertically, horizontally, or inclined on suction or discharge lines. The meter must have a full pipe of liquid for proper operation. Fluid must be grounded to the downstream flange of the sensor.
- C. Any 90 or 45 degree elbows, valves, partially opened valves, etc. should not be placed closer than one pipe diameters upstream and zero pipe diameters downstream. All blending and chemical injection should be done early enough so the flow media is thoroughly mixed prior to entering the measurement area.
- D. Meter shall be provided with a four written and one electronic copy of operating instructions.

3.02 PAINTING

- A. Provide manufacturer's standard coating.
- B. Finish coat under provisions of Section 09 90 02 High Performance Painting and Coating.

END OF SECTION 40 71 13

SECTION 40 71 76 THERMAL MASS FLOW METER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and Special Provisions of the Contract, including general and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.02 SUMMARY

A. This specification includes the installation of a thermal dispersion type, linearized mass flow meter suitable for fixed-site measurement of air, compressed air, or nitrogen. The flow meter shall be an insertion style flow meter with no moving parts. The method of operation shall utilize a varying differential temperature signal, generated by a constant power source, between two RTDs. The flow meter shall produce two output signals, one linearized to the mass flow rate of the process air or gas and one linearized to the temperature of the process air or gas. Standard flow calibration shall be based on measuring the maximum velocity associated with a fully developed flow profile. The electronics shall be housed in an IP67 rated enclosure (NEMA 4X) with dual conduit ports, and dual 4-20 mA outputs (flow rate and temperature). The sensing element shall be platinum RTD embedded in small diameter, all metal thermowells to provide superior accuracy and repeatability. Instantaneous flow and temperature will be recorded. The following schedule shows the size of the meter and location.

Schedule for Thermal Mass Flow Meters

Location

Pipe Diameter

Aeration Manhole

10"

1.03 SUBMITTALS

- A. Submit Product Materials lists of items proposed to be provided under this section.
- B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
- C. Shop drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this section with the work of adjacent trades.
- D. Manufacturer's recommended installation procedures which, when approved, will become the basis for accepting or rejecting actual installation procedures used on the work.
- E. Calibration shall be completed at the factory at a specified flow range under given conditions on NIST traceable flow stands. Calibration data sheet to be provided with each individual meter.
- F. Operations manuals for each part or piece of equipment, suitable to instruct the operator in the use, calibration and programming of the flow measuring equipment. Four hard

copies and one electronic copy of the manual will be required.

PART 2 - PRODUCTS

2.01 METER

- A. Shall be an insertion style thermal dispersion gas flow measuring meter with an IP67 rated housing. The meter size shall be as described in the schedule in the previous section 1.0 above, based on use of Fluid Components International (FCI) ST50 Mass Flow Meter or approved equal.
- B. Media Compatibility:
 - 1. Air
 - 2. Compressed Air
 - 3. Nitrogen
- C. Agency Approvals:
 - 1. FM/CSA: Class 1, Div. 2 Groups A, B, C, D: T4
- D. Output Signals:
 - 1. Dual 4-20 mA Analog
- E. Digital Display:
 - 1. LCD with ± 9999 count, 0.45" height characters scalable to flow rate engineering units or 0-100%
- F. Pipe Size Compatibility:
 - 1. 2" to 24"
- G. Flow Rate:
 - 1. 0.75 SFPS to 400 SFPS
- H. Accuracy:
 - 1. $\pm 2\%$ reading, $\pm 0.5\%$ full scale
- I. Repeatability:
 - 1. $\pm 0.5\%$ of reading
- J. Temperature Compensation:
 - 1. 0°F to 100°F
- K. Turndown Ration:
 - 1. Up to 100:1
- L. Flow Element: The flow element shall be an insertion style thermal dispersion flow meter. The sensor head shall have a greater diameter than probe shaft diameter as an added safety measure against accidental blowout past the compression fitting.
 - 1. Material of Construction: 316 stainless steel body with Hastelloy-C276 thermowell sensors, 316 stainless steel compression fitting with stainless steel ferrule and a 316 stainless steel packing gland. The thermowells shall be surrounded by a protective

shroud.

- 2. Pressure (Maximum Operating without Damage) shall be 500 psig
- 3. Operating Temperature shall be 0°F to 250°F
- 4. Process Connection shall be $\frac{3}{4}$ " MNPT with stainless steel ferrule.
- 5. The flow element shall be installed in a horizontal configuration to allow the flow transmitter to be readable from above.
- M. Flow Transmitter:
 - 1. Enclosure shall be IP67 (NEMA 4X) aluminum, epoxy coated, 4-1/2" diameter.
 - 2. Operating Temperature: 0°F to 140°F
 - 3. Input Power: AC 85 Vac to 265 Vac
 - 4. Communication Port: RS-232C
 - 5. The flow transmitter shall be integrated into the flow element. The readout shall be oriented to be readable from above.

2.02 SERVICE & SUPPORT

A. Supplier must have flow calibration laboratories and personnel to perform testing and certify calibration. Personnel must also provide instruction or training as required assuring meters are supported and maintained throughout the guarantee period.

2.03 CALIBRATION

A. Testing of all meters must be performed and approved prior to shipment. A copy of the certified calibration record shall be provided at no charge to the Owner.

PART 3 - EXECUTION

3.01 INSTALLATION/WORKMANSHIP

- A. The insertion style meter and transmitter will be installed in accordance with the manufacturer's specifications.
- B. Calibration: Factory calibrated at the specified flow range under given conditions on NIST traceable flow stands.
- C. Any 90° or 45° elbows, valves, partially opened valves, etc. should not be placed closer than twenty pipe diameters upstream and ten pipe diameters downstream.
- D. Meter shall be installed in a horizontal configuration (on the side of the pipe) inside the airflow meter manhole. The transmitter readout shall be readable from grade by looking through the manhole casting with the lid removed.
- E. Meter shall be provided with a four written and one electronic copy of operating instructions.

END OF SECTION 40 71 76

DIVISION 41

MATERIAL PROCESSING & HANDLING EQUIPMENT

SECTION 41 65 13 TANK MOUNTED RECIPROCATING AIR COMPRESSOR

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section specifies the requirements for one tank mounted air compressors which will be installed in the blower/UV building near the blowers, as shown on the drawings. The compressor shall be anchored to the floor and the wall as per manufacturer's instructions.
- B. The compressor is part of Alternate #2

1.02 SUBMITTALS

- A. The following submittals for construction shall be made in accordance with the project submittal requirements as described in the Supplementary Conditions.
 - 1. Manufacturer's data sheets and operating instructions.

PART 2 - MATERIALS

- 2.01 GENERAL
 - A. The compressor shall be splash lubricated reciprocating belt-driven compressor utilizing multi-finned cylinders, with cast iron cylinder (or liners), gasket free integral cylinder/ head to decrease the chance for oil leakage, aluminum alloy domed first stage piston, cast iron domed second stage piston, two compression rings, one oil ring, single unit disc valves, fan bladed flywheel, finned intercooler with pressure relief valve, tapered roller main bearings that support both ends of crankshaft, and centrifugal unloader for loadless starting.
 - B. Compressor shall be two stage, tank mounted with a 120 gallon vertical tank, and be rated for 34.8 CFM @ 175 PSIG
 - C. Supplier's reference for the compressor: Gardner Denver R-Series CASRSA VR10-12, or equal.
- 2.02 MOTOR
 - A. Electric motor shall be 10 HP, 1800 RPM, open drip-proof motor wired for 460 volt, 3-phase, 60 hz.
- 2.03 AFTERCOOLERS
 - A. Compressor shall be equipped with an air cooled aftercooler capable of reducing outlet air to within 20oF of ambient.
- 2.04 CONNECTIONS
 - A. Compressor shall be equipped with a discharge valve and flexible discharge connector.
- 2.05 RECEIVER TANK

AIR COMPRESSOR

- A. Tank shall be an ASME coded air receiver rated for MAWP of 200 PSIG and shall be equipped with pressure gauge and pressure relief valve.
- 2.06 CONTROLS
 - A. Compressor shall come furnished with the following controls/features:
 - 1. Wall mounted Simplex controls,
 - 2. Magnetic starter with thermal overload,
 - 3. Oil monitor,
 - 4. NEMA 1 Enclosure
- 2.07 REFRIGERATOR DRYER
 - A. Refrigerator Dryer shall be installed adjacent to air compressor. The Refrigerator Dryer shall be Gardner Denver GSRN40 or approved equal.
- 2.08 AIR FILTER
 - A. Air filters shall be High efficiency coalescing filter meeting the following requirements:
 - 1. Particle removal down to 0.01 micron
 - 2. Max. oil carryover 0.008 PPM w/w
 - 3. Clean dry pressure drop 1.4 PSID
 - 4. Oil saturated pressure drop 3.0 PSID
 - 5. ISO 8573 (Class 1)
 - B. Air filter shall be Gardner Denver GIL70H or approved equal
- 2.09 HOSE & REEL
 - A. The compressor shall have a wall mounted hose reel with a 50' hose capacity. The hose reel shall be metal in construction and contain a spring return to wind the hose automatically. The size and grade of the air hose shall meet or exceed the air compressor manufacturer's recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION/WORKMANSHIP

- A. The compressors will be installed in accordance with the manufacturer's specifications. The equipment shall be adequately secured to the wall and the floor to prevent tipping during seismic events.
- B. Provide Startup and Maintenance kit suitable for first year of operation including all required spare parts.
- C. Equipment shall be provided with a four written and one electronic copy of operating instructions and warranty.

END OF SECTION 41 65 13

AIR COMPRESSOR

DIVISION 43

PROCESS GAS & LIQUID HANDLING, STORAGE EQUIPMENT

SECTION 43 12 51 ROTARY SCREW LOBE BLOWERS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install complete, ready for operation and field-test two (2) new rotary lobe compressors and appurtenances, as shown on the Drawings and as specified herein.
- B. The entire package and its components shall comply with all applicable safety and environmental regulations.

1.02 RELATED WORK

- A. Valves, except as otherwise specified herein, are included in Section 40 27 20 Process Valves.
- B. Piping, except
- C. Instrumentation work, except as otherwise specified herein, is included in Division 40.
- D. Electrical work, except as otherwise specified herein, is included in Division 26.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following information:
 - 1. Certified general arrangement drawings showing materials, details of construction, dimensions and connections.
 - 2. Complete Performance Data at the Design Point and all specified operating points including:
 - a. Actual Operating Speed (RPM) and % of maximum rated speed
 - b. Capacity scfm and icfm
 - c. Design inlet conditions, pressure, temperature and relative humidity (%)
 - d. Discharge pressure
 - e. Decibel (dB) noise pressure level
 - f. Blower Shaft HP, Motor HP and Package HP
 - 3. List of recommended spare parts broken down into on hand parts and long term for 2 years operation and 3 to 5 years operation.
 - 4. Descriptive Brochures
 - 5. Motor Data
 - 6. Instrumentation and Wiring Diagram

ROTARY SCREW LOBE BLOWER

- 7. ISO-1217 Factory Performance Test Results. Slip test results shall not be unacceptable as an alternate. Manufacturer shall provide documented results for the purchased machines. Typical or average data shall not be acceptable.
- 8. ISO-8573-1 Class Zero Oil Free Certificate
- 9. Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex II, No.1 A.
- B. Complete blower package operating and maintenance instructions professionally published, hard copy and electronic copy, shall be furnished for all equipment included under these specifications in accordance with Section 01 78 23.
- 1.04 QUALITY ASSURANCE
 - A. Qualifications
 - 1. Package shall be Aerzen Delta Hybrid Model D52S. Regardless of manufacturer, the package shall be produced by the manufacturer of the blower stage, to ensure single source responsibility for blower performance and compatibility of associated accessories. Packagers shall not be permitted to bid.
 - 2. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings.
 - 3. The rotary lobe compressors shall be covered by a warranty for 24 months from date of commissioning, or 30 months from date of shipment, whichever occurs first.

1.05 BLOWER PERFORMANCE CRITERIA

A. Quantity of Machines	2
B. Design Inlet Temperature	100 °F
C. Site elevation	4840 ft
D. Design Inlet Pressure	12.30 psia
E. Design Relative Humidity (%)	80%
F. Design Flow	1114/1492 scfm/icfm per machine
G. Minimum Flow (\approx 73.5% turndown)	293/393 scfm/icfm per machine
H. Design Discharge Pressure	6.50 psig
I. Maximum Blower Speed	5775 RPM
J. Brake Horsepower (Max)	46.8 bHp
K. Motor Size (Max)	60Hp
L. Maximum Sound Pressure w/ Enclosure	72 dB(A) at 3ft. distance (excluding pipe noise)
M. Tolerance on Power and Airflow:	$\pm 5\%$

1. Package BHP to include pressure loss through a clean inlet filter/silencer, pressure loss of the exhaust silencer and check valve.

- 2. Package Performance shall be guaranteed to ISO 1217 with a tolerance is \pm 5% on volume flow and \pm 5% on package horsepower. Manufacturer of blower shall provide data for purchased machine(s).
- 3. Sound data shall be from an ISO 2151 method of measurement, in an ISO 3745 qualified test facility. Sound data shall be compliant with a Declaration of Conformity assessment standard.
- 1.06 DELIVERY, STORAGE AND HANDLING
 - A. All equipment shall be completely factory assembled, skid mounted, crated and delivered to protect against damage during shipment.
 - B. All exposed flanges shall be covered and sealed with shrink-wrap to prevent the entrance of moisture or debris. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
 - C. All equipment delivered to the site shall be stored as specified in accordance with the manufacturer's instructions.
- 1.07 MAINTENANCE
 - A. Spare Parts
 - 1. Furnish the following spare parts for each blower package specified:
 - a. Two (2) complete sets of matched V-belts
 - b. Two (2) inlet air filter elements
 - c. One US gallon of oil (Delta Lube) for first service interval
 - 2. Spare parts shall be properly bound and labeled for easy identification without opening the packaging.

PART 2 - PRODUCTS

- 2.01 GENERAL
 - A. Rotary Lobe Compressor Packages shall be designed to minimize the life-cycle costs and maximize plant reliability. The design and the selection of the components shall be based on a minimum useful life of 20 years and a Mean Time Between Overhauls of 5 years of continuous operation. Bearing life shall be submitted by manufacturer of the blower stage, based on specified conditions.
 - B. No special foundations shall be required. The packages will be installed directly on a concrete slab without grouting the base frame. There shall only be 4 easily accessible anchor points.
 - C. Manufacturer shall guarantee that the rotary lobe compressor shall provide oil-free operation and be certified to ISO 8573-1 Class Zero.
 - D. Blower Casing:
 - 1. The casing shall be of one-piece construction, with separate side-plates that are

ROTARY SCREW LOBE BLOWER

bolted and pinned to the housing.

- 2. Casing materials shall be close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions.
- 3. Inlet and outlet shall be flanged connections, not threaded.
- 4. Airflow shall be vertical top to bottom with inlet and outlet connections offset so that the flow travels horizontally across the blower stage. Casings that do not utilize a horizontal internal flow shall not be allowed.
- 5. The vibration level as measured at the casing, in the X/Y planes of the bearings, shall not exceed 0.3 inch·sec RMS when operating at the specified operating pressure and speed. The vibration level shall be checked at start-up and documented in the field start up report.
- E. Factory Testing:
 - 1. Each rotary lobe compressor stage shall be factory performance tested in accordance with ISO 1217 standards to verify flow and brake horsepower. A slip test shall not be acceptable, nor is average data for the manufactured size.
 - 2. The acceptance criteria are $\pm 5\%$ tolerance on power and $\pm 5\%$ tolerance on flow regardless of the size of the machine.
 - 3. The manufacturer shall submit free field noise data for the complete blower package. The results have been obtained using an ISO 2151 method of measurement, in an ISO 3745 qualified test facility. The performance data shall include a Declaration of Conformity, per Machinery Directive 2006/42/EC, Annex II, No.1 A.
- F. Rotors:
 - 1. Each rotor (male and female) shall be of the "stiff" design with first lateral critical speed at least 120% of the maximum allowable operating speed.
 - 2. The rotors shall operate without rubbing nor shall they require lubrication.
 - 3. Rotors shall be drop forged in one single piece of AISI 1043 or equivalent, machined to final tolerance. Minimum material tensile strength shall be 90 ksi (620Mpa). Lesser precision cast iron rotors with surface coatings shall NOT be accepted.
 - 4. Open rotors shall not be acceptable.
 - 5. For maximum strength and reliability, the female rotor shall be driven by the drive motor and the male rotor shall be driven by the timing gear set. Stages that utilize a male driven rotor shall not be accepted.
 - 6. A male and female rotor configuration with internal compression ratio and axial flow entry must be used to increase the adiabatic efficiency of the blower stage. Twisted rotor profiles applied for pulsation cancelation only shall not be allowed. Radial flow entry type rotors shall not be allowed.
 - 7. Only precision-machined rotors with sealing strips to optimize clearance and performance shall be accepted. Manufacturers using coated rotors are required to

include the following additional services in their proposal, with a broken out adder to their proposed cost:

- a. For the first 5 years of service, the manufacturer (not the packager) will visit the site. Each machine will be shut down and visually inspected for evidence of degradation. Inspection will include clearance measurement with feeler gauges. An annual report will be submitted, including photographs, for each machine.
- An annual performance test will be performed on site, including flow and power measurement, for each machine. The results will be compared to the original ISO-1217 test results for each machine, and a report submitted to the owner and the engineer.
- c. Any sign of performance loss or coating degradation will be monitored. If the engineer or owner determine that the results pose a threat to the reliability of the aeration system over the first five years, the manufacturer will, at their own expense (including parts and labor) replace the designated compressor stage, or overhaul and recoat the existing stage, depending on the number of units affected by the degradation.
- 8. Rotors shall be statically and dynamically balanced per ISO1940/ANSI S2.19 G2.5.
- G. Bearings:
 - 1. Each rotor/shaft shall be supported by anti-friction bearings, and fixed to control the axial location of the rotor/shaft in the unit.
 - 2. Regardless of theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of 5 years between overhauls.
 - 3. The applied design conditions shall yield a bearing load and minimal L-10 bearing life calculation of 200,000 hrs. Calculated bearing life shall be submitted, based on specified operating conditions.
- H. Timing Gears:
 - 1. The rotors shall be timed by a pair of single helical gears with quality equivalent to AGMA 12. Spur cut gears shall not be acceptable.
 - 2. Gears shall have hardened and ground teeth and a minimum AGMA service factor of 1.70.
 - 3. Gears shall be mounted via hydraulic expansion onto the shafts with a tapered interference fit, and secured by a locknut. Pinned gears shall not be acceptable.
- I. Seals:
 - 1. Seals shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine.
 - 2. The seal shall be a cartridge type consist of two rotary slip rings mounted in a retainer on the air end, an atmospheric air gap in the center with top and bottom ventilation and a noncontact labyrinth seal with no wearing parts on the oil end.

Internal lip seals shall not be permitted.

- 3. The rotor input shaft shall have a noncontact labyrinth seal with no wearing parts.
- J. Lubrication:
 - 1. The timing gears and the bearings shall be oil lubricated. Grease lubrication shall be not acceptable.
- K. Oil Sight Glass:
 - 1. An oil sight glass shall be provided on the exterior of the noise enclosure so the operator can easily view the oil level.
 - 2. Sight glasses inside the enclosure or that cannot be easily viewed by the operator shall not be acceptable.
- L. Painting:
 - 1. Painting shall be per supplier's standard meeting the following criteria:
 - a. Except for machined sealing and machined mounting surfaces, the package shall be painted dark blue.
 - b. Aluminum, stainless steel, and brass shall not be painted.
 - c. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color.
 - d. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70□m. Surface preparation SSPC10 or better.
 - e. Sound enclosure shall be powder-coated polyester base total dry film thickness $80\Box m$.
 - f. Galvanized components shall only be painted with appropriate surface preparation

2.02 BLOWER ACCESSORIES

- A. Inlet Filter / Silencer:
 - 1. Each package shall be supplied with one combination inlet filter and silencer.
 - 2. The inlet filter silencer shall be mounted directly to the inlet flange of the blower.
 - 3. The inlet filter/silencer housing shall be equipped with an 8" flanged connection outside the blower enclosure.
 - 4. The filter media efficiency shall meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns corresponding to EN779 G4.
 - 5. The silencer portion shall be located upstream of the inlet filter.
 - 6. The filter element shall be designed to trap dirt on the inside so that upon changing, dirt does not fall into the machinery. Filters where dirt accumulates on the external surface of the filter shall not be permitted.

- 7. Filter and silencer performance losses (clean element) shall be included in the entire package performance calculation.
- B. Base Frame/Discharge Silencer:
 - 1. Each package shall be supplied with one combination base frame/discharge silencer.
 - 2. The silencer shall be a chamber type design for maximum sound attenuation and shall not use internally any absorption materials of any kind (fibrous or otherwise) which have been shown to degrade, reduce the attenuation quality of the silencer, and internally foul diffusers. Silencers that utilize internal absorption material shall not be accepted.
 - 3. The silencer shall be fabricated of a single shell of pressure vessel quality steel with continuous welds.
 - 4. The silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum design pressure.
 - 5. The silencer shall have a machined flanged inlet connection and bolt directly to the discharge flange of the rotary lobe compressor, with no intermediary or interconnecting pieces. Threaded connection between the compressor stage and the discharge silencer is subject to leakage and misalignment, and shall not be permitted.
 - 6. Discharge silencer performance losses shall be included in the entire package pressure calculation. Blower accessories shall be supplied by the manufacturer of the blower stage.
 - 7. The base frame shall be constructed from welded carbon steel that shall be designed to maintain alignment of the blower internal components and the drive during operation.
 - 8. The base frame shall be designed to resist distortion while being installed on vibration isolating mounts.
 - 9. The manufacturer shall supply a stainless steel grounding lug fully welded to the base.
- C. Flexible Connectors:
 - 1. Flexible connectors shall prevent the transmission of noise and vibrations from the blower package into the piping.
 - 2. Flexible discharge connectors shall be Proco Style 240, Type EE, EPDM, with a standard ANSI flange discharge connection, rated for 300 °F at 20 psig. Soft face range with galvanized split ring reinforcement.
- D. Electric Motor:
 - Each package shall be supplied with a WEG manufactured TEFC NEMA Premium Efficiency motor that shall operate on 460 Volts, 3 Phase, 60 Hertz current, 3600 RPM. Operation of motors above 60 Hertz shall not be allowed under any circumstance.

- 2. Motors shall be horizontal, foot mounted, rigid base, Torque NEMA B, Temperature rise Class B, TEFC IP55, water tight and dust tight enclosure.
- 3. Class F, inverter rated insulation, Class H applied varnish, 3:1 constant torque VFDduty.
- 4. Re-greasable bearings, positive pressure lubrication system with automatic drawn plugs pressure compensated (frame sizes 254T and larger).
- 5. All frame sizes shall be domestic NEMA standard frame sizes, suitable for overhung belt drive and with the conduit box on top of the motor. IEC frame motors shall not be allowed.
- 6. The motor will be mounted on a pivoting base to provide automatic tensioning of the belts. The motor nominal rating after any corrections for ambient conditions shall be 10% above the maximum operating horsepower.
- 7. The motor shall have a 1.25 service factor for sizes up to 100 HP and a 1.15 service factor for sizes above 100 HP.
- 8. Motor windings shall be supplied with a normally closed thermostat, one per phase, wired in series to form a fail-safe motor protection circuit for the external fault circuit of the motor controller on all frame sizes at or above 324T. Thermostat shall be a Klixon Precision Thermostat by Sensata Technologies.
- 9. Motors shall be equipped with an Aegis ring to mitigate the effects of stray motor currents.
- 10. Blower manufacturer shall be responsible for coordinating the starting torque requirement of the blower and the motor.
- 11. The use of the TEFC motor to cool the blower system or circulate the enclosure air shall not be allowed.
- 12. Regardless of VFD supply, the manufacturer shall publish the VFD program settings in the submittal documentation to verify operation is within the intended RPM range of the motor.
- 13. Under no circumstances shall operation above 60Hz be permitted to achieve the required flow rate. Motor operation shall be limited to a maximum of 60Hz by the motor controller.
- E. V-Belt Drive:
 - 1. Each package shall be supplied with a V-belt drive that shall be of the high capacity type, oil and heat resistant.
 - 2. Drive shall be designed for a minimum service factor of 1.4 times operating power (bHp), or 1.1 times the motor nameplate Hp, whichever is larger to allow a minimum of 1.4-service factor based on the maximum blower bHp.
 - 3. Belt tensioning shall be automatic without the use of any spring devices or interaction on the part of the operator. Slide rails or spring tensioners shall not be

used as a tensioning device.

- 4. Sheaves shall be dynamically balanced regardless of the operating speed and hydraulically mounted on the compressor drive shaft.
- 5. The automatic tensioning system shall yield a v-belt life of 16,000 hrs of operation.
- F. Belt Guard:
 - 1. The belt drive shall be guarded in compliance with OSHA regulations.
 - 2. Portions of the guard shall be easily removable allowing for belt inspection and replacement.
 - 3. Guard material shall be perforated galvanized carbon steel.
- G. Vibration Isolators:
 - 1. Each package shall be supplied with vibration isolating feet with a minimum efficiency of 80%.
 - 2. The manufacturer shall be responsible for attenuating noise and vibration in the package such that no special installation base shall be required, nor shall any additional measures be required to reduce vibrations from the package being transmitted to the base or the piping.
- H. Pressure Safety Valve:
 - 1. Each package shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve.
 - 2. The safety valve shall be set to protect the machine from exceeding its maximum pressure rating, and shall be sized to pass 100% of the design flow.
 - 3. The valve shall be field adjustable, spring loaded, and have a certificate of conformity to PED if operating above 15 psig.
 - 4. The pressure safety valve shall be housed inside and attenuated by the sound enclosure. The safety valve shall relieve hot air into a segmented and sealed section of the sound enclosure so that the hot air cannot reenter the inlet of the machine. Weighted relief valves inside the enclosure shall not be permitted. Diaphragm electronically actuated relief valves shall not be permitted.
 - 5. The valve shall be manufactured by Aerzen.
- I. Check Valve:
 - 1. Each package shall be supplied with one check valve that shall be installed on the discharge line.
 - 2. The check valve shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal.
 - 3. The valve shall be easily removable without disturbing the piping. Check valves

requiring installation in the discharge piping shall not be considered, unless installation cost of the external valve is included in supplier's proposal.

- 4. Pressure losses produced by the check valve shall be included in the entire package performance calculation.
- 5. The check valve shall be manufactured by Aerzen.
- J. Local Control Panel:
 - 1. Each package shall be supplied with the following control functions and features:
 - a. Intuitive TFT color touch screen display.
 - b. Display, monitoring, alarm, and shutdown of inlet pressure, discharge pressure, discharge temperature, enclosure cooling fan thermal overload, main drive motor thermal overload, oil temperature and oil pressure.
 - c. Display run hours
 - d. Log errors and first out indication
 - e. Track and log maintenance
 - f. E-Stop button mounted on front of blower enclosure
 - g. Operation of enclosure cooling fan motor starter and oil demister
 - h. Ability to transfer measured values, fault and status messages, as well as remaining times of the service intervals to the customer control system via Modbus RTU or Ethernet IP.
 - i. Permissive control function of customer start and stop signals to a motor controller
 - j. The local control panel shall be provided with the following digital outputs:
 - i. Common alarm
 - ii. Common fault
 - iii. Ready to run
 - iv. Transfer of external start/stop command
 - v. Status remote
 - vi. Maintenance required
 - vii. Alternatively, these outputs can be obtained using the communication protocol
 - k. The local control panel shall be provided with the following digital inputs:
 - i. Remote start/stop
 - ii. Motor controller fault
 - iii. Customer E-stop

- iv. Alternatively, these inputs can be supplied using the communication protocol
- 2. Control Enclosure
 - a. IP54 suitable for indoor/outdoor installation
 - b. Factory installed, integral to sound enclosure
- 3. Control Supply Power
 - a. 460 VAC, 10 Amp feed with 24 VDC transformer
- 4. Monitoring Sensors
 - a. Inlet Pressure Transducer
 - b. Discharge Pressure Transducer
 - c. PT 1,000 Discharge Temperature RTD
 - d. PT 1,000 Oil Temperature RTD
 - e. Oil Pressure Transducer
- 5. Local control panel shall be the Aerzen AERtronic Digital Controller
- K. Each blower shall receive its initial oil filling at the factory. Oil to be fully synthetic and rated for 16,000 hours of operation between change intervals.
- L. Acoustical Sound Enclosure:
 - 1. Each package shall be supplied with a sound enclosure covering the entire blower package.
 - 2. The enclosure shall provide suitable protection for outdoor installation under wind loads of 50mph and snow loads of 25 lb/ft².
 - 3. The enclosure shall be designed so as to be able to install them side-by-side with all maintenance done from the front or back of the package.
 - 4. Details shall be as follows:
 - a. Enclosure Panels shall be made of galvanized steel sheet, powder coated in a light reflecting, blue color per RAL 5001. The skid shall be of the same color.
 - b. Sound enclosure acoustic material shall comply with UL 94 HF1 for fire-retardant, self-extinguishing, non-dripping materials.
 - c. The enclosure and the blower package shall both be mounted on a skid/oil-drip pan designed for meeting environment protection standards and for easy transportation and installation.
 - d. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts for grounding continuity.
 - e. Quick release panels, each less than 50 lb (as mandated by MSHA) must provide easy and quick access for routine maintenance of the blower and the package

components.

- f. Enclosure Cooling / Ventilation Fan:
 - i. Ventilation fan shall be provided for cooling the sound enclosure.
 - ii. The fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is operated with a VFD.
 - iii. The cooling fan shall be driven separately by a 460V, 3Ph, 60Hz electric motor powered by the same 460 VAC electric feed as the local control panel. A 120V single phase motor for this application will not be acceptable as the current draw and motor operating temperature are too high.
 - iv. The enclosure cooling fan shall be a dedicated device. The use of the TEFC drive motor to cool the blower or circulate the sound enclosure shall not be allowed.
 - v. To prevent possible operator damage, electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.
 - vi. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance. An oil level indicator shall be mounted on the outside of the enclosure, which gives an accurate oil level indication while the blower is in operation. All oil lines shall be industrial-quality hydraulic hose and fittings.
- M. Variable Frequency Drive:
 - 1. Each blower package shall include a wall mounted, 6-pulse, constant torque, variable frequency drive.
 - 2. Drive shall operate on 460 VAC, 3 phase, 60 hertz power and shall be integrated with the local blower permissive switches.
 - 3. The drive shall include the following features and accessories:
 - a. NEMA 4X enclosure complying with UL 508 standards for safety
 - b. Fused disconnect
 - c. Method to minimize power line harmonics while providing a near unity power factor.
 - d. Input surge protection to withstand surges of 2.3 times line voltage for 1.5 msec.
 - e. Modbus or Ethernet IP communication over CAT5 cable
 - f. 100ka SCCR safety rating
 - 4. Branch wiring for AERtronic LCP supply power so that each blower/VFD will require a single 460VAC feed.
 - 5. See Section 26 29 23 Blower Control Panel

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The Contractor shall install the rotary lobe compressors in accordance with the manufacturer's written instructions.
- B. The Contractor shall make all electrical and process connections to the blower package prior to the arrival of the manufacturer's representative.
- C. Manufacturer's authorized service technician shall verify proper installation, electrical connections and equipment alignment prior to start up.

3.02 FIELD SERVICE & TESTING

- A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall provide one (1) trip for a total of two (2) 8 hour days to verify the installation and conduct an acceptance test under actual operating conditions.
 - 1. The Manufacturer shall perform a physical check of the blower installation, perform safety checks, power up the equipment and perform functional testing.
 - 2. The functional test shall consist of 4 hours of operation of each blower with vibration, temperature, and pressure readings as well as motor amp readings taken and recorded at 60-minute intervals.
 - 3. The Manufacturer shall provide operations and maintenance training to the plant personnel. The training shall consist of 1 hour of classroom training using the Operation and Maintenance Manual for reference and 2 hours of hands on training at the blower package.
- B. If required, Contractor shall make any changes, at his own expense, to the installation that may be necessary to assure satisfactory operation. Contractor shall be held liable for changes needed in the installation.
- C. Manufacturer shall provide a written field test / start up report after completion of testing.

END OF SECTION 43 12 51

SECTION 43 23 31 VERTICAL CENTRIFUGAL PUMP

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. These specifications are intended to cover the furnishing of two complete motor-driven vertical centrifugal pumps for the Montana State Hospital. The pumps will be used to supply a non-potable plant water system supplying process water for utilization at the wastewater treatment facilities and on-site irrigation. The water to be pumped will be treated and disinfected wastewater coming directly downstream from an ultraviolet disinfection system. VFD motor controls will by integrated into the pumps. Pumps shall be Grundfos CRE vertical, multistage centrifugal pumps with an integrated frequency converter or approved equal.
- B. Installation will be made by the general contractor. Pumps shall be mounted on reinforce concrete pedestals as shown in the contract Drawings. Pumps shall be vertical centrifugal type operating under the service conditions specified. No consideration will be given to equipment which has not demonstrated its reliability and efficiency through results obtained from operation of similar units of approximately the same capacity and type under similar circumstances. The general design shall be such that all components may be easily disassembled and that replacement parts are readily available. The contractor/manufacturer shall review pumping conditions and verify that the provided pumping system will meet design conditions.
- C. All combinations of manufactured equipment which are approved under this specification shall be entirely compatible and the CONTRACTOR and the listed manufacturer shall be responsible for the compatible and successful operation of the various components of the units conforming to the specified requirements. All necessary mountings, couplings, and appurtenances shall be included with each unit. All materials employed in the pump equipment shall be suitable for the intended application and shall be high grade commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.
- D. Should the equipment selected by the CONTRACTOR require revisions to the structures, piping, electrical, or other work shown on the drawings, the CONTRACTOR shall include the cost of such revisions in his bid for the equipment, and no extra payment shall be made for such revisions. All such revisions shall be submitted for OWNER approval, and shall be subject to the approval of the ENGINEER.

1.02 REFERENCE STANDARDS

A. The work in this section is subject to the requirements of applicable portions of the following standards:

- 1. Hydraulic Institute
- 2. ANSI American National Standards Institute
- 3. ASTM American Society for Testing and Materials
- 4. IEEE Institute of Electrical and Electronics Engineers
- 5. NEMA National Electrical Manufacturers Association
- 6. NEC National Electrical Code
- 7. ISO International Standards Organization
- 8. UL Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

- 2.01 VARIABLE SPEED PUMP
 - A. Furnish and test two variable speed pumps utilized in a non-potable water pumping system to maintain constant water delivery pressure as shown on the contract Drawings.
 - B. The pump system shall be a standard product of a single pump manufacturer. The entire pump system including pump, motor, variable frequency drive and pump controller, shall be designed and built by the same manufacturer.
 - C. The complete motor and drive shall be certified and listed by UL for conformance to U.S. and Canadian Standards.
 - D. Operating Conditions
 - 1. Capacity of pump: 50 gpm (minimum)
 - 2. Total pumping head: 185 ft
 - E. Pumps shall be Grundfos CRE 10-6 N-GJ-A-E-HQQE or approved equal.

2.02 PUMPS

- A. The pumps shall be ANSI/NSF 61 approved for drinking water.
- B. The pumps shall be of the in-line vertical multi-stage design.
- C. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.
- D. Vertical In-Line Multi-Stage Pumps shall have the following features:
 - 1. The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.
 - 2. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.
 - 3. Pump Construction.
 - a. Suction/discharge base, pump head, motor stool: 316 Stainless Steel

b.	Impellers, diffuser chambers, outer sleeve:	304 Stainless Steel
c.	Shaft	316 Stainless Steel
d.	Impeller wear rings:	304 Stainless Steel
e.	Shaft journals and chamber bearings:	Silicon Carbide
f.	O-rings:	EPDM
g.	Shaft Couplings	Cast Iron

4. The shaft seal shall be a balanced o-ring cartridge type with the following features:

a.	Collar, Drivers, Spring:	316 Stainless Steel
b.	Shaft Sleeve, Gland Plate:	316 Stainless Steel
c.	Stationary Ring:	Silicon Carbide (Graphite Imbedded)
d.	Rotating Ring:	Silicon Carbide (Graphite Imbedded)
e.	O-rings:	EPDM

- 5. Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor.
- 2.03 INTEGRATED VARIABLE FREQUENCY DRIVE MOTOR
 - A. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) with a built-in pump system controller. The complete VFD/motor assembly shall be built and tested as one unit by the same manufacturer.
 - B. The VFD/motor shall have an IP55 (TEFC) enclosure rating as a complete assembly. The motor shall have a standard NEMA C-Face, Class F insulation with a Class B temperature rise.
 - C. The VFD shall be of the PWM (Pulse Width Modulation) design using up to date IGBT (Insulated Gate Bipolar Transistor) technology.
 - D. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of the motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
 - E. The VFD shall have, as a standard component, an RFI filter (Radio Frequency Interference) to minimize electrical noise disturbances between the power electronics and the power supply. The VFD/motor shall meet all requirements of the EMC directive concerning residential and light industry equipment (EN 61800-3).
 - F. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
 - G. The VFD shall have internal solid-state overload protection designed to trip within the

range of 125-150% of rated current.

- H. The VFD/motor shall include protection against input transients, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. The motor over-temperature protection shall consist of three series connected PTC thermistors, one for each motor phase.
- I. The VFD/motor shall provide full nameplate output capacity (horsepower and speed) within a balanced voltage range of 414 to 528 volts.
- J. Automatic De-Rate Function: The VFD/motor shall reduce speed during periods of overload allowing for reduced capacity pump operation without complete shut-down of the system. Detection of overload shall be based on continuous monitoring of current, voltage and temperature within the VFD/motor assembly.
- K. The VFD/motor shall have, as a minimum, the following input/output capabilities:
 - 1. Speed Reference Signal: 0-10 VDC, 4-20mA
 - 2. Digital remote on/off
 - 3. Fault Signal Relay (NC or NO)
 - 4. Fieldbus communication port (RS485)
- L. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.
- 2.04 PUMP SYSTEM CONTROLLER AND USER INTERFACE
 - A. The pump system controller (Proportional-Integral) shall be a standard component of the integrated variable frequency drive motor developed and supported by the pump manufacturer.
 - B. The pump system controller shall have an easy to use interface mounted on the VFD/motor enclosure. Pump system start/stop and set-point adjustment shall be possible through the use of two push buttons located on the drive enclosure.
 - C. The VFD/motor shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote on/off (digital) signal. VFD/motor shall receive signals from the effluent flow meter to shut down when a low flow event occurs and turn back on when the low flow event has commenced.
 - D. Pump status and alarm state shall be indicated via two LED lights located on the VFD/motor enclosure and communicate with the Remote Monitoring System, see Section 40 68 26.
 - E. Advanced programming and troubleshooting shall be possible via an infra-red hand held programmer or a field connected personal computer. Pump system programming (field adjustable) shall include as a minimum the following:

System Pressure set-point, psig

System start pressure, psig

System Stop pressure, psig	Minimum Pump Speed, %
Pressure Transducer supply/range	Maximum Pump Speed, %
System Time (Proportional Gain)	Integral Action Time

- F. The infra-red programmer shall be capable of displaying the following status readings:
 Pump Status (on, off, min., max.)
 Actual system pressure, psig
 Pump speed, rpm
 VFD/Motor input power, kW
 VFD/Motor total cumulative kWh
 VFD/Motor total operating hours
- G. The infra-red programmer shall also be capable of displaying the following alarms, with the last five alarms stored in memory:

Loss of sensor signal	Loss of external set-point signal
Under-voltage & Over-voltage	Motor overload (blocked pump)
Motor over-temperature	Drive over-temperature
Drive Over-current	

2.05 SEQUENCE OF OPERATION

- A. The system controller shall receive an analog signal, 4-20mA, from the factory installed pressure transducer indicating the actual system pressure. When a flow demand is detected (system pressure drops below the start pressure) the VFD/motor shall start and increase speed until the actual system pressure matches the system set-point. As flow demand changes (increases or decreases), the speed of the pump shall be adjusted to maintain the system set-point pressure.
- B. If a no flow shut-down is required (periods of zero demand) a bladder type diaphragm tank shall be installed. The tank shall be downstream of the pump. When zero flow is detected by the system controller, the pump shall be switched off. When the system pressure drops to the start pressure, (flow begins after shut-down), the pump shall be switched on, increasing speed to maintain the system set-point pressure. Zero flow conditions shall be detected by the system controller/factory installed pressure transmitter without the use of additional flow switches or motor current sensing devices.
- C. A foot valve shall be installed on the end of the pump suction line in the Ultraviolet Disinfection effluent basin to prevent loss of pump prime. The foot valve shall be a Sure Seal Foot Valve manufactured by Val-Matic or approved equal.

2.06 SYSTEM CONSTRUCTION

- A. The CRE pump shall have a maximum working pressure ranging up to 435 psig at a temperature of 176°F.
- B. A diaphragm tank (field installed) is required for the stop function. A minimum diaphragm tank connection size of 2" shall be provided on the discharge piping by others.

- C. A pressure transducer shall be factory installed on the pump head. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.
- D. An optional factory pressure switch shall be available for mounting on the suction piping for water shortage protection. The pump shut-down pressure shall be 3 psig with a reset pressure of 5 psig. Systems with a flooded suction inlet or suction lift configuration will require a field installed water shortage device. A normally open dry contact shall be available on the VFD/Motor for field installation.
- 2.07 WARRANTY
 - A. The warranty period shall be a non-prorated period of 24 months from date of installation, not to exceed 30 months from date of manufacture.

PART 3 - EXECUTION

3.01 START-UP PROCEDURE

- A. The pump and motor shall be installed in strict compliance with the pump manufacturer's instructions. The correct motor rotation shall be confirmed prior to installing the top shaft and the impeller lateral adjustment shall be in accordance with the pump manufacturer's instructions. Pumping capacity at design conditions shall be verified.
- 3.02 TESTING
 - A. The pump motor and VFD shall be factory performance tested as a complete unit prior to shipment.
 - B. The pump shall undergo a hydrostatic test.
 - C. The pump motor and VFD shall be performance tested after installation has been completed.

END OF SECTION 43 23 31

SECTION 43 25 00 SUBMERSIBLE LIFT STATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Work under this section includes, but is not limited to, furnishing and installing a factory built duplex pump station as indicated on the project drawings and herein specified, as necessary for proper and complete performance.
- B. The principal items of equipment to be provided shall include two submersible centrifugal solids handling pumps, each with compatible quick discharge connector system, guide rails, anchor bolts, stainless steel lifting cables or chain with associated hardware, steel powder coated station valves, internal piping, and a complete factory-built motor control center with circuit breakers, motor starters and automatic liquid level control system as specified herein to constitute a complete, working system.
- C. The pumps and mechanical slide rail accessories shall be installed in the existing concrete wet well as shown on the project plans. The pump control panel shall be installed inside the screening building, valves, piping, and fittings shall be installed within a concrete structure as shown on the project plans.
- D. Factory built pump station design, including materials of construction, pump features, and motor controls shall be in accordance with requirements listed under Part 2 Products of this section.
- E. The wet well shall be lined in accordance with Section 03 11 15 Corrosion Resistant Manhole Liner.
- 1.02 REFERENCES
 - A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.
 - B. American National Standards Institute (ANSI) and American Water Works Association (AWWA)
 - 1. ANSI B16.1, Cast iron pipe flanges and flanged fittings
 - 2. ANSI/AWWA C115/A21.51, Cast/ductile iron pipe with threaded flanges
 - 3. ANSI 253.1, Safety Color Code for Marking Physical Hazards
 - 4. ANSI B40.1, Gauges, Pressure and Vacuum
 - 5. AWWA C508, Single Swing Check Valves
 - 6. AWWA C504, Plug Valves
 - C. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48, Gray Iron Castings

- 2. ASTM A126, Valves, Flanges, and Pipe Fittings
- 3. ASTM A307, Carbon Steel Bolts and Studs
- 4. ASTM F593, Stainless Steel Bolts, Hex Cap Screws, and Studs
- 5. ASTM A36, Structural Steel
- D. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. ANSI/IEEE Std. 100, Standard Dictionary of Electrical Terms
 - 2. ANSI/IEEE Std. 112, Test Procedure for Polyphase Induction Motors
 - 3. IEEE Std. 242, Protection of Industrial and Control Power Systems
- E. National Electric Code (NEC), National Electrical Manufacturers Association (NEMA)
 - 1. NEC 701, National Electric Code article 701
 - 2. NEMA Std. MG1, Motors and Generators
- F. Miscellaneous References
 - 1. Ten-State Standards Recommended Standards for Sewage Works
 - 2. Hydraulic Institute Standard for Centrifugal, Rotary and Reciprocating Pumps
 - 3. NMTBA and JIC Std. National Machine Tool Builders Association and Joint Industrial Council Standards

1.03 PERFORMANCE CRITERIA

- A. Each pump must be designed to handle raw, unscreened, wastewater. Pumps shall be furnished with a 4" discharge connection and be capable of delivering the flows indicated for the pumps in Part 2 Products.
- B. Site power furnished to pump station shall be 480V, 3-Phase 4 Wire, 60 Hertz, maintained within industry standards.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 30 00. In addition, the following specific information shall be provided:
- B. Product Data:
 - 1. Prior to fabrication, the pump station manufacturer shall submit copies of submittal data for review and approval. Additional copies will be provided as required to comply with the contractor, supplier, or manufacturer's need for extra returned copies.
 - 2. Submittal shall include shop drawings, electrical schematic diagrams, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves to illustrate the design duty point capacity (GPM), head (FT), pump efficiency (np) and brake horsepower (BHP). Electrical components used in

the motor branch and liquid level control shall be fully described.

- 3. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for the Quick Discharge Connector, base elbow, and guide rail components. Pipe penetrations and station access clearances shall be dimensioned relative to the station centerline. Electrical schematic diagrams shall illustrate motor branch and liquid level control circuits to the extent necessary to validate function and integration of circuits to form a complete working system.
- C. Operation and Maintenance Manuals
 - 1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly install, operate, and maintain all equipment supplied. Content and instructions shall assume operations personnel are familiar with pumps, motors, piping and valves, but lack experience on the exact equipment supplied.
 - 2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. A separate section in the O&M Manual shall be designated for support data on any equipment supplied by others, even if mounted or included in overall station design; support data shall be provided by those supplying the equipment and inserted into the O&M Manual in this section. Instructions shall include the following as a minimum:
 - a. Functional description of each major component, complete with operating instructions.
 - b. Instructions for operating pumps and pump controls in all modes of operation.
 - c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
 - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
 - e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
 - f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, valves and piping.

3. Operation and maintenance instructions that rely on vendor cut-sheets and literature that includes general configurations, or requires operations personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.05 QUALITY ASSURANCE

- A. Upon request from the engineer (or owner), the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
- B. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse- engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.
- C. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.
- D. All pump openings and passages shall be of adequate size to pass 2.5" diameter spheres (minimum) and any trash or stringy material which can pass through an average house collection system.
- E. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.06 MANUFACTURER'S WARRANTY

- A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
 - 1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures are warranted for five (5) years to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
 - 2. All other equipment, apparatus, and parts furnished shall be warranted for one (1) year, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump station manufacturer

shall be solely responsible for warranty of the station and all components.

- B. Components that fail to perform as specified by the Engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
- C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.
- D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.
- E. This limited warranty shall be valid only when installation, use, and maintenance is performed in accordance with manufacturer recommendations. A start-up report competed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

PART 2 - PRODUCTS

2.01 UNITARY RESPONSIBILITY

A. In order to unify responsibility for proper operation of the complete pump station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer.

2.02 MANUFACTURER

- A. The specifications and project drawings generally depict equipment and materials manufactured by Xylem/Flygt (pumps) and isiWEST (control panel, wet well and buried valve vault). It is not intended, however, to eliminate other products of equal quality and performance.
- B. In event the Contractor obtains Engineer's approval for equipment substitution, the Contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to bid.

2.03 WET WELL AND BURIED VALVE VAULT

A. Components of the Packaged Wastewater Lift Station, but not limited to, wet well duplex pump system, access hatches, and process piping.

- 1. Furnish all components factory-assembled to greatest extent possible; where field installation is required, provide piping, wiring, and other components as required for a complete installation.
- B. Dimensions per construction drawings.
- C. Identification: For each item of equipment, provide the manufacturer's name or trademark and model number on corrosion-resistant identification plate, cast integrally, stamped, or otherwise permanently marked in conspicuous place.
- D. Wet Well
 - 1. Construction: Pre-Cast, watertight concrete construction.
 - a. Alternate: Filament Wound Straight Wall Fiberglass Basin/Wet Well (6" fillet tapered bottom, anti-floating flange, duplex pump rail bases and upper guide brackets with 2" stainless steel rail pipe, 4" ductile iron discharge pipe and fittings) with "Key Hole" style attached valve box with common discharge (including valving as shown on contract drawings, link seals, 2" drain back to main wet well) aluminum hatch cover with no vent, conduit hubs, stainless steel float bracket, CI intake hub, stainless steel coupling for vent, and ballast buoyancy counterweight. Complete assembly by Steel Plastics Inc.
 - b. All alternates to the pre-cast concrete wet well shall be approved by the Engineer a minimum of 10 days prior to bid opening.
 - 2. Contractor shall provide structural drawings for wet well, sealed by a Professional Engineer licensed in the State of Montana.
 - a. Design precast concrete units to withstand load conditions in accordance with ACI 350.
 - b. Design shall conform to wet well interior dimensions indicated on the construction drawings.
 - c. Design shall evaluate discontinuities in the structure produced by openings.
 - d. Design shall consider stresses induced during handling, shopping, and installation in order to avoid product cracking or other handling damage.
 - e. Design loads for precast concrete units shall be indicated on the shop drawings.
 - 3. Concrete Construction:
 - a. Concrete minimum compressive strength: 5000 psi at 28 days.
 - b. Concrete shall be sulfate resistant and contain an A-Lok liner or approved equal as per Section 03 11 15 Corrosion Resistant Manhole Liner.
 - c. For non-machine cast products, the concrete shall be self-consolidating concrete
 - d. Concrete Mix design:
 - i. At minimum, ACI 211.1 shall be used for selection of proportions of concrete.

ii. Submit mix designs per the submittal requirements listed above.

iii. Material:

- Aggregates conforming to ASTM C33/C33M.
- Type I/II Portland Cement conforming to ASTM C150/C150M.
- Fly ash and pozzolans conforming to ASTM C618.
- Silica fume conforming to ASTM C1240.
- Ground granulated blast-furnace slag conforming to ASTM C989/C989M.
- Water conforming to ASTM C1602/C1602M.
- Air entraining admixtures conforming to ASTM C260/C260M.
- Chloride corrosion inhibitors conforming to ASTM C1582/C1582M.
- Accelerating, retarding, or water reducing admixtures conforming to ASTM C494/C494M.
- Reinforcing steel bars conforming to either ASTM A615/A615M or ASTM A706/A706M.
- Plain or deformed, welded wire reinforcement conforming to ASTM A1064/A1064M.
- Epoxy coated reinforcing bars conforming to ASTM A775/A775M.
- Epoxy coated welded wire reinforcement conforming to ASTM A884/A884M.
- Hot-dipped galvanizing for inserts conforming to ASTM A123/A123M.
- Preformed flexible joint sealants conforming to ASTM C990.
- e. Grout:
 - i. Manufacturers:
 - BASF: MasterFlow 928.
 - Or approved equal.
 - ii. Grout shall be sulfate-resistant non-metallic, non-gas forming, non-shrink, pre-blended, and ready-to-use requiring only the addition of water at site.
 - iii. Grout shall conform to CRD-C621 and ASTM C1107/C1107M.
- 4. Access Hatches:
 - a. Manufacturers:
 - i. Halliday Products
 - ii. Bilco

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iii.approved equal

- b. Design Criteria:
 - i. Live load: 300 psf.
 - ii. Hatch shall be as shown on the contract drawings. Hatch shall provide proper access to pumps and trash basket for maintenance without interfering with other accessories on the lift station slab.
- c. Materials:
 - i. 1/4 inch aluminum diamond pattern cover with channel frame, continuous anchor flange, and full slab-height skirt.
 - ii. Type 316 stainless steel slam lock with fixed interior handle.
 - iii. Compression spring operators enclosed in telescopic tubes, with automatic hold-open arm with release handle locking cover arm in open position.
- 5. Finishing:
 - a. Exterior coating: Shop applied bituminous dampproofing per Section 07 11 13 Bituminous Damproofing.
 - b. Interior coating: Manhole shall have a protective liner as per Section 03 11 15 Corrosion Resistant Manhole Liner.

2.04 SUBMERSIBLE SEWERAGE PUMPS

- A. Requirements
 - 1. Furnish and install 2 submersible non-clog wastewater pump(s). Each pump shall be equipped with a suitably-sized, submersible electric motor connected for operation on 460 volts, 3-phase, 60 hertz, 3 or 4 wire service, with a minimum16 feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and have P-MSHA Approval. Preliminary pump sizing indicates a 5 HP motor will be suitable to achieve the operating point outlined in 2.04.B.1 below:
- B. Pump Design Configuration (Wet pit installation)
 - 1. The pump shall be supplied with a mating cast iron 4 inch discharge connection and be capable of delivering 400 gpm at 30 ft. TDH. To further define the desired pump performance curve, two more points on the pump curve shall be: 300 gpm at 34' and 500 gpm at 25'. Shut off head shall be 50 ft. (minimum). The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with a minimum <u>15 ft</u> of stainless steel

lifting chain or stainless steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

- C. Pump Construction
 - 1. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be AISI type 316 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
 - 2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or optional Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
 - 3. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.
- D. Cooling System
 - 1. Motors are sufficiently cooled by the surrounding environment or pumped media. A water jacket is not required.
- E. Cable Entry Seal
 - 1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. *The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.*
- F. Motor
 - The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use

of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40° C (104° F) and capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125° C (260° F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

- 2. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
- 3. The motor shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
- 4. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
- G. Shielded Power Cable:
 - 1. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The power cable shall be of a shielded design in which an overall tinned copper shield is included and each individual phase conductor is shielded with an aluminum coated foil wrap. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.
 - 2. This cable is required for use with Flygt SmartRunTM intelligent controls.
- H. Bearings
 - 1. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The

lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. *Single row lower bearings are not acceptable*. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

- I. Mechanical Seal
 - 1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant *tungsten-carbide* ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven resistant tungsten-carbide seal ring.
 - 2. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.
 - 3. The following seal types shall not be considered acceptable or equal to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
 - 4. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.
 - 5. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.
 - 6. Seal lubricant shall be non-hazardous.
- J. Pump Shaft
 - 1. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The pump shaft shall be stainless steel ASTM A479 S43100-T.

 If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-T is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided for in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

K. Impeller (Adaptive)

- 1. The impeller shall be of Hard-IronTM (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on a replaceable insert ring.
- 2. The impeller shall have vanes hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater. The impeller shall be capable of momentarily moving axially upwards a distance of 15mm/0.6-in. to allow larger debris to pass through and immediately return to normal operating position.
- L. Volute / Suction Cover
 - 1. The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, nonconcentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiralshaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall have a guide pin integral to the casting and shall be cast of ASTM A-48, Class 35B grey iron and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

M. Protection

- 1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. The thermal switches shall open at 125°C (260°F), stop the motor and activate an alarm.
- 2. A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.
- 3. The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS shall be designed to be mounted in any control panel.

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- 4. Note: FLS not available in NZ configuration.
- N. Modifications
 - 1. Explosion-proof Pumps.
- 2.05 ELECTRICAL CONTROL COMPONENTS
 - A. Contractor shall furnish all labor, materials, equipment and incidentals required to provide motor control panel as specified herein.
 - B. The motor control panel shall be assembled and tested by a shop meeting U.L. Standard 508 for industrial controls. The motor and control panel shall be assembled and tested by the same manufacturer supplying the pump so as to insure suitability and assurance of experience in matching controls to motors and to insure single source responsibility for the equipment.
 - C. The control panel shall comply with the NEC regulations. The panel shall contain all components required by the pump manufacture for starting and protection of the motor. Any features required by the pump manufacture for warranty of the pump shall be included in the control panel.
 - D. The level control system shall start one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level rise to the "lag pump start level", the system shall start the second pump so that both pumps are operating to pump down the well. Both pumps shall stop at the same "stop" level.
 - E. The control panel shall alternate pumps (lead pump) between starts. Alternation shall occur at the end of each pumping cycle.
- 2.06 CONSTRUCTION
 - A. The controls for the pump shall be contained in a painted steel enclosure meeting NEMA 3R requirements with a hinged door and neoprene gasket. The sub-panel shall be painted steel.
 - B. The enclosure shall have provisions for padlocking. A nameplate shall be permanently affixed to the panel and include the model number, voltage, phase, hertz, ampere rating and horsepower rating. A warning label against electric shock shall be permanently affixed to the outer door.
 - C. Hand-Off-Auto switches shall be provided for each pump. All switches and push buttons shall be mounted on a corrosion-resistant operator safe dead-front with a corrosion resistant full length hinge.
 - D. Pilot lights shall be furnished for each pump for run status and seal failure. All pilot lights shall be mounted on the corrosion-resistant operator safe dead-front.
 - E. All pilot lights and switches shall be properly labeled as to function. The labels shall be $\frac{3}{4}$ " by 3" two layer laminated plastic, white on black background. The labels shall be

custom engraved by the control panel manufacturer and fastened to the dead-front.

- F. Pump control panel shall incorporate seal failure relays into control operation. Should water penetrate the lower seal of the pump, an adjustable seal failure relay shall be energized via the pump manufacturer's seal fail probe, alerting the operator of impending pump failure. The relay shall energize a pilot light on the operator dead-front. The relay shall be 120VAC and have an adjustment of 4.7 to 100k ohms.
- G. The incoming power shall be 480 volts, 3 phase, 60 hertz service. Terminal blocks with box type lugs shall be supplied to terminate all wiring for floats and heat and seal sensors for the pump, if required. The pump leads shall be terminated at the overload relay or at box type terminal blocks. The terminal blocks for the float connections shall be on the pump controller.
- H. A circuit breaker shall be used to protect from line faults. The panel shall have a main power disconnect interconnected with a handle on the dead-front for safety, and to disconnect the pump from the incoming power. Circuit breaker shall be thermal magnetic and sized to meet NEC requirements for motor controls.
- I. Control voltage shall be 120 VAC and may be accomplished by the means of a transformer or available line voltage. A control fuse shall protect and isolate the control voltage from the line. Control transformer shall have primary and secondary circuit protection.
- J. Wire ties shall be used to maintain panel wiring in neat bundles for maintenance and to prevent interference with operating devices. All wiring shall be color coded to facilitate maintenance and repair of the control panel. Where a color is repeated, number coding shall be added. A schematic shall be permanently attached to the inside surface of the front door.
- K. All ground connections shall be made with ring tongue terminals and star washers to assure proper ground.
- L. A duplex pump controller shall be provided for control logic. Pump controller shall be relay logic utilizing conventional wiring. The pump control panel shall be completely self-contained and will require no additional hardware, software, or accessories for full operation. The pump controller shall be UL listed for Class I, Division 2.
- M. The high level alarm shall be the only external light on the pump control panel.

2.07 VARIABLE SPEED DRIVE

- A. A variable speed drive will be provided sized of the appropriate horsepower per equal size of each main pump. Furnish complete VFD as specified herein or in the equipment schedule for loads designated to be variable speed. VFD's shall be user-selectable for either constant or variable torque loads.
- B. The VFD shall be a six-pulse input design. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform and shall output a waveform that closely approximates a sine wave.

- C. The manufacturer of the VFD shall demonstrate a continuous period of manufacturing and development of VFD's for a minimum of 40 years. VFD's that are brand-labeled are not acceptable. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.
- D. VFD shall automatically boost power factor at lower speeds. In variable torque applications, the VFD shall provide a CT-start feature and be able to provide full torque at any speed up to the base speed of the motor. In either CT or VT mode, the VFD shall be able to provide its full rated output current continuously and 110% of rated current for 60 seconds.
- E. Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.
- F. The VFD shall include an integral RFI filter conforming to the A2 standard as a minimum. VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes. All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
- G. The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. DC Link reactor shall be installed so that power fluctuations to the DC Capacitors shall be reduced to increase Capacitor life. VFD's without a DC link reactor shall provide a 5% impedance line side reactor and provide spare capacitors.
- H. VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.5 msec. Printed Circuit boards shall be conformal coated to reduce the corrosion effect from environmental gases and other conditions. The conformal coating must meet IEC 61721-3-3, Class 3C2. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
- I. VFD shall include current sensors to monitor all three-output phases to detect and report phase loss or unbalance or other power issues to the motor. The VFD will identify which of the output phases is low or lost.
- J. VFD shall provide an alphanumeric backlit display keypad (LCP) which may be remotely mounted using a standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. The remote mount must meet N4 rating. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD
- K. All VFD's shall be of the same series and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be

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interchangeable through the entire range of drives used on the project.

- L. A battery back-up shall be provided to maintain internal clock operation during power interruptions. Battery life shall be no less than 10 years of normal operation.
- M. The VFD shall have an adjustable output switching frequency.
- N. Four complete programming parameter setups shall be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to be programmed for up to four alternate control scenarios without requiring parameter changes.
- O. In each programming set up, independent acceleration and deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed.
- P. The VFD shall have four programmable "Bypass frequencies" with adjustable bandwidths to prevent the driven equipment from running at a mechanically resonant frequency. The feature shall offer a Semi-Automatic program to simplify the set-up. In each programming setup, independent current limit settings, programmable between 50% and 110% of the drives output current rating, shall be provided.
- Q. The VFD will include a "loss of follower" function to detect the loss of process feedback or reference signals with a live-zero value and a user-selectable choice of responses (go to set speed, min speed, max speed, stop, stop, and trip). An initial ramp function shall be available to provide a user-selectable ramp, up to 60 seconds, for applications requiring a faster or slower ramp than the normal ramp. A Dual Ramp feature shall include a Check Valve Ramp and a final Ramp feature. The Check Valve Ramp shall be programmable to gently seat a check valve and reduce the potential of damage from excess pressure while shutting-down the system. Both time and end speed shall be programmable. On the Final Ramp, the VFD shall be programmable to quickly stop the motor after seating of a check valve or for a more rapid stopping than the normal ramp down setting.
- R. The ambient operating temperature of the VFD shall be -10°C to 50°C (14 to 1227F), with a 24- hour average not to exceed 45°C. Elevation to 3,300 feet (1000 meters) without de-rating. VFD shall provide full torque to the motor, given input voltage fluctuations of up to +10% to -15% of the rated input voltage (525 to 690VAC, 380 to 480VAC, or 200 to 240VAC). Line frequency variation of \pm 2% shall be acceptable.
- S. The VFD shall be equipped with a standard RS-485 serial communications port and front-of-drive accessible USB port. Danfoss FC or ModBus RTU communications shall be integrally mounted. VFD Keypad shall be mounted and accessible from the exterior of the control panel door in a NEMA 4 configuration. Keypads mounted internally shall not be allowed.
- 2.08 PANEL
 - A. The Panel shall be equipped with the following additional features;
 - 1. High level alarm light (Flashing)

- 2. High level alarm horn
- 3. Test-Off-Auto switch for alarm
 - a. Lift Station/Screen Building Alarm/Horn/Test off auto switch to be integrated into lift station panel and integrated into local remote monitoring and messaging system, see Section 40 68 26 Remote Monitoring System.
 - Blower/UV Building Alarm/Horn/Test off auto switch to be integrated into local remote monitoring and messaging system. See 40 68 26 – Remote Monitoring System.
- 4. Elapsed time meter (per pump)
- 5. Seal failure light
- 6. Lightning arrestor
- 7. 110 volt convenience outlet
- Blower/UV Building Non-Potable Water Tank Level Transduce in UV Effluent Basin – to be integrated with the remote monitoring and messaging system. See 40 68 26 – Remote Monitoring System.
- 2.09 WIRING
 - A. The control panel, as furnished by the manufacturer, shall be completely wired. The Contractor shall field connect the power feeder lines to the main terminal block, final connections to the remote alarm devices, and the connections between the pump and the pump motor control. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications set forth by the National Electric Code (NEC).
 - B. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:

1.	Line and load circuits, AC or DC power	Black
2.	AC control circuit less than line voltage	Red
3.	DC control circuit	Blue
4.	Interlock control circuit, from external source.	Yellow
5.	Equipment grounding conductor	Green
6.	Current carrying ground.	White
7.	Hot with circuit breaker open.	Orange

- C. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring shall be 14-gauge minimum.
- D. Motor branch and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in

accordance with the electrical diagrams. All wires on the sub-plate shall be bundled and tied.

E. Wires connected to components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be provided to allow the door to swing to its full open position without undue stress or abrasion on the wire or insulation. Bundles shall be held in place on each side of the hinge by mechanical fastening devices.

2.10 CONDUIT

A. All conduit and fittings shall be UL listed. Liquid tight flexible metal conduit shall be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code. Conduit shall be sized according to the National Electric Code.

2.11 GROUNDING

A. The pump control manufacturer shall provide a common ground bar mounted on the enclosure back plate. The mounting surface of the ground bar shall have any paint removed before making final connections. The Contractor shall make the field connections to the main ground lug and each pump motor in accordance with the National Electric Code.

2.12 IDENTIFICATION

- A. A permanent corrosion resistant name plate(s) shall be attached to the control and include the following information:
 - 1. Equipment serial number
 - 2. Control panel short circuit rating
 - 3. Supply voltage, phase and frequency
 - 4. Current rating of the minimum main conductor
 - 5. Electrical wiring diagram number
 - 6. Motor horsepower and full load current
 - 7. Motor overload heater element
 - 8. Motor circuit breaker trip current rating
 - 9. Name and location of equipment manufacturer
- B. Control components shall be permanently marked using the same identification shown on the electrical diagram. Identification label shall be mounted adjacent to the device.
- C. Switches, indicators, and instruments shall be plainly marked to indicate function, position, etc. Marking shall be mounted adjacent to and above the device.

2.13 SENSING & CONTROLS

- A. Level Sensing Transducer
 - 1. Station manufacturer shall supply one submersible pressure transmitter with a full scale (FS) range of 0 to 5 psi with a 2-wire loop powered 4-20mA output. The transmitter shall be PMI model 710-140-00005-009-815-50' or equal and shall be rated for lift station environment. Transmitter shall be supplied with required mounting hardware.
 - 2. The level sensing transducer(s) shall be a non-fouling design with non-clogging PTFE coated elastomeric diaphragm, specifically designed for adverse environments encountered in wastewater applications.
 - 3. Proof pressure shall be minimum 1.5 x FS and burst pressure shall be 2 x FS;
 - 4. Static accuracy shall be $\pm 0.25\%$ FSO using the BFSL method;
 - 5. Resolution shall be +0.0001% FS;
 - 6. All wetted materials shall be 316 stainless steel or titanium; FKM; PTFE; polyurethane or ETFE the unit shall have a protection rating of IP 68, NEMA 6P;
 - 7. Thermal error shall be \pm -.10% FSO/°C and the compensated temperature range shall be 0°C to 50°C;
 - 8. Input current shall be 20 mA maximum;
 - 9. Output shall be 4-20 mA, 0-5 VDC, 0-2.5 VDC;
 - 10. Capability to re-zero after installation for optimum accuracy and the span shall not be affected;
 - 11. Insulation resistance shall be 100 mega ohm at 50 VDC;
 - 12. The transducer(s) shall be CE compliant (EN 61326-1:2013 and 61326-2-3:2013; UL, CUL and FM compliant Class I, II, III, Div. 1, Groups A, B, C, D, E, F & G;
 - 13. Cable pull strength shall be a minimum of 200 lb;
 - 14. Cable shall have 4 conductors, each 22 AWG with a molded polyurethane cable seal;
 - 15. Transducer(s) and cable assembly shall be the KPSI 705 as manufactured by TE Connectivity Sensors.
 - 16. The level control system shall be provided with field-adjustable set points for speed reference commands. Setpoint adjustments will be made using the operator keypad on the controller HMI or the mounted touchscreen. The maximum field adjustable setpoint range is 0.0 ft W.C. (4794.20) to 10.0 ft W.C. (4804.20).
 - 17. Upon operator selection of "Automatic", the lead pump shall start when the wet well level rises to the "lead pump start level". <u>The pump shall start at a prescribed speed and ramp up and down in response to the speed at which the liquid level in the wet well rises or falls. Sensing and responding to the rate of rise and fall of liquid level in the wet well shall be intrinsic to the control system operating protocol. A rising wet well liquid level will induce the control system to increase the pump speed</u>

through control of the VFD typical operating range. A falling wet well liquid level will induce the control system to decrease the pump speed through control of the VFD typical operating range. The lowest VFD range shall be determined by the pump manufacturer such that it will not result in damage to the pump through lack of cooling. When the wet well liquid level reaches the "lead pump stop", the controller shall stop the lead pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise beyond the lead pump maximum VFD frequency, the controller shall start the lag pump when the "lag pump on" level is reached. At this point, the operating pumps shall ramp up until the rpm's match, after which, all pumps shall ramp up and down together in response to the speed at which the liquid level rises or falls. Once the wet well liquid level reaches the "lead pump stop" level, the controller shall stop all operating pumps and the typical lead pump control scenario shall be re-instituted.

- 18. The level control system shall activate the "high water alarm" in the event that the liquid level continues to rise to a pre-determined setpoint. The high water alarm shall provide a signal to the Remote Monitoring System located in the Screening Building. The alarm requires a manual reset at the Lift Station Control Panel.
- 19. The level control system shall alert the operator of a low liquid level in the event the wet well level reaches the preset low water alarm set point where the alarm contact will energize an alarm relay. The controller will flash a low water alarm banner on the HMI screen to indicate such. Low water alarm will also cause interruption of electrical power to all pump motors. Power will be automatically be restored to the motors, without manual reset, when the wet well level rises to the "lead pump on" and the typical lead pump control scenario shall be re-instituted.
- 20. The level control system shall utilize a primary level-sensing transducer with redundant backup floats for: "lead pump start"; "lag pump start"; "lead pump stop" and "high water level alarm".
- B. Backup Floats
 - 1. A completely independent intrinsically safe two (2) float backup alarm system shall be provided. The float system shall provide backup alarm and control functions in the event of high level and low level conditions and shall control the pumps start and stops in the event that the level transducer system fails.
 - 2. Under the backup float operation, pumps shall operate in duplex on/off operational sequence with "Pump On" at HWL and "Pump off" at LWL, while at the same time initiating an alarm condition.
 - 3. Intrinsically safe relays shall be provided for each float. Provide sealed, mercuryfree float switches. Provide two floats with timer and a sufficient length of cable as required for an un-spliced length. All floats shall have the same length of cable to allow for full height adjustment and interchangeability. Stainless steel float mounting brackets with strain relief grommets shall be provided, to allow for adjustment of the float levels. Floats shall have weighted cable to minimize the effects of turbulence. Additional float wire supports shall be provided to prevent float wires from crossing hatch openings.

SUBMERSIBLE LIFT STATION

2.14 ALARM LIGHT

A. Station manufacturer shall supply one 115 volt AC alarm light fixture with vapor-tight red globe, guard, conduit box and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the Contractor.

2.15 ALARM FLASHER

A. The alarm light circuit shall be equipped with a repeat cycle timer causing the alarm light to flash. Flash rate shall be approximately 1 second. (1/2 second on and off).

PART 3 - EXECUTION

3.01 EXAMINATION

A. The Contractor shall off-load lift station components at the installation site using equipment of sufficient size and design to prevent injury or damage. Station manufacturer shall provide written instruction for proper handling. Immediately after off-loading, Contractor shall inspect the entire pump station and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in a written claim with shipper prior to accepting delivery. Validate all station serial numbers and parts lists with shipping documentation. Notify the Engineer and manufacturer's representative of any unacceptable conditions noted with shipper.

3.02 INSTALLATION

- A. The Contractor shall install, level, align and lubricate all equipment associated with the pump station as indicated on the project drawings, and as outlined in the O&M manual provided with the equipment. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
- B. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to station control panel.
- C. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that all protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD QUALITY CONTROL

- A. Operational Test
 - 1. Prior to acceptance by Owner, an operational test of all pumps, and control systems shall be conducted to verify that the installed equipment meets the purpose and intent of these specifications. Tests shall demonstrate that all equipment provided is electrically, mechanically, structurally, and otherwise acceptable; that it is safe and in optimum working condition; and that it conforms to the specified operating

characteristics.

2. After construction debris and foreign material has been removed from the wet well, the Contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, discharge gauge readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

3.04 MANUFACTURER'S START-UP SERVICES

A. Coordinate station start-up with the manufacturer's technical representative. The representative or factory service technician will inspect the completed installation, calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures. The pump station warranty is contingent on receipt of a complete start-up report in accordance with specification Section 1.06.E.

3.05 CLEANING

A. Prior to acceptance, inspect interior and exterior of pump station for dirt, splashed material or damaged paint. Clean or repair accordingly. Remove from the job site all tools, surplus materials, scrap and debris.

3.06 PROTECTION

A. The pump station should be placed into service immediately upon completion of field startup. If operation is delayed, the station shall be stored and maintained per the manufacturer's written instructions until it is ready for use.

END OF SECTION 43 25 00

SECTION 43 42 23 BLADDER TYPE HYDRO-PNEUMATIC TANK

PART 1 - GENERAL

1.01 APPLICATION

The hydro-pneumatic tank will be installed on the non-potable water system which will pump treated and disinfected wastewater to a distribution system which serves various needs throughout the treatment plant. Two vertical centrifugal pumps will pump water from the Ultraviolet Disinfection Effluent Basin to the distribution system and irrigation system, generally operating in a 50 to 60 psi pressure range. Variable speed control will be utilized on the pumps to regulate system pressure in conjunction with the hydro-pneumatic pressure tank.

1.02 DESIGN PRESSURE AND TEMPERATURE

- A. Maximum design pressure: 125 PSI (862 kPa)
- B. General operation pressure: 60 PSI
- C. Maximum design temperature: 240°F (115°C)

PART 2 - PRODUCT

- 2.01 TYPICAL DESIGN SPECIFICATION
 - A. Furnish and install as shown on plans John Wood Model No. JOPR-22-012, 211 gallon ASME pre-charged vertical steel hydro-pneumatic tank with a replaceable heavy-duty butyl rubber bladder or approved equal.
 - B. The tank shall have a bottom mounted 2.0" FNPT galvanized system connection and a charging valve connection (Schrader valve) with full guard to facilitate on-site charging of the tank to meet system requirements.
 - C. The tank shall be fitted with a lifting lug and angle type legs designed for vertical installation.
 - D. The tank must be designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code Section VIII, Division 1, with a stamped MAWP of 125 PSI (862 kPa) and a maximum design temperature of 240°F (115°C).
 - E. Design and installation shall comply with ASCE 7-10 seismic design standards using the following site specific parameters:

$$\begin{split} S_S &= 0.627\\ S_1 &= 0.179\\ S_{DS} &= 0.604\\ S_{D1} &= 0.389\\ \text{Seismic Design Category D}\\ \text{Risk Category III} \end{split}$$

2.02 SPECIFICATIONS

A. Designed and built in accordance with the ASME BPV Code Section VIII, Division 1

BLADDER TYPE HYDRO-PNEUMATIC TANK

- B. Installation: vertical
- C. Shell: Carbon Steel with exterior gray primer finish
- D. System connection: FNPT bottom mounted Stainless Steel coupling with stainless steel elbow
- E. Replaceable bladder: high quality butyl rubber, NSF/ANSI Standard 61 bladders are available upon request
- F. Full acceptance bladder
- G. Maximum acceptance volume is approximately 90% of the tank capacity
- H. Air charge valve: 1/4" Schrader charging valve, top mounted with protective guard
- I. Standard factory precharge: 12 PSI
- J. An automatic air vent (JHAV-63-075 or similar) must be installed in the piping to the tank to vent off accumulated air. The valve shall be installed as per tank manufacturer's instruction and capable of being isolated with two ball valves.

PART 3 - EXECUTION

- 3.01 DELIVERY, STORAGE, AND HANDLING
 - A. The tank shall be package and shipped in accordance with manufacturer's instructions.
 - B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.
 - C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit.
- 3.02 INSTALLATION
 - A. Install the tanks in strict accordance with manufacturer's Installation Manual and shop drawings. Tank installation to be reviewed using tank manual installation check list as supplied by manufacturer.
 - B. The tank must be painted as per Division 9 requirements.
 - C. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings, materials of construction, and recommended maintenance program. Four hard copies and one electronic copy of operation and maintenance manuals shall be provided.

END OF SECTION 43 42 23

DIVISION 46

WATER & WASTEWATER EQUIPMENT

SECTION 46 05 01 WASTEWATER TREATMENT PROCESS

PART 1 - GENERAL

1.01 SUMMARY

- A. The design, supply, and installation of all individual components, which collectively are integrated into a biological wastewater treatment process, shall be specified herein.
- B. The work shall include furnishing all process design materials including a comprehensive design report illustrating basis of design, design calculations, equipment sizing, spreadsheets, and all reference materials. Compliance with Montana DEQ regulatory standards (Circular DEQ-2) shall be demonstrated.
- C. The work shall include furnishing all equipment packaged as a complete biological wastewater treatment process capable of achieving effluent limits as required by the engineer.
- D. The work shall include furnishing a supervisor to ensure proper installation of all biological wastewater treatment process equipment and provide necessary start-up and training required for ongoing operations of the equipment and process.
- E. The work shall include furnishing a process warranty according to the owner's criteria.

1.02 DESIGN CRITERIA

- A. TheLemTecTM Wastewater Treatment System installed at the above facility has been designed per the following criteria:
 - 1. Hydraulic Loading
 - a. Current ADF 130 gpm (187,200 gpd)
 - b. Design ADF 165 gpm (237,600 gpd)
 - c. Current Wet Weather Flow* 165 gpm (237,600 gpd)
 - d. Design Wet Weather Flow* 200 gpm (288,000 gpd)
 - e. Design Peak Day Flow 260 gpm (374,400 gpd)
 - f. Design Peak Hour Flow 400 gpm (576,000 gpd) **Wet weather flow typically occurs in May-July*

2. Influent Values

- a. Influent BOD (monthly average)
- b. Influent TSS (monthly average)
- c. Influent NH₃-N (monthly average)
- d. Estimated influent water temperature
- e. Influent pH (daily average)
- 3. Effluent Standards
 - a. Monthly Average Effluent BOD₅ \leq 45 mg/l (summer)

 $\leq 319 \text{ lbs/day}$ $\leq 352 \text{ lbs/day}$ $\leq 32.5 \text{ lbs/day}$ $\geq 10^{\circ} \text{ C (minimum)}$ = 7.2-8.6

- b. Monthly Average Effluent TSS $\leq 30 \text{ mg/l} \text{ (summer)}$
- c. Ammonia Limits (mg/l)

	Mar-Jun	Jul-Oct	Nov-Feb
MDL	29.9	2.8	26.3
AML	14.9	1.4	13.1

1.03 QUALIFICATIONS

- A. The design of the biological wastewater treatment process shall be supplied by Lemna Environmental Technologies, Inc. or approved equal. Alternative process suppliers and/or equipment manufacturers who wish to be considered must submit to the Engineer all process design materials as specified in 1.01.B. above, all equipment specifications and submittal drawings, equipment operation and maintenance manuals, CPA audited financial data from previous 12 months, list of all installations and the name, address, contact and telephone numbers of the owners of the last 10 U.S. installations no later than 15 days prior to the bid opening to allow engineer adequate time to evaluate alternative designs.
- B. The process supplier shall be experienced in the design, supply, installation, start-up, and operation of similar installed systems as demonstrated by a minimum of 20 years in the wastewater treatment process business and a minimum of 50 installed systems.
- C. The process supplier shall have full time engineers specializing in wastewater treatment and licensed wastewater operators employed at their place of business to provide design services, installation supervision, start-up, training, and ongoing technical operations support.

1.04 SUBMITTALS

A. The General Contractor shall furnish a submittal package from the Process Supplier to the Engineer for approval prior to fabrication. The submittal package shall include a layout drawing and individual system component drawings, as specified herein; individual component cut-sheets; and product and process warranty.

PART 2 - PRODUCTS

- 2.01 The process supplier shall be responsible for supply and related warranties for equipment listed in Part 2 of this specification.
 - A. Aeration System
 - The process supplier shall provide a complete aeration system according to product specification section 43 12 51 Rotary Lobe Blowers, 46 51 31 Aeration System Diffusers.
 - B. Modular Insulated Floating Cover
 - 1. The process supplier shall provide a complete modular insulated floating cover system according to product specification section 33 88 33 Insulated Pond Cover.

- C. Control Panel
 - 1. The process supplier shall provide a complete control panel according to product specification section 43 12 51 and 26 29 23.
- D. Polishing Reactor
- 2.02 The process supplier shall provide a complete polishing reactor system according to section 46 23 54 Polishing Reactor.
- 2.03 The process supplier shall provide process design materials including a comprehensive design report illustrating basis of design, design calculations, equipment sizing, spreadsheets, and all reference materials.
- 2.04 The process supplier shall provide all equipment packaged as a complete biological wastewater treatment process.
- 2.05 The process supplier shall provide all services required to supervise proper installation of all supplied equipment and to provide necessary start-up and training required for ongoing operations of the equipment and process.

PART 3 - INSTALLATION, WARRANTY AND PERFORMANCE

- 3.01 INSTALLATION
 - A. Aeration Equipment
 - 1. Contractor shall furnish, inspect, store, and install aeration system in accordance with manufacturer's written instructions and approved submittals.
 - 2. Diffuser assemblies on a common grid shall be installed within an elevation tolerance of $\pm \frac{1}{2}$ inches.
 - 3. Contractor shall provide all valves, air header piping, wall sleeves with seals, wall pipes, and concrete pedestals as necessary to complete the system as shown on the plans.
 - 4. Air piping including blower manifold, header, and in-basin piping must be clean prior to delivering air up the diffusers.
 - 5. Installation Contractor shall be responsible for cleanliness of piping and may be required to manually clean pipe, or air or water flush piping as required.
 - B. Influent Plug Valves, Aeration Butterfly Valves and Decanter Valves
 - 1. Contractor shall furnish, inspect, store and install all automated/manual valves and actuators in accordance with manufacturer's written instructions and approved submittals.
 - 2. Valves and actuators shall be routinely exercised while stored to prevent seizing.

3.02 START-UP

After installation is completed, the Contractor shall perform the following field tests in the presence of the Engineer and the Owner

- A. Aeration Equipment
 - 1. Fill the reactor to the bottom of the diffuser assemblies.
 - 2. Adjust the pipe supports and diffuser assemblies such that all diffuser units are installed within $\pm \frac{1}{2}$ inches of the design diffuser elevation.
 - 3. Fill the reactor to a level of 2 feet above the top of the diffusers.
 - 4. Release air to the system and inspect the system for air leaks at all piping or diffuser connections.
 - 5. Check all membrane for cuts or tears that may have occurred during the installation.
 - 6. Adjust any piping or diffusers that show leaks or disproportionate amount of airflow.
 - 7. Operate the blowers at the design air rate and observe air release and air distribution patterns. After this exercise, the aeration system shall be controlled to function effectively and current wastewater flows and loads, minimizing energy use where possible.
- B. Valves
 - 1. Influent plug valves, aeration butterfly valves and effluent decanter valves shall be operated through a minimum of 3 cycles (under typical operating conditions) using the manual actuators and shall be adjusted by the Contractor to meet the open/close limits as required by the manufacturer.
- C. All water, air, power and labor associated with testing and adjustment of aeration system, mixers, control valves, decanters, etc. are to be supplied by Contractor.
- 3.03 FIELD SERVICES, START-UP AND TRAINING
 - A. The services of the field representative for the Supplier shall include minimum five (5) days, exclusive of travel time, and two (2) travel. The Owner shall notify the manufacturer a minimum of ten (10) working days prior to the time that the field services are desired.
 - B. The Owner or Contractor shall notify supplier when the installation of the LemTec equipment has been completed. A representative of the supplier shall inspect the installation. The Owner shall be advised in writing of any corrections or adjustments that are required for the LemTec equipment installation. After the LemTec installation has been completed to the supplier's satisfaction, a letter of certification that all equipment is installed in accordance with its instructions and that the LemTec equipment is ready for operation shall be furnished.
 - C. A process engineer shall complete operator process training onsite, including review of the controls description, a discussion of the process control features, and recommendations for process adjustments.
- 3.04 OXYGEN TRANSFER TEST
 - A. Provide performance testing information as needed to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.

- B. Testing should generally meet the following criteria:
 - 1. A minimum of 3 tests for each specified condition in complete accordance with ASCE Clean Water Test Procedure (1992 or latest edition)
 - 2. Conduct tests by an independent aeration testing firm in a full scale aeration test tank (minimum of 300 sq. ft.) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.
 - 3. Conduct shop test with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.
 - 4. Plot of pounds of oxygen per day per 1000 cubic feet of tank volume versus air per 1000 cubic feet of tank volume in tap water at 14.7 psig, 20°C and zero dissolved oxygen at the specified submergence.
- C. Certify and stamp all tests by a registered Professional Engineer.

3.05 CERTIFIED OXYGEN TRANSFER PERFORMANCE CURVES

- A. Submit certified oxygen transfer performance curves to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.
- B. Base oxygen transfer curves on the following criteria:
 - 1. A minimum of 3 tests for each specified condition in complete accordance with ASCE Clean Water Test Procedure (2006 or latest edition)
 - 2. Tests conducted in a full scale aeration test tank (minimum of 200 sq. ft.) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.
 - 3. Tests conducted with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.
 - 4. Certify and stamp all curves by a Professional Engineer.
 - 5. Submit curves for all specified conditions for approval by the Engineer prior to manufacturing aeration equipment.

3.06 PREVENTATIVE MAINTENANCE AND OPERATIONAL SERVICES

- A. Provide preventative maintenance and operational services for the first year of operation after the warranty period is initiated.
- B. Onsite services
 - 1. Provide two site visits during the first year of operation
 - 2. Site visits shall consist of one day onsite and be coordinated between the owner and supplier a minimum of ten working days prior to the time that the field services are desired.

- 3. Site visits shall be completed by a qualified biological process engineer experienced in the LemTec process.
- 4. Site visits shall include the following services:
 - a. Visual check of bubble patterns in each basin/grid. Dissolved oxygen data shall also be collected to assess performance of the aeration system.
 - b. Review of process performance during variable loading and climatic conditions
 - c. Collection of performance data
 - d. Examine supplied pipework and associated joints perform leak and level testing [customer must drain basin(s) for this step to be completed]
 - e. Inspection and assessment of supplied instrumentation
 - f. Refresher process training
 - g. Review of biological process operating data and effluent requirements
- 5. Upon completion of the onsite inspection a complete written report shall be provided detailing energy use, process assessments and recommendations.
- C. Remote services
 - 1. Provide remote process support and troubleshooting including review of operating data and control strategies
 - 2. Provide remote reporting modifications and changes
 - 3. Provide electrical and mechanical phone support 24 hours per day, 7 days per week
- 3.07 OPERATION AND MAINTENANCE MANUAL
 - A. Four (4) paper copies and two (2) flash drives (or as specified by Owner) with electronic copies of the Operation & Maintenance Manuals shall be furnished during start-up. These manuals shall include maintenance instructions for all equipment provided. See Section 01 78 23 for more detail on O&M Manual and Training.
 - B. Operation & Maintenance Manual shall include a Functional Design Specification (description of control software logic) and Operational Description (description of process).

3.08 MECHANICAL WARRANTY AND PERFORMANCE GUARANTEE

Seller shall furnish its standard warranty against defects in material and workmanship for all Equipment provided by Seller under this Section. Manufacturer shall guarantee all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of twenty (24) months (unless otherwise specified) after the project is substantially complete and final acceptance of the equipment has been granted.

- 3.09 BIOLOGICAL PROCESS PERFORMANCE GUARANTEE
 - A. Supplier of the LemTec process shall provide a Process Performance Guarantee to the Owner, guaranteeing the LemTec process shall meet effluent wastewater quality, as

determined during the Performance Test. Performance testing shall occur during the first year of operation and shall include consideration of the variation in hydraulic and organic loading and the influence of weather conditions as they impact process performance. Demonstration of plant performance capability at design conditions shall be simulated. Performance testing shall be completed with the one-year operational services provided under Paragraph 3.06 of this section.

- B. The full Process Performance Guarantee language and details of the Performance Test; defining conditions of guarantee, responsibilities, testing protocol, sampling, and analysis shall be provided with the Equipment Submittal.
- C. The Supplier shall guarantee that the LemTec process shall meet effluent wastewater quality, as determined during the Performance Test equal to or less than the effluent quality as defined in Section 1.02 Effluent Quality Requirements.
- D. Characteristics of the influent wastewater to the LemTec process shall be defined by Section 1.02. Influent BOD, TSS, and ammonia loadings are defined by the maximum monthly flow and the respective concentrations as outlined.
- E. Limitation Of Liability Supplier shall not be liable for indirect, special, incidental or consequential damages of any description, whether arising out of warranty or any other contract, negligence or other tort, or otherwise. The parties expressly agree that the limitations of damages set forth herein are agreed allocations of risk and shall survive the determination of any court or competent jurisdiction that any remedy provided herein fails of its essential purpose. Under no circumstances shall Supplier's liabilities hereunder exceed the purchase price paid to the Supplier for the LemTecTM Wastewater Treatment System, its components or its services in question.

END OF SECTION 46 05 01

SECTION 46 21 33 ROTARY SCREEN

PART 1 - GENERAL

- 1.01 There will be furnished one Model HLS 300M 35 Helisieve Spiral Screening unit, as manufactured by Parkson, Vernon Hills, IL, or approved equal. The Helisieve unit will consist of: a spiral assembly, screen basket, transport tube, press zone assembly, drive system, pivot stand, bagger and controls.
- 1.02 The influent stream to be screened will be introduced to the internal surface of the screen basket with the solids being retained on the surface of the basket until transported up the spiral. The solids will then be dewatered and discharged. The Helisieve unit will be installed at 35 degrees in a 16.0 inch-wide channel, and will have a channel depth of 77.28 inches at the influent end and 78.48 inches at the effluent end. The Helisieve unit will have a clearance of 52.08 inches between ground level (top of channel same elev.) and the bagging device. These dimensions must be verified by the contractor during construction.
- 1.03 Performance. The screen will have a capacity of 0.576 MGD peak flow and a typical influent suspended solids concentration of 250 mg/l. The influent to the screen will flow by gravity and the wastewater flow and constituents therein are derived from a medical institution. The screen shall effectively remove solid particles larger than the screen openings, wash organics back to the flow stream, compact, dewater and deliver the removed material to a receptacle. Screened material shall be sufficiently dewatered so as to pass the "paint filter test" prior to disposal in a landfill. The design and performance of the screen shall minimize odor generation.
- 1.04 Specifications and equipment arrangement are based on the Model HLS 300 M 35 by Parkson, and changes to this arrangement will be at the expense of the installing contractor. The screen manufacturer will have a minimum of 5 years of design and manufacturing experience with shaftless spiral screening units, with not less than 50 similar units installed as screening devices in similar applications. Manufacturer will include U.S. installation list with the equipment submittal.
- 1.05 Any changes in or alternates to the specified equipment must fit within the building footprint and height as shown on the contract drawings.

PART 2 - CONSTRUCTION AND MATERIALS

- 2.01 SPIRAL ASSEMBLY
 - A. The spiral assembly will consist of the spiral, brush and drive shaft.
 - B. Spiral. The spiral will be shaftless except in the press zone and discharge section and will be constructed of high-strength carbon steel. The spiral will be constructed of two concentric flights formed continuously from bar stock and welded together to form a spiral. The outer spiral will have a thickness of 0.59 inches and the inner spiral will have

a thickness of 0.39 inch. The spiral will have a constant inner diameter through the entire length. The spiral outer diameter shall be 7.68 inches in the transport section and will transition to 10.23 inches in the basket with additional flight welded to the outer spiral.

- C. Brush. The spiral in the screen basket will be fitted with a water-resistant brush, which will clean the screen basket openings and be fastened to the trailing side of the spiral edge in the screen basket. Each brush section will be molded into a plastic core and cover a 180 degree section of the spiral. Brush sections will be mounted to form a continuous brush and clean the entire basket area during operation. The brush sections will have stainless steel nuts pressed into the core and can be attached to the spiral with stainless steel fasteners.
- D. Shaft. The spiral shaft will be constructed of carbon steel and welded to the spiral. The shaft will include a flange with a bolted connection to the drive shaft stub flange for ease of disassembly for maintenance.

2.02 SCREEN BASKET.

- A. The screen basket will be constructed of 11 gauge perforated 316 stainless steel. The screen basket will be fitted with rubber flaps to provide a seal between the channel walls and the screen basket. The screen openings will be 1/4 inch diameter standard.
- 2.03 BASKET SPRAY WASH SYSTEM.
 - A. The spray wash system will have nine (9) stainless steel nozzles to aid in the conveyance of screened material from the screen basket and removal of organics. The spray system will have an output of approximately 9 GPM at 40 psig (11 GPM at 60 psi). Pipe and fittings will be Schedule 40. A 3/4" NPT solenoid valve will be provided to operate the water spray system automatically. The solenoid valve body will be of brass. The control system for the spray wash will allow for both automatic or manual operation, at the discretion of the operator.

2.04 TRANSPORT TUBE.

A. The transport tube is constructed of 11 gauge type 316 stainless steel and includes a tapered transition section to convey screenings from the screenings basket, through the straight transport section, and then to the press zone. The transport tube will be fitted with four (4) wear bars in the transition section and four (4) wear bars in the straight section to prevent the spiral from wearing on the surface of the tube. The wear bars will be constructed of .38" thick stainless steel. The wear bars will be fixed to the taper and straight sections of the tube by cap screws inserted through the tube and threaded into tapped holes in the wear bars. This construction will allow for ease of replacement and monitoring of wear rate on the bars by periodic removal and length measurement of the cap screws.

2.05 PRESS ZONE ASSEMBLY.

- A. The press zone assembly will consist of a press zone enclosure, a compaction tube, a spray flush system, and a discharge chute.
- B. Press Zone Enclosure -The press zone enclosure will be mounted to the end flange of the

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transport tube, and be constructed of minimum ¹/₄" type 316 stainless steel. The enclosure will include provision to mount the gear reducer, compaction tube and discharge chute. The enclosure shall have a top mounted hinged lid for full access to the press zone and discharge sections. The lid shall be secured with latches for easy access and have an interlock switch to stop the screen when the lid is open.

- C. Compaction Tube-The compaction tube will be flange mounted to the inside of the press zone enclosure. The bottom half of the tube will have 1/8" perforations to drain the screenings pressate.
- D. Spray Flush System-The spray flush system will have one spray header mounted to the enclosure, which will flush the pressate into a discharge hose to be returned to the downstream side of the screen. The spray system will have an output of approximately 8 GPM at 40-60 psi and can use non-potable water. Pipe and fittings will be 1/2 " NPT Schedule 40 stainless steel.
- E. Discharge Chute-The discharge chute will be bolted to the bottom of the press zone enclosure. It will include a drain under the compaction tube, and have a discharge opening under the discharge section. The pressate and flush water will be directed into a discharge hose to be returned to the downstream side of the screen. The discharge opening will direct screenings to the solids receptacle or solids handling equipment.
- F. Bagging Device The end of the discharge section pipe will be equipped with a 316 stainless steel adapter plate to mount a bagging device to contain and enclose the pressed screenings. The device will be fitted with a replaceable magazine of continuous clear plastic hose, 22 inches in diameter by 260 feet long, and 1.5 mils thick. Additionally, an extra magazine of plastic bagging hose shall be provided.

2.06 DRIVE SYSTEM.

- A. The spiral drive system will be fitted with a single speed, dual voltage, Class I, Division 1, Group D explosion-proof rated motor direct coupled via an AM143 C-face adapter, to a SEW-Eurodrive FAF type helical gear reducer. The electric motor will be 1.0 HP, 1800 RPM, 230/460 volt, 3 Phase, 60 Hz, FCXP. The gear reducer will be AGMA Class II service based on the horsepower required to operate the screen and will have an output speed of 11 RPM.
- 2.07 PIVOT STAND.
 - A. The Helisieve unit will have a support stand with integral pivot. The stand's structural members will be constructed of stainless steel with a minimum thickness of 0.13 inch. The integral pivot will allow rotation of the unit out of the channel and lateral pivoting above the channel for ease of maintenance.

2.08 SURFACE FINISH

A. Surface Treatment of Stainless Steel Components. All stainless steel subassemblies will be acid passivated after welding for corrosion resistance and to provide a superior surface finish. This will be done by full dipping of weldments; or by using an acid passivation paste in the weld and heat affected areas and spray-on acid solutions elsewhere. After

passivation, the weldments will be thoroughly rinsed with clean water and allowed to air dry. Sandblasting, bead blasting or grit blasting of stainless steel surfaces will not be allowed in lieu of acid passivation.

- B. The spiral will be prime coated for protection during shipment. Final coating will be provided as recommended by the manufacturer.
- C. The motor and gear reducer, and all unit-mounted electrical devices, will have the standard manufacturer's finish.

PART 3 - ELECTRICAL DEVICES AND CONTROLS

- 3.01 ELECTRICAL DEVICES.
- 3.02 Interconnecting conduit and wiring will be the responsibility of the installing contractor. All electrical components utilized for the screening equipment shall be designed for use in a NEC Class I, Division 1, Group D environment. In addition to the drive motor, the following electrical devices will be furnished with each unit:
- 3.03 EXPLOSION-PROOF SOLENOID VALVE.
 - A. There shall be two (2) 120 volt, single phase, 60 Hz solenoid valves housed in NEMA 7 enclosures with 18-inch-long integral leads. The solenoid valves will be for the screen basket spray and for the pressure zone spray.

3.04 EXPLOSION-PROOF INTERLOCK SWITCH.

A. The NEMA 7 access door interlock switch will indicate when the press zone cover is opened.

3.05 INTRINSICALLY SAFE FLOAT SWITCHES

- A. The mercury free float switch will be of polypropylene construction, and will have a type 316 stainless steel pipe mounting bracket, and a float mounting clamp. The pipe mounting bracket and float mounting clamp require a suitable length of 1 inch pipe to suspend the float in the channel, by others. The float will have a 20-foot-long integral cable. An intrinsically safe barrier relay will be mounted in the main control panel. A similar switch will be used as for a high level alarm notification system.
- 3.06 EXPLOSION-PROOF EMERGENCY STOP LOCAL PUSH BUTTON STATION.
 - A. A NEMA 7 emergency stop push button station will be mounted to the support stand.
- 3.07 CONTROLS. The following controls will be provided:
 - A. A 480 volt primary U.L. listed and labeled control panel in a NEMA 4X type 304 stainless steel enclosure suitable for wall-mounting. The control panel will be located in a separate room outside of the classified environment where the screen will be installed. It will contain the following logic devices for proper operation of the equipment:
 - 1. Programmable relay to monitor equipment mounted electrical devices to perform necessary logic functions.
 - 2. Emergency Stop push button.

- 3. Hand-Off-Auto selector switches for the drive and spray wash.
- 4. Forward-Off-Reverse selector switch for the spiral drive.
- 5. Control power and spiral run incandescent indicating lights.
- 6. Spiral motor current monitor and hour meter.
- 7. Fault and fault reset push button incandescent light.
- 8. Run and fault auxiliary output contacts for customer use.
- B. A step-down control transformer, IEC rated reversing motor starter and fused main disconnect will be provided.

3.08 SEQUENCE OF OPERATION

- A. Hand Operation. The spiral motor and spray wash will run continuously.
- B. Automatic Operation. The level sensor will start the unit in the forward direction. After the upstream level has been lowered, the unit will continue to run for the length of time set per the off delay timer, typically set at 30 seconds. After forward operation is complete, the unit will stop and then operate in reverse for a short duration.

The press zone spray wash will provide a periodic flush based on the settings of an independent repeat cycle timer.

If provided, a basket spray will operate whenever the screen runs forward or by manual operation.

Timer Control of Operation - The control system will activate the screen based on water elevation in the influent channel or as a function of a preset time sequence selected by the operator.

- C. Emergency Stop-The unit can be deactivated at any time by pressing either the control panel mounted or unit mounted Emergency Stop push button.
- D. Fault Conditions- Motor overload or high current will stop the drive motor and illuminate the fault light. Any fault conditions will trigger an general alarm which will be sent to the plant's remote alarm notification system
- E. High Level Alarm A high level in the influent channel to the screen will trigger an general alarm which will be sent to the plant's remote alarm notification system.

PART 4 - SPARE PARTS

4.01 Unless otherwise specified, no spare parts will be provided.

PART 5 - ANCHOR BOLTS

5.01 In accordance with manufacturers recommendations, the installing contractor will furnish 1/2"-13UNC by 7 ½ inches long to anchor the screen unit. Equipment supplier shall furnish 3/8"-16UNC by 3-3/4 inches long stainless steel expansion anchors to secure the level sensor mounting brackets.

PART 6 - FACTORY SERVICE

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6.01 Helisieve unit manufacturer will provide factory service during one (1) trip, for one (1) day, for inspection of installation, equipment start up and operator training. The manufacturer or the manufacturer's representative shall be available to the Owner for phone consultation at no additional expense.

PART 7 - FACTORY ASSEMBLY, TESTING AND INSPECTION

7.01 The unit will be factory operated and inspected prior to shipment. The Engineer and/or Owner may, at their option and own expense, witness the factory test.

PART 8 - INSTALLATION, OPERATION AND MAINTENANCE MANUAL

8.01 In addition to the normal Installation, Operation and Maintenance Manuals required by contract in Specification 01 78 23 a spare manual will be shipped with the unit in order to allow for proper operation of equipment prior to release of all final Installation, Operation and Maintenance Manuals to the end user.

END OF SECTION 46 21 33.

SECTION 46 23 54 LEMNA POLISHING REACTOR (LPR)

PART 1 - GENERAL

1.01 SUMMARY

- A. The design, fabrication, supply, and installation of the polishing reactor system shall be as specified herein. The LPR system shall be located in a singular concrete basin as shown on the drawings. Ten polishing modules shall be provided in the concrete basin. The basin will be covered with an insulated floating modular cover. The primary purpose of the LPR system is to nitrify ammonia compounds in the treated wastewater discharged from the lagoon system, as required to meet prescribed effluent requirements.
- B. The work shall include furnishing equipment, material and supplies to complete the work as specified herein.
- C. The polishing reactor system shall be shipped for final assembly in the field. The system modules and aeration assemblies shall be connected together and anchored as shown in the drawings.

1.02 QUALIFICATIONS

- A. The design and supply of the polishing reactor system shall be by Lemna Environmental Technologies, Inc. Alternative equipment manufacturers who wish to be considered must submit to the Engineer equipment specifications and submittal drawings, equipment operation and maintenance manual, CPA audited financial data from previous 12 months, list of all installations and the name/address/contact/telephone numbers of the owners of the last 10 U.S. installations. Above information is due no later than 15 days prior to the bid opening to allow engineer adequate time to perform due diligence.
- B. The polishing reactor system supplier shall be experienced in the manufacture, installation, and operation of specified polishing reactor, as demonstrated by a minimum of 10 years in the polishing reactor business and a minimum of 25 installed polishing reactor systems.
- C. The polishing reactor system supplier shall be experienced in the design, integration, and installation of similar polishing reactors when used in conjunction with aerated pond systems, as demonstrated by a minimum of 10 years' experience and a minimum of 25 installed polishing reactor/aerated pond systems
- D. The polishing reactor system supplier shall be experienced in wastewater treatment processes and shall be prepared to demonstrate the effect on the client's process of the polishing reactor supplied through documented analysis relating to flow, hydraulic retention time, and biological contact.
- E. The polishing reactor system supplier shall have full time registered engineers specializing in wastewater treatment and licensed wastewater operators employed at their

place of business to provide design services, installation supervision, start-up, training, and ongoing technical operations support.

F. The polishing reactor system supplier shall have documented water and wastewater treatment and design experience for a minimum of twenty (20) years.

1.03 SUBMITTALS

A. The polishing reactor system supplier shall furnish a submittal package to the Engineer for approval prior to fabrication. The submittal package shall include polishing reactor plan and section drawings showing all appurtenances, drawings of individual components showing dimensions and materials of construction, individual component cut-sheets, and warranty.

PART 2 - PRODUCTS

2.01 POLISHING REACTOR SYSTEM

- A. The polishing reactor system shall consist of a specified number of discrete polishing modules composed of the individual components specified herein and a modular cover of equal R value as specified in Section 33 88 33.
- B. The polishing reactor system serves as an integral part of the overall wastewater treatment process, primarily to remove ammonia in the treated effluent originating from the aerated lagoon system. Standards for ammonia are described in Specification 46 05 01. The polishing reactor system supplier shall guarantee their product provides adequate treatment and shall accept responsibility for the final effluent quality according to the end user's requirements.

2.02 FIXED FILM BIOLOGICAL TREATMENT MEDIA

- A. The fixed film biological treatment media is fabricated from rigid polyvinyl chloride (PVC) sheets completely corrugated and forming a cross-corrugated pattern with each adjacent sheet, permitting continuous internal horizontal redistribution of both air and wastewater throughout the entire depth of media.
- B. To ensure adequate contact time and liquid film diffusion, the media shall be capable of redistributing the wastewater horizontally a minimum of 1 meter per meter (one foot per foot) of media depth. The media provides a minimum of 120 mixing or horizontal redistribution points per 0.02832 cubic meters (1 cubic foot) of media.
- C. The fixed film media is designed with a surface area of more than 0.223 square meters per cubic meter (more than 72 square feet per cubic foot) of media with a minimum 95% void to volume ratio.
- D. The fixed film biological treatment media PVC sheets shall be resistant to rot and fungal growth, and be chemically resistant to normal municipal concentrations of sewage acids, alkalis, organic solvents and organic compounds.
- E. The PVC compound shall be UV resistant and specially formulated to resist long-term fatigue cracking under continuous loading.

- 2.03 MEDIA SUPPORT FRAME
 - A. The media support frame shall be fabricated from 2 inch x 2 inch x 1/8 inch 316 stainless steel angles and fastened together with 1/4 inch threaded 316 stainless steel rods as shown on the drawings.
 - B. All hardware shall be 316 stainless steel.
- 2.04 BLOWER SYSTEM
 - A. Refer to Section 43 12 51 (Rotary Lobe Blower).
- 2.05 PRE-AERATION DIFFUSER ASSEMBLY
 - A. Refer to Section 46 51 31 (Diffused Aeration System Diffusers).
- 2.06 REACTOR DIFFUSER ASSEMBLY
 - A. The aeration piping used in the reactor diffuser assembly shall be constructed of Schedule 40 PVC tubing in the configuration shown on the drawings.
 - B. All feedlines shall be 1-1/4 inch EPDM flexible hose fastened with stainless steel hose clamps.
 - C. All assembly fittings shall be of Schedule 40 or greater PVC piping.

PART 3 - EXECUTION

- 3.01 All fabrication and welding of the individual components of the polishing reactor system shall be performed in a climate-controlled building.
- 3.02 The polishing reactor system shall be designed to enable installation of the reactor in either a full or empty basin.
- 3.03 The polishing reactor system supplier shall provide installation supervision services as part of overall polishing reactor system supply.
- 3.04 The polishing reactor system supplier shall provide technological wastewater treatment start-up services as part of overall polishing reactor system supply.

PART 4 - WARRANTY

- 4.01 The polishing reactor supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of twenty-four (24) months from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective.
- 4.02 The polishing reactor supplier shall be responsible for guaranteeing effluent quality according to the end user's requirements, as the polishing reactor is an integral part of the overall treatment process.

END OF SECTION 46 23 54

SECTION 46 51 31 AERATION SYSTEM DIFFUSERS

PART 1 - GENERAL

1.01 SUMMARY

- A. The design, fabrication, supply, and installation of the diffused aeration system shall be as specified herein.
- B. The work shall include furnishing equipment, material and supplies to complete the work as specified herein.
- 1.02 QUALIFICATIONS
 - A. The design and supply of the diffused aeration system shall be by Lemna Environmental Technologies, Inc. Alternative equipment manufacturers who wish to be considered must submit to the Engineer equipment specifications and submittal drawings, equipment operation and maintenance manual, CPA audited financial data from previous 12 months, list of all installations and the name/address/contact/telephone numbers of the owners of the last 10 U.S. installations. Above information is due no later than 15 days prior to the bid opening to allow engineer adequate time to perform due diligence.
 - B. The diffused aeration system supplier shall be experienced in the manufacture, installation, and operation of specified aeration systems, as demonstrated by a minimum of 20 years in the aeration system business and a minimum of 50 installed aeration systems.
 - C. The diffused aeration system supplier shall be experienced in the fabrication, assembly, and welding of polyethylene and ductile iron piping as demonstrated by a minimum of 10 years' experience in the piping business and a minimum of 50 installed diffused aeration systems.
 - D. The diffused aeration system supplier shall be experienced in the manufacture, design, integration, and installation of similar aeration systems when used in conjunction with modular insulated floating pond covers, as demonstrated by a minimum of 20 years' experience in the aeration system business and a minimum of 10 installed diffused aeration/ modular cover systems.
 - E. The diffused aeration system supplier shall be experienced in wastewater treatment processes and shall be prepared to demonstrate the effect of the aeration system supplied on the client's process through documented analysis relating to flow, hydraulic retention time, and biological contact.
 - F. The diffused aeration system supplier shall have full time registered engineers specializing in wastewater treatment and licensed wastewater operators employed at their place of business to provide design services, installation supervision, start-up, training, and ongoing technical operations support.
 - G. The diffused aeration system supplier shall have documented water and wastewater

AERATION SYSTEM DIFFUSERS

treatment and design experience for minimum of 20 years.

1.03 SUBMITTALS

- A. The diffused aeration system supplier shall furnish a submittal package to the Engineer for approval prior to fabrication. The submittal package shall include a diffused aeration system plan drawing showing all appurtenances, drawings of individual components showing dimensions and materials of construction, individual component cut-sheets, and product warranty.
- B. Upon installation and startup the aeration system supplier will assess the capability of the system to transfer oxygen into wastewater, utilizing field measurements of dissolved oxygen in a systematic cross-sectional analysis of each of the lagoon cells, including measurements at variable depths. The first cell shall be completely mixed and a minimum dissolved oxygen level of 2.0 mg/l found throughout under all anticipated conditions. The supplier shall also demonstrate that the partially mixed cells have sufficient aeration to maintain aerobic conditions in the upper 5.0 to 6.0 feet of the lagoon cell. If under proposed design conditions, the aeration system cannot provide sufficient oxygen, the aeration equipment supplier shall add additional diffuser units to improve the aeration capacity of the system, at no additional cost.

PART 2 - PRODUCTS

2.01 AERATION SYSTEM

- A. The diffused aeration system shall consist of specified quantities of individual components, including a blower system, a diffuser system, and in-basin piping.
- B. The diffused aeration system serves as an integral part of the overall wastewater treatment process described in Specification 46 05 01. The diffused aeration system supplier shall guarantee their product provides adequate treatment and shall accept responsibility for final effluent quality according to end users' requirements.

2.02 DIFFUSER SYSTEM

- A. A complete diffuser system shall consist of all diffuser components, including the connection to the feedline through the hardware for connection to the anti-flotation base. One supplier shall supply all components. Diffuser details are included in the drawings.
- B. The diffuser shall be a flexible membrane tube type diffuser.
- C. The diffuser shall achieve standard oxygen transfer efficiency (SOTE) of 1.44% per foot depth of submergence.
- D. Each diffuser shall be provided with a lifting point for cleaning or replacement of the membrane without lowering the pond. Each lifting point shall be equipped with a minimum 1/8" PVC wrapped stainless steel aircraft cable fitted with stainless steel clips. The lift cable shall be attached to the air lateral with a strap or suitable fitting not subject to movement or wear.
- E. Each diffuser shall be constructed in such a manner that the membrane is held to the

support tube without glues or mastics.

- F. The construction of the diffuser shall allow automatic purging of water from the aeration system during start-ups without additional components.
- G. Anchoring hardware for the diffuser shall be provided with each diffuser.

2.03 IN-BASIN PIPING

- A. A complete aeration piping system shall include the flange adapter, aeration lateral, feedline pipe, stainless steel hose clamps, and miscellaneous fittings. One supplier shall supply all components.
- B. Flange Adapter
 - 1. Flange adapter shall consist of a flange adapter with back up plate. All nuts, bolts and washers shall be supplied with header piping.
- C. Aeration Lateral
 - 1. The aeration lateral piping and fittings shall be assembled using a butt fusion welder as directed by the diffused aeration system supplier.
 - 2. Minimum pipe physical properties shall be as those designated by PE 3408 Industrial Piping.
 - 3. The minimum pipe pressure ratings for different pipe size thickness shall be as follows:

Thickness	Rating
1 ¼ " (3.2mm)	SDR11 1103.2 kPa/160 psi
2" (50.8 mm)	SDR11 1103.2 kPa /160 psi
3" (76.2mm)	SDR17 689.5 kPa /100 psi
4" (101.6mm)	SDR17 689.5 kPa /100 psi
5" (127mm) or greater	SDR17 689.5 kPa /100 psi

- 4. All tees and crosses shall be fabricated by Sidewall Fusion or equivalent.
- 5. Approved lateral piping shall be Driscopipe 8000 as manufactured by Phillips 66, Georg Fisher or equivalent.
- 6. Lateral piping shall be High Density Polyethylene (HDPE) pipe.
- D. Feedline Piping
 - 1. Feedline piping shall be EPDM (Ethylene Propylene Diene Monomer) reinforced with spiral synthetic cords.
 - 2. Feedline piping shall be Yeoman 250 Hose as manufactured by YEOMAN, Valuflex, Parker or equivalent.
- E. Stainless Steel Hose Clamps
 - 1. Hose clamps shall be of the worm-gear type with the entire assembly constructed of stainless steel.

- 2. Clamps shall be as manufactured by Dixon or equivalent.
- F. Miscellaneous Fittings
 - 1. All fittings such as elbows, reducers, tees, crosses, etc., shall be constructed of the same material as the aeration lateral.

PART 3 - EXECUTION

- 3.01 The diffused aeration system supplier shall provide installation supervision services as part of overall diffused aeration system supply.
- 3.02 The system supplier shall oversee the startup of the diffuser system including adjusting air flow to the three aeration cells, laterals and diffuser units to insure that aeration is balanced and consistent with the original design intent. A profile of dissolved oxygen levels will be developed by the system supplier to verify proper distribution of oxygen. A final report summarizing this information will be prepared by the system supplier and provided to the Engineer for review.
- 3.03 The diffused aeration system supplier shall provide technological wastewater treatment start-up services as part of overall diffused aeration system supply.

PART 4 - SPARE PARTS

4.01 Two complete spare diffuser assembles with drop pipe and retrieval cable shall be provided. Additionally, five spare membrane sheaths shall be provided.

PART 5 - WARRANTY

5.01 The aeration system supplier shall warrant to buyer that all components furnished will be free from defects in materials and workmanship for a period of twenty-four (24) months from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective components or services or refund payments to buyer for the components or services found to be defective. The warranty will also cover the installation and performance of the diffuser system.

Seller shall furnish its standard warranty against defects in material and workmanship for all Equipment provided by Seller under this Section. Manufacturer shall guarantee all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of twenty-four (24) months after the project is substantially complete and final acceptance of the equipment has been granted.

5.02 The aeration system supplier shall be responsible for guaranteeing effluent quality according to the end user's requirements, as the aeration system is an integral part of the overall treatment process.

END OF SECTION 46 51 31

SECTION 46 66 56 UV DISINFECTION SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The work described under this section shall cover the furnishing of a complete and operational open channel, gravity flow, ultraviolet (UV) disinfection system. The system shall be complete with UV modules, integral module lifting mechanism(s), electrical cabinets housing the electronic ballasts, power distribution, and system control, UV detection system, automatic mechanical wiping system and water level control device(s) as shown on the drawings and specified herein.
- B. The system described herein shall be capable of disinfecting effluent to meet the water quality standards listed in this section.
- C. All components that do not meet the technical requirements as specified herein shall be itemized on an appropriate deviation list. Deviations of critical items shall cause disqualification of bid.
- D. The contractor shall purchase the UV system type WEDECO TAK Smart Series from Xylem or an approved equal. The system is to be installed by the Contractor and tested and commissioned by Xylem Representatives as specified herein. The Owner will consider alternates if all requirements of this specification are met without exception including prequalification.

1.02 QUALITY ASSURANCE

Pre-qualification Requirements: Any alternate UV System Supplier that is not named or listed as approved equal must submit the following 15 days prior to bid to be considered for approval:

- A. Evidence of qualification and at least ten (10) years of experience in manufacturing and delivering open channel UV disinfection systems using low pressure high output amalgam lamps.
- B. The proposed UV System Supplier must be able to demonstrate a minimum of one hundred (100) permanent installations of open channel low pressure, high output systems in similar applications.
- C. Submittal including UV system details, control panel, lamp and ballast descriptions, and engineering reports stating headloss. Calculation or validation of the delivered dose will also be submitted for consideration.
- D. The UV system must utilize True Dose Pacing Control and control based on the following dose parameters: sensor intensity, flow rate, and UV transmittance. Based on these parameters, the system shall automatically vary the UV lamp power within a range of 50% to 100% proportionally to the dose requirement.

- E. The UV system must be equipped with a pneumatically powered automatic wiping system and shall use PTFE / FKM sandwich wipers to clean the quartz sleeves.
- F. A statement by the UV System Supplier listing any deviations or exceptions taken to these specifications will be submitted. State specification reference and proposed alternative with reason for exception.
- G. Description of UV System Supplier's service capabilities including local support offered for technical service and spare part availability.
- H. All UV manufacturers will be required to prequalify, unless the manufacturer is the base bid manufacturer.

PART 2 - PRODUCT

2.01 DESIGN CRITERIA FOR THE UV SYSTEM

A. Wastewater Treatment

Prior to the UV system the effluent has undergone secondary treatment process including filtration.

B. Design Conditions

1.	Treated Peak Flow:	260 gpm
2.	Peak Hydraulic Flow:	400 gpm
3.	Total Suspended Solids: average	30 mg/l, 30 day
4.	Annual Effluent Temperature Range: °F)	5 to 35°C (41 to 95
5.	Ultraviolet Transmittance @ 253.7 nm:	55% minimum
6.	Quartz Sleeve Fouling Factor (FF)	0.95
7.	End of Lamp Life Factor (EOL)	0.87
8.	Effluent disinfection standard:	126 E.coli / 100 ml
		(30 day geometric mean)

C. System Configuration

The UV system shall conform to the following configuration:

Total Number of Channels:
 Total Number of Banks
 Total Number of Lamps
 Number of Lamps per Module

5.	Number of channels operating at average flow:	1
6.	Overall channel length:	18.8 ft
7.	Channel width (Widest Point):	36.5 in
8.	Channel height:	46.75 in
9.	Nominal water depth in channel:	13.8 in

- D. Performance Requirements
 - 1. The ultraviolet disinfection system will produce an effluent conforming to the microbiological discharge limit as indicated. Grab samples will be taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Ed.
 - 2. Standard disinfection of secondary effluents (MS-2 approach): The UV system shall be designed to deliver a minimum validated dose of 30mWs/cm2 at peak flow and UVT conditions as described above after reductions for sleeve fouling and end of lamp life (EOL) and including the validation factor. The basis for evaluating the UV dose delivered by the UV system will be the manufacturer's biodosimetric performance validation testing conducted by a recognized independent 3rd party expert according to the procedures described in the US EPA UV Disinfection Guidance Manual (2006) and IUVA Uniform Protocol. Validation testing shall have been conducted with MS-2 phages of the above UV sensitivity.
 - a. The following parameters shall have been considered during validation testing:
 - i. UVT
 - ii. Measured UV intensity
 - iii. Flow rate per lamp
 - iv. Power consumption
 - v. UV sensitivity of challenge organism
 - vi. Head loss across UV banks

Validation testing that does not utilize all of the above parameters is considered inadequate as it does not allow for appropriate system sizing. Bids based on inadequate validation testing shall not be considered.

To be acceptable, UV sensor data must be collected during the biodosimetry validation testing.

3. The UV system shall be capable of dose pacing to reduce electrical energy consumption in response to the disinfection demand based on a minimum of channel flow signal (provided by others through either SCADA communications or 4-20mA signal), and the UV sensor signal(s).

- 4. For determining UV dose during operation and for dose pacing, the UV intensity signal shall be incorporated into the UV control system's operating equation: this provides the most reliable method of monitoring and controlling the UV disinfection process during operation.
- 5. To avoid misrepresentation and possible over-reporting of UV dose during operation, equipment that does not utilize the UV sensor signal in determination of operational dose shall not be accepted.
- 6. Lamp aging and sleeve fouling factors shall not be allowed in lieu of UV sensor signal(s) for determination of UV dose during operation.
- 7. The UV dose will be adjusted using an end of lamp life factor of 0.5 of initial UV lamp output. The use of a higher aging factor will be considered only upon review and approval of independent 3rd party certificate submitted with the bid.

For sizing the TAK Smart system, the UV dose will be adjusted using an end of lamp life factor of 0.87. Aging factors exceeding 0.9 are considered unrealistic and shall not be accepted to prevent under design of the system.

8. The UV dose will be adjusted using a quartz sleeve fouling factor of 0.8 when sizing the system in order to compensate for attenuation of the minimum dose due to sleeve fouling during operation. The use of a higher aging factor will be considered only upon review and approval of independent 3rd party certificate submitted with the bid.

For sizing the TAK Smart system, the UV dose will be adjusted using a quartz sleeve fouling factor of 0.95. Fouling factors exceeding 0.95 of clean, clear quartz sleeves are considered unrealistic and shall not be accepted.

2.02 DETAILS OF CONSTRUCTION

- A. General
 - 1. The system shall be designed for immersion of the UV lamps in the effluent within their protective quartz sleeve. Both electrodes and the full arc length of the lamp shall be below the water surface.

Systems which prevent uniform cooling of the lamp electrodes (e.g. vertical lamp systems) by the effluent shall not be permitted.

- 2. The UV lamps shall be arranged horizontally, parallel to the flow to minimize head loss.
- 3. UV systems being installed in steps in the channel to compensate for negative effects related to high head loss shall not be accepted.
- 4. All wetted channel metal parts shall be fabricated of stainless steel 304. Aluminum wetted materials shall not be used
- 5. All module materials exposed to UV light shall be 316 stainless steel, quartz

glass, PTFE, FKM, or other suitable long-term UV resistant materials.

- B. UV Lamps
 - 1. Lamps shall be low-pressure mercury amalgam "doped", high intensity type. Lamps containing liquid mercury shall not be allowed.
 - 2. The lamp filaments shall be pre-heated prior to striking of the arc in order to promote lamp longevity.
 - 3. Lamp types with a polychromatic UV output or UVC output efficiency of less than 30% at 254nm are not acceptable.
 - 4. Each lamp shall be tested in UV-output, lamp current and lamp voltage from supplier. All results shall be stored in a database referencing to the individual batch number. The lamp batch number shall be printed on the lamp surface.
 - 5. UV output energy of the lamp shall be variable from 50 -100% of UV-C ballast power input. Lamps with no capability to automatically vary the UV power output in operation shall not be permitted.
 - 6. Useful lamp life shall be guaranteed at 14,000 operating hours for each lamp under normal operation conditions. Normal operation conditions include a maximum of four on/off cycles per 24 operating hours.
 - 7. UV lamps shall not require a long cool down period (>10 minutes) prior to re-start should the power to the UV system fail or be interrupted for a short period of time.
 - 8. Each lamp base shall incorporate a dielectric barrier or pin isolator. The pin isolator shall consist of a non-conductive divider placed between the lamp pins to prevent direct arcing across the pins in moist conditions. The barrier shall be dielectrically tested for 2500 volts.
 - 9. The UV manufacturer shall ensure disposal of returned lamps (old/used) at no costs to the owner upon receipt of the returned lamps at the manufacturing headquarters.
- C. UV Modules
 - 1. The UV modules shall be designed for submergence without causing failures or damage to the system or components. Ballasts for powering UV lamps shall be located in electrical enclosures located beside the channel.
 - 2. Each UV module shall be equipped with an interlock switch, which will automatically disconnect power to its associated UV bank if the module is raised from the UV channel or the quick disconnect plug is removed.
 - 3. The UV module design and mounting shall provide plug and socket quick disconnect facilities enabling non-technical personnel to carry out lamp replacement, wiper insert replacement, etc. without the need for any tools or specialist isolation procedures.

- 4. Lamps shall be removable with the quartz sleeve and wiper system remaining in place.
- 5. The UV lamp sleeve shall be a single piece of clear fused quartz circular tubing, which shall not be subject to degradation over the life of the system
- 6. The lamp socket shall be centered against the inside of the quartz sleeve and shall be retained by a cap nut with a ribbed exterior surface providing a positive handgrip for tightening / loosening without the need for any tools. This connection includes a self-contained o-ring, sealing the lamp and socket module (independently from the quartz sleeve).
- D. Wiping System
 - 1. Each UV module shall be equipped with an automatic wiping system with selectable wiping frequency and number of strokes.
 - 2. Systems without automatic mechanical wiping or systems requiring chemicals or removal of the module from the channel as the only means of cleaning will not be acceptable.
 - 3. The wiping system shall be controlled by the UV system controller and provide a fully automatic, unattended operation.
 - 4. The number of wiping strokes per interval shall be factory preset for optimum effect and shall be easily reset by the owner from 1 to 5 strokes per time interval, with time intervals being user adjustable.
 - 5. Actuation mechanism(s) for the automatic wiping system shall be driven by a pneumatic cylinder integral with the module. Mechanisms that utilize pressurized hydraulic fluid in the vicinity of the UV channel shall not be allowed due to risk of oil leakage.
 - 6. The wiper blades shall use PTFE/FKM sandwich wipers to continuously keep the quartz sleeves clean without the use of chemicals. Systems that require the addition of chemical cleaning substances should not be allowed to avoid handling risks with aggressive chemicals and reduce storage needs.
- E. UV Monitoring System
 - 1. A submersible UV sensor shall continuously sense the UV intensity produced in each bank of UV lamp modules.
 - 2. The UV sensor shall be according to ÖNORM M 5873-1 and shall measure only the germicidal portion of the light emitted by the UV lamps as measured at 254 nm.
 - 3. The UV intensity monitoring system shall be field calibrated. Regular UV sensor field calibration shall be possible via a separate UV reference radiometer to ensure reliable monitoring of UV dose delivery.
 - 4. The measured UV intensity signal shall be fed into the UV System Controller

and used for continuous monitoring and control of UV dose. In automatic mode the UV Control System shall automatically adjust to draw the minimum electrical power while maintaining the prescribed minimum dose required for disinfection. The UV dose shall be displayed on the operator interface as an absolute value in mW/cm².

- 5. Systems that use theoretical data or data from laboratories to determine lamp aging or fouling in the control logic should not be allowed. Only measured intensity and flow rate should be used to determine the actual disinfection performance / dose applied acc. to the validation protocol or design calculation method.
- 6. The UV sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and resulting false alarms for low intensity.
- 7. The UV sensor design shall be such that sensor removal can be easily conducted without complete removal of the module from the channel.
- 8. There shall be no fewer than (1) UV sensor for every bank of UV lamps.
- F. Air Compressor System
 - 1. The automatic wiping system will utilize the compressed air provided by the air compressor system. The air compressor system will be equipped with the following equipment.
 - a. Receiver tank & compressor/motor
 - b. NEMA 4 Pressure Switch
 - c. Air treatment including coalescing & particulate filters
 - d. Silica Gel Type Desiccant Dryer
 - e. Air Operated Tank Drain
 - f. 3/8" NPT Pressure Regulator w/ Gauge
 - 2. The air compressor & treatment equipment will come preassembled for easy installation.
 - 3. The compressor will operate independently of the UV system controls. The start/stop sequence of the compressor will be controlled by the pressure switch located on the compressor.
 - 4. An airline from the pressure regulator outlet to the UV Control Panel will need be provided by the installing contractor. Polyethylene tubing, Polyurethane tubing, stainless steel tubing or copper pipe is the recommended material type. The use of carbon steel or ductile pipe is not recommended.
 - 5. The compressor motor is to be an ODP rated motor. TEFC motor is available as an option.

- 6. The air compressor system will come with vibration dampener pads to be located under each mounting foot. Anchor bolts & Installation by the contractor.
- 7. The power required is 120V/1 Ph/60 Hz.
- G. Water Level Control
 - 1. A fixed finger weir located at the channel outlet shall provide control of water level in the UV channel. The weir design shall be such that a maximum plume of 40 mm over the weir will not be exceeded to guarantee safe disinfection.
 - 2. Each channel shall have one fixed overfall weir.
 - 3. Water level control with moving parts shall not be acceptable.
 - 4. Systems that use mechanical flap gates are not allowed, in order to avoid interference between multiple gates.
- H. Davit Crane
 - 1. The davit crane shall be provided by the UV manufacturer and shall be capable of removing the UV modules from the UV channel. The crane shall be able to rotate and place/remove the UV modules from the wall storage rack(s) (provided by the UV manufacturer).
 - 2. The davit crane shall be a commander 1000 series model 5PT10G with a galvanized finish and include the following options:
 - a. Spur gear hand winch with brake
 - b. Galvanized pedestal base
 - c. 3/16" Galvanized aircraft cable 20 lineal feet long
 - 3. Or approved equal.

2.03 ELECTRICAL AND CONTROLS

- A. General
 - 1. Sensitive electronic components such as electronic ballast cards shall not be exposed to the risk of being flooded.
 - 2. All heat sensitive components shall be adequately cooled with dry air utilizing forced or natural ventilation.
 - 3. Systems or designs that expose sensitive electrical or electronic components to excess humidity or poor air quality for cooling are not acceptable.
 - 4. Systems that lack positive mechanical heat transfer such as fans (or air conditioning) for the sensitive electronic components are not acceptable.
 - 5. The electrical enclosures for the UV system shall be Type 12/ IP54 painted (nano coated) steel where inside a building.

- B. Electrical Cabinet
 - 1. The UV system shall be supplied with (1) electrical cabinet to house the UV system controller, operator interface, ballast cards, and plant interface termination points associated with each individual UV bank.
 - Electrical power supply (by others) to each individual cabinet shall be 480/277 volts (+/- 10%), 60 Hz, WYE plus ground (L1, L2, L3, N, GND) (cUL)
 - 3. Full application software will be generated by the UV equipment manufacturer to operate the UV system.
 - 4. Low UV intensity alarms shall be provided to detect possible water quality problems or fouling of the system. Alarm set point shall be field adjustable.
 - 5. The microcontroller shall monitor individual lamp status, and provide specific location of any faulted lamps.
 - 6. The UV system controller shall monitor hardwired protection circuits, e.g. Module Lifted, Module Connected, Cabinet High Temperature, Bank Isolation, etc. which will shut the appropriate area of plant down directly, to aid rapid fault finding when personnel attend site.
 - 7. Each electrical cabinet shall be equipped with a temperature control device, which will shut off this part of the UV system in case of surpassing the critical limit of $50^{\circ}C = 122^{\circ}F$.
- C. Electronic Ballasts
 - 1. The electronic ballasts shall comply with the CE & UL requirements, specifically the IEEE519 and the IEC 6100-3-2.
 - 2. The ballasts shall be electronic microprocessor controlled, designed as slot cards fitting into a rack system with a plug connector for ease of maintenance.
 - 3. Each ballast shall drive a pair of lamps with independent control and monitoring circuits, and providing individual lamp status information to the system control.
 - 4. The ballast shall detect lamp failure and initiate a re-strike sequence, independently from any external influence. The ballast shall attempt three re-starts before shutting off.
 - 5. The ballast shall incorporate a galvanic separation of the input and output circuits. In case of the output circuit operating in abnormal conditions regarding voltage and/or amperage, the ballast shall shut off the lamp concerned. Ballasts without this feature shall be equipped with one GFC per ballast.
 - 6. The ballast shall incorporate a pre-heat circuit to heat lamp filaments prior to

striking the lamp arc in order to promote lamp longevity.

- 7. The operating power factor for the ballasts shall be minimum 0.99 over the entire power range of the ballast.
- 8. One power factor correction circuit shall power a max. of 2 UV lamps in order to increase system reliability.
- 9. The ballast efficiency shall be min. 95% at maximum power and >94% across the entire range.
- 10. The ballast shall be capable of varying power between 50 100%.
- 11. The lamps shall be square wave driven by the ballasts for optimum UVC output efficiency and lamp life.
- 12. In order to avoid radiated interferences, the electronic ballasts shall be equipped with a harmonic filter.
- 13. The ballasts shall be tested on line disturbances up to 4000 V.
- 14. The ballasts shall be capable to operate down to 208 V to increase system reliability with regards to voltage fluctuations.
- 15. Ballasts requiring liquid closed loop re-circulating heat exchanger systems, e.g. propylene glycol, for cooling shall not be permitted.
- 16. Ballasts, for which replacement requires a watertight seal to be broken, shall not be permitted.
- 17. Ballasts, for which replacement requires removal of the module, shall not be permitted.
- D. Control and Instrumentation
 - 1. The UV Disinfection Management System shall control and display the ON/Off cycling of the UV bank, individual lamp status, alarm messages, UV dose and intensity, bank wiping system status and lamp power of the UV banks.
 - 2. Low UV dose alarms shall be provided to detect possible water quality problems, flow rate too high (flow rate signal required by others) or fouling of the system. Alarm set point shall be field adjustable.
 - 3. The Management System shall utilize a UV sensor located within the UV bank(s) to accurately sense any change in UV intensity. The sensor signal together with the flow rate signal (and UVT for validated systems) shall be fed into the EcoTouch Controller as input parameters to accurately control and adjust UV lamp output to the required level.
 - 4. Systems that take only flow and water transmittance into account are not acceptable.
 - 5. Systems that rely on calculated lamp intensity reduction due to aging instead

of measured UV intensity for UV dose calculations and UV system control are not acceptable.

6. Alarms shall integrate with Plants Remote Monitoring System.

2.04 SPARE PARTS & SAFETY SUPPLIES

- A. General Two (2) UV modules are to be provided to serve as 100% redundancy. In the event of failures within the installed bank, those modules will be removed and the two UV modules that are stored on a 304 SS wall mounted rack will be placed in the UV channel. The failed modules will be serviced and ready for installation. The module storage rack shall be designed and provided by the UV System Supplier. In addition to these modules, the following spare parts are to be provided:
 - 1. Six (6) UV Lamps
 - 2. Two (2) Electronic Ballasts
 - 3. Two (2) Quartz Sleeves
 - 4. Twelve (12) Wiper Rings
 - 5. One (1) UV Intensity Sensor
 - 6. One (1) UV Resistant Face Shield

2.05 START-UP AND FIELD SERVICES

- A. A field service technician or start-up engineer of the UV System Supplier shall commission the UV equipment.
- B. Local manufacturer's representatives are not acceptable to perform these tasks unless authorized by the UV System Supplier.
- C. The field service technician shall certify that all equipment is properly installed and that the plant operators have been trained on proper operation and maintenance procedures.
- D. The minimum recommended man-days / trips for installation inspection, start-up, system commissioning, and operator training shall be a total of six (6) days and two (2) trips.
- 2.06 OPERATIONS & MAINTENANCE
 - A. Upon shipment of the UV equipment, Operations & Maintenance Manuals will be provided that will cover the routine actions and inspections as well as a troubleshooting guide. The format for O&M manuals are specified in Section 01 78 23 Operations and Maintenance Data.
- 2.07 WARRANTY
 - A. The UV equipment supplier shall warrant to the buyer that all components furnished will be free from defects in materials and workmanship for a period of two (2) years from the date of shipment. In the event of material or workmanship failure, supplier shall either repair or replace the damaged or defective

components or services or refund payments to buyer for the components or services found to be defective.

2.08 TOTALCARE MAINTENANCE PROGRAM

- A. Site visits will be provided by a trained Wedeco Field Service Engineer annually to perform the necessary preventative maintenance required to ensure the life span of the equipment. This maintenance allows the operators an opportunity to learn from hands-on trainings and better understand the UV equipment. In addition, these visits can be scheduled in advance to coordinate with the beginning of the disinfection season to perform a seasonal "re-commissioning" of the equipment to ensure the seasonal start-up is adequate and the units will provide disinfection throughout the necessary period.
- B. The TotalCare contract will last from the first day of Final Acceptance of the UV equipment and finalize two years from that date. Within that TotalCare contract year a total of one site visit annually can be anticipated by the Owner.
- C. Scope of Services for the TotalCare Maintenance Program

Total Care Activities – Open Channel UV Systems		
Typical Tasks	Duron & TAK Systems	
System Review	Pre-visit:	
	• Identify outstanding issues from prior visits as well as new issues.	
	Recommend parts required for upcoming work.	
	Onsite:	
	• Review system history and alarm log since last visit- identify key tasks to resolve during visit.	
Control	• Inspect cabinets for dust and/or corrosion. Clean as necessary.	
Cabinets	• Confirm adequate cooling and or airflow through cabinet.	
	• Check for hot spots that could cause temperature faults.	
	• Replace filters as need from spares stock.	
	• Troubleshoot and resolve faulty ballasts.	
	Replaced failed ballasts from spares stock as needed.	
	• If indicated, measure incoming, voltage, current, neutral, and ground of supplied system power. Identify deficiencies and diagnostic recommendations.	
	• Validate proper operation and set points of HMI, adjust as needed.	
	• Validate proper operation and set points of internal UV system controllers, adjust as needed.	
	• Validate proper function of all signal isolators. Replace from onsite spares as needed.	
	• Validate proper function of all safety circuits.	
	• Perform basic functional test of AC units if present.	
	Check remote communications if applicable.	
Cables &	• Examine cables, connectors and Harting hardware for proper function. Replace	
Junction Boxes	faulty hardware with onsite spares.	
	• Identify and provide recommendations for unusual wear, rust and/or corrosion of	
	components. Replace as needed from onsite spares.	
Modules,	• Identify and provide recommendations for unusual wear, rust and/or corrosion of	
Lamps,	components. Replace as needed from onsite spares.	

Peactor	• Chaole quarter alcourse for averaging quefere alcourse and a former it
Reactor, Sleeves &	 Check quartz sleeves for excessive surface abrasions, replace as needed from onsite spares.
Connectors	 Check quartz sleeves for excessive water ingress, replace from onsite spares as
connectors	• Check quartz sieeves for excessive water ingress, replace from onsite spares as needed.
	 Identify and resolve any loose connections.
	 Validate cable connector functionality. Replace O-rings, or connector assembly
	from onsite spares as needed.
	 Check intensity sensors for proper operation, clean if needed, replace from onsite
	spares as necessary.
	• Examine Intensity sensor cleaning brushes. Replace from onsite spares as needed.
	• Examine a representative sampling of lamps for signs of excessive aging, replace as
	needed. Identify source of problem if premature.
	• Troubleshoot failed components and replace from onsite spares as needed.
Control	Identify chronic alarms - root cause and resolve.
Philosophy	Validate intensity readings.
	• Root cause and resolve UV intensity issues if system related (doesn't include
	system cleaning).
	 Validate incoming flow signal. Identify any inconsistencies.
	Validate basic PLC function in Manual, Maintenance and Automatic modes
Wiper	• Repair junction box, pneumatic line, fitting and wiper module leaks utilizing onsite
Cleaning	spares as needed.
Systems	• Change air compressor filtration desiccant from onsite spares as needed.
	• Purge system of all water and oil.
	• Identify airline freezing risks. Make resolution recommendations as needed.
	• Validate all compressor set points. Fine tune as needed.
	• Validate operation of wiper modules to specification. Replace from onsite spares as
	needed.
	• Validate proper operation of wiper module limit switches. Replace from onsite
	spares as needed.
	 Confirm operation of automatic drain valve repair or replace from onsite spare as needed
Control	Clean and validate level switches.
Instrumentation	 Clean and validate proper operation of ultrasonic level/flow measurement system.
	 Clean & calibrate onsite transmittance monitor.
Physical and	 Validate proper manual and auto operation of all control gates. Adjust set points,
Mechanical	torque settings and lubricate penstocks as necessary.
Components	• Validate weir elevation in conjunction with level controls.
*	• Identify excessive gate and/or weir leakage if indicated by level control issues (if
	possible).
	• Check baffle plate for buildup. Recommend cleaning process as needed.
Water Quality	Check fouling of quartz sleeves. Provide instruction and recommendations on
	cleaning if necessary.
	• Remove excessive debris (algae, trash, etc.) from module and cable assemblies
	• Identify recommendations for excessive channel fouling, debris buildup and other
	possible sources of sampling contamination.
	Compare effluent transmittance against system design requirements. Identify
	possible sources of discrepancies.
Operational	• Provide informal operation, maintenance, and/or safety training as requested.

• Identify maintenance and/or operation concerns and associated improvement recommendations
• Identify spares utilized and recommendations for replacement or adjustments to existing levels.
• Identify approximate future timeline for consumables (lamps, ballasts, sleeves, wiper rings, etc.) replacement.
 Identify operational enhancements (power settings, timer adjustments, etc.). Review Xylem 24/7 contact information.
• Provide Summary Report of site visit include a checklist outlining items evaluated, summary and recommendations.
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END OF SECTION 46 66 56

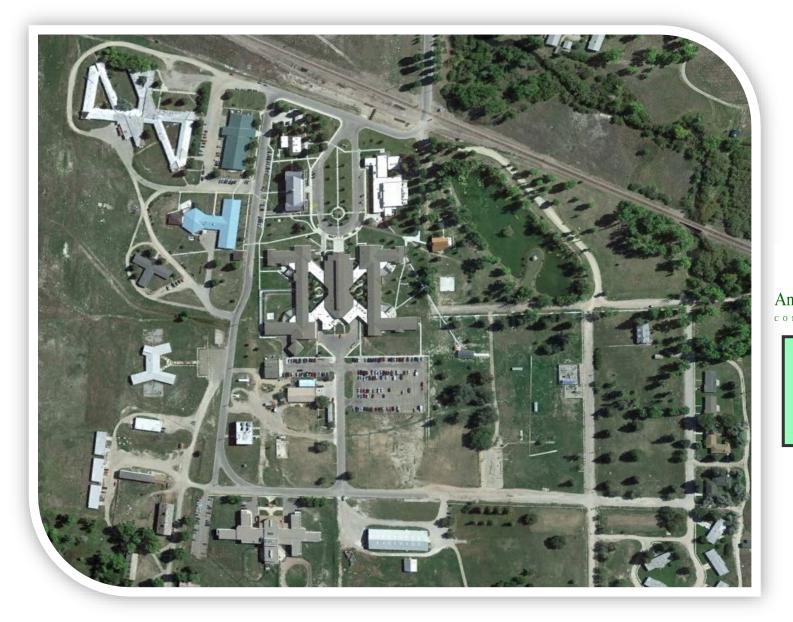
APPENDIX A

Project Drawings (See bound copy of Construction Drawings)

Construction Drawings Montana State Hospital

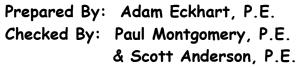
Warm Springs, Montana Upgrade Wastewater System Project 2020

> A/E # 2011-11-01-03 October 2020



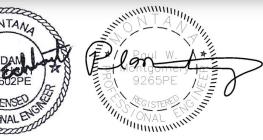


<u>Prepared by:</u> Anderson-Montgomery Consulting Engineers Helena, MT



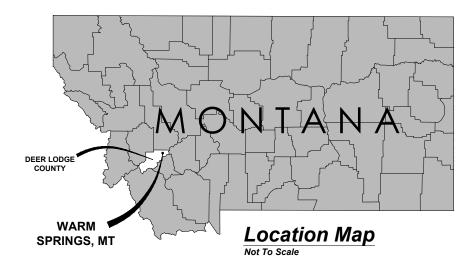








Upgrade Wastewater System Project 2020 Montana State Hospital - Warm Springs, Montana A/E #2011-11-01-03





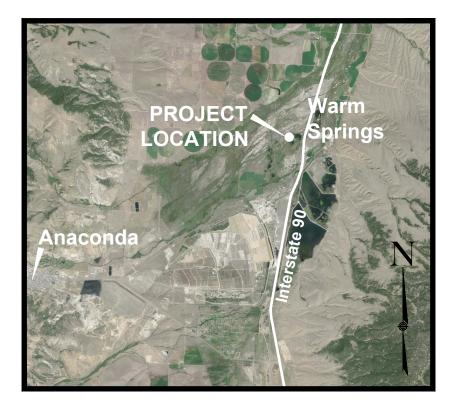
Install New Lift Station, Rotary Screen, Three Aerated Lagoon Treatment Reactors, Polishing Reactor, Ultraviolet Disinfection, New Outfall, New Rotary Screen Building and New Blower/UV Building, Non-Potable Water System, Fencing, Gravel Access Road, Parking Area, and Lagoon Access Road.

PROJECT DESIGN TEAM

ANDERSON MONTGOMERY CONSULTING ENGINEERS DCI ENGINEERS KINGDOM BUILDERS ENGINEERING, INC.

PRIMARY CONTACTS

Project Administrator - Architecture and Engineering Division, 1520 E. Sixth Avenue, P.O. Box 200103, Helena, MT 59620 Mark Hines, (406) 444-3331, mhines@mt.gov AMCE - Adam Eckhart, (406)449-3303, Adam@a-mce.com On Site - Raul Luciani, (406) 693-7110, Raul.Luciani@mt.gov



Additive Alternate #1

- Non-potable water piping extension, including 3 frost free hydrants located on the lagoon dikes
- Non-potable water irrigation stub-out

Additive Alternate #2

- Landscaping: including grass seeding around both buildings, trees along the secondary highway and a non-potable water irrigation system
- Asphalt access road and parking area to replace the base bid gravel access road and parking area
- Two stage air compressor located in the blower/UV building

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GC-11 GC-12 GC-13 GC-14 GC-15 GC-16 GC-17 GC-18	Outfall Line Plan & Profile Outfall Line Plan & Profile Outfall Line Plan & Profile Lagoon Decommissioning New Sewer Plan and Profile New Sewer Plan and Profile Fencing Plan Manhole Details
GC-11 GC-12 GC-13 GC-14 GC-15 GC-16 GC-17 GC-18 GC-19	Outfall Line Plan & Profile Outfall Line Plan & Profile Outfall Line Plan & Profile Lagoon Decommissioning New Sewer Plan and Profile New Sewer Plan and Profile Fencing Plan Manhole Details Civil Details
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PIPING AND INSTRUMENTATION DIAGRAM

STRUCTURAL/ARCHITECTURAL

	Civil
C-1	Screen Building Plan
C-2	Screen Building Section
C-3	Rotary Screen Sections
C-4	Headworks Details
C-5	Main Lift Station Plan View
C-6	Main Lift Station Section View
C-7	Forcemain Plan and Profile
C-8	Interpond Piping Plan and Profile
C-9	Interpond Piping Plan and Profile
C-10	Interpond Piping Plan and Profile
C-11	Interpond Piping Plan and Profile
C-12	Interpond Piping Plan and Profile
C-13	Lagoon Overflow Piping Plan and Profile
C-14	Lagoon Effluent Piping to PR Plan and Profile
C-15	Effluent Piping to UV Disinfection Plan and Profile
C-16	Plant Effluent Piping Plan and Profile
C-17	Aerated Lagoon Cell #1
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C-20	Aeration Plan
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C-24	Liner Details
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C-28	Polishing Reactor
C-29	Blower/UV Bldg Plan
C-30	Blower Plan
C-31	Blower Section
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C-33	Non-Potable Water Plan & Section
C-34	Non-Potable Water Plan & Profile
C-35	Non-Potable Water Plan & Profile
C-36	Non-Potable Water Plan & Profile
C-37	Blower/UV Building Sewer Service Plan & Profile
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C-39	Polishing Reactor Drain Piping Plan & Profile

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S-2	General Notes
S-3	General Notes Continued
S-4	General Notes Continued
S-5	General Notes Continued
S-6	General Notes Continued
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S-17	Exterior Elevation Screening Building
S-18	Exterior Elevation Screening Building
S-19	Exterior Elevation Screening Building
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S-22	Exterior Elevation Blower/UV Building
S-23	Exterior Elevation Blower/UV Building
S-24	Exterior Elevation Blower/UV Building
S-25	Exterior Elevation Blower/UV Building
S-26	Exterior Elevation Polishing Reactor
S-27	Exterior Elevation Polishing Reactor
S-28	Exterior Elevation Polishing Reactor
S-29	Exterior Elevation Polishing Reactor
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S-32	Details
S-33	Details
S-34	Details
S-35	Details
S-36	Details
S-37	Details
S-38	Details
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S-41	Screen Building East Architectural Elevation
S-42	Screen Building West Architectural Elevation
S-43	Blower/UV Building North Architectural Elevation
	Blower/UV Building South Architectural Elevation
S-45	Blower/UV Building East Architectural Elevation
S-46	Diower/OV Duilding East Architectural Elevation

DRAWING IDENTIFICATION SYSTEM: Additive Alternate #1

- Non-potable water piping extension, including 3 frost free hydrants located on the lagoon dikes
- Non-potable water irrigation stub-out

Additive Alternate #2

- Landscaping: including grass seeding around both buildings, trees along the secondary highway and a non-potable water irrigation system
- Asphalt access road and parking area to replace the • base bid gravel access road and parking area
- Two stage air compressor located in the blower/UV building

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M-1 Scree M-2 Screet M-3 Blowe M-4 Blowe M-5 Mecha M-6 Mecha

Electrical		
E-1	Electrical Symbols & Legend	
E-2	Screen Building Electrical Plan	
E-3	Blower/UV Building Electrical Plan	
E-4	Electrical Site Plan	
E-5	Electrical Riser Diagram	
E-6	Panel Schedules - Screen Building	
E-7	Panel Schedules - Blower/UV Building	
E-8	Electrical Schedules	
E-9	Electrical Details	

Mechanical Drawings
n Building Plumbing Schematic
n Building Floor Drain Plan
er/UV Building Plumbing Schematic
er/UV Building Floor Drain Plan
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LEGEND
BASEBID
ALTERNATE #1 - Items Shown on Sheet
ALTERNATE #2 - Items Shown on Sheet

ADMAL BUT
Revision Date By Draft 7/21/20 AE Draft 8/28/20 AE Final 9/30/20 AE
Revision Final Plot Scale 1:2 Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By P.Montgomery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.
Engineer Anderson~ Montgomery consultino transferes 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3304 Fax (406) 449-3304
State Of Montana
Project Title Montana State Hospital Upgrade Wastewater System
Sheet Title
Sheet G-2

DETAIL DESIGNATION:



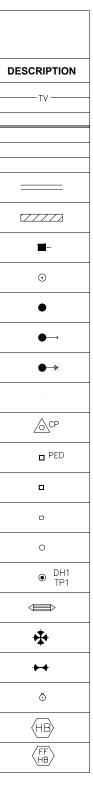
 DETAIL OR SECTION DESIGNATION - ON DWG WHERE SECTION OR DETAIL IS TAKEN: DWG NO. WHERE SHOWN ON DWG WHERE SECTION OR DETAIL IS SHOWN: DWG NO. WHERE TAKEN

	PI	PE AND FITT	ING SYMBO	LS	
DOUBLE LINE	SINGLE LINE	DESCRIPTION	DOUBLE LINE	SINGLE LINE	DESCRIPTION
2		EXISTING PIPE (SCREENED)			CONCENTRIC REDUCER
8		NEW PIPE			ECCENTRIC REDUCER
	_ • • •	EXISTING PIPE TO BE ABANDONED			UNION
££	<u> </u>	EXISTING PIPE TO BE REMOVED			BLIND FLANGE
20	*	WELDED JOINT		E	CAP
5		GROOVED END JOINT (FLEXIBLE)		, <u>+</u> ,	07000
6		GROOVED END JOINT (RIGID)			CROSS
6		GROOVED END FLANGE		<u>_</u>	TEE
		FLANGED JOINT			IEE
		FLANGE COUPLING ADAPTER			ELBOW, 45°
		MECHANICAL COUPLING			ELBOW, 45
S P	⊙+	ELBOW UP			LATERAL (WYE)
	C+	ELBOW DOWN		<u> </u> ∠` <u> </u>	
808		TEE UP			ELBOW, 90°
		TEE DOWN		+ [±]	ELBOW, 90

VALVE SYMBOLS

DOUBLE LINE	SINGLE LINE	DESCRIPTION	DOUBLE LINE	SINGLE LINE	DESCRIPTION
		GLOBE		<u> </u>	SAMPLE VALVE NO THREAD OUTLET
8		GATE			HOSE VALVE
8		BALL		x 🛈 —	NON FREEZE HOSE VALVE, X=NO IN SPECS
8	\rightarrow	PLUG			NON FREEZE HOSE VALVE, X=NO IN SPECS
8		BUTTERFLY		S	SAMPLE
8 2		DIAPHRAGM			PRESSURE RELIEF
8		PINCH			SURGE CONTROL
8		SWING CHECK		\uparrow	AIR/VACUUM
2K B	$-\!$	DOUBLE DISK CHECK		, Alexandre	REGULATED SIDE PRESSURE REDUCING
26		BALL CHECK			PRESSURE REDUCING VALVE
				X	FLOW CONTROL VALVE / NEEDLE VALVE

DOUBLE LINE	SINGLE LINE	DESCRIPTION	DOUBLE LINE	SINGLE LINE	
CONCRETE			CABLE TV	TV	
GRAVEL			CURB		
PAVEMENT			DRAINAGE DITCH		
CURB AND SIDEWALK			ROAD		
PROPERTY LINE			BUILDING		
EASEMENT			DROP INLET	∎-	
RIGHT OF WAY			EASEMENT PIN	\odot	
GRAVEL ROAD			POWER POLE	•	
CONTOURS	4200	4200	POWER POLE WITH GUY WIRE	$\bigoplus \rightarrow$	
DRAINAGE			LIGHT POLE	•*	
WATER	12"₩		SURVEY POINT		
WATER SERVICE LINE	>		CONTROL POINT	CP	
WATER SERVICE			TELEPHONE PED	🗖 PED	
SANITARY SEWER	© 		TELEPHONE BOX	D	
STORM DRAIN	=============	•	ELECTRICAL BOX		
FENCE LINE (BARB WIRE)			CURB BOX, SIGN	0	
FENCE LINE (CHAIN LINK)			DRILL HOLE OR TEST PIT	● DH1 TP1	
SIGN	-o- o o -		CATTLE GUARD		
OVERHEAD POWER	<u>с</u> о ² — онрwr ———		SECTION CORNER	*	
JNDERGROUND FIBER OPTIC	F0		QUARTER CORNER	++	
UNDERGROUND ELEPHONE, PEDESTAL	— PH		FROST FREE HYDRANT		
UNDERGROUND GAS	GAS		HOSE BIB		
UNDERGROUND POWER, TRANSFORMER	-		FROST FREE HOSE BIB		
NATURAL GAS			NOTES: • CONTACT THE E	NGINEER FOR SYN	лв
HOT WATER			THIS IS A STAND SOME SYMBOLS	ARD LEGEND SHE MAY APPEAR ON	ET TH
COLD WATER			MAY NOT BE UTI	LIZED ON THIS PRO	ЭJ
NON-POTABLE WATER					
PLANT AIR			1		



MBOLS NOT LISTED. ET. THEREFORE, THIS SHEET AND OJECT.

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	Draft	7/21/20	AE
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ABBREVIATIONS:

Ø @AAA AB AC AFF ADA AH AL ANC ANSI APPROX ARV AVE AWWA BC BF BFF BFF BFV BGS BK BLVD BM BOC BOD BV	AIR RELEASE VALVE AVENUE AMERICAN WATER WORKS ASSOCIATION BUILDING CORNER BLIND FLANGE BELOW FINISH FLOOR BUTTERFLY VALVE BELOW GROUND SURFACE BACK BUILDING BOULEVARD BENCH MARK BACK OF CURB BIOCHEMICAL OXYGEN DEMAND BALL VALVE	FG FH FL FOC FM FPT FS FTG FT G GA GALV GPD GPS GV HD HDR HDR HDR HDR HDR HDR HT HWY HYD	FINISH GRADE FIRE HYDRANT FLOOR, FLANGE OR FLOW LINE FACE OF CURB OR FACE OF CONCRETE FORCE MAIN FEMALE PIPE THREAD FINISHED SURFACE FOOTING FOOT OR FEET GAS GAUGE GALVANIZED GALLONS PER DAY GALLONS PER DAY GALLONS PER DAY GALLONS PER SECOND GALVANIZED STEEL PIPE GATE VALVE HEAVY DUTY OR HOT-DIPPED HIGH DENSITY POLYETHYLENE PIPE HEADER HEIGHT HORSEPOWER HEIGHT HIGHWAY HYDRANT	R RCB RCPA RCPA RDC RFC ROW RPA RT RW RW RW RW S SBB SCH SD SDI SDI SDI SDI SDI SDI SDI SDI SDI	RADIUS REINFORCED CONCRETE BOX REINFORCED CONCRETE PIPE REINFORCED CONCRETE PIPE REDUCER ROTATED FOR CLARITY RIGHT-OF-WAY ROBERT PECCIA & ASSOCIATES RED PLASTIC CAP REINFORCED POLYPROPYLENE RAILROAD RIGHT RIGHT-OF-WAY OR RACEWAY RIGHT-OF-WAY RAIN WATER LEADER SLOPE SLUDGE BUFFER BASINS SERVICE CONNECTION SCHEDULE STORM DRAIN INLET STANDARD DIMENSION RATIO SMALL END BELL SECTION SQUARE FOOT/FEET SQUARE FOOT/FEET
C CARV CATV CF CFS CI CIP	BEGIN VERTICAL CURVE CHANNEL OR CENTER COMBINATION AIR RELEASE VALVE CABLE TELEVISION CUBIC FEET CUBIC FEET PER SECOND CAST IRON OR CURB INLET CAST IRON PIPE OR CAST-IN-PLACE	I&C IBC ID INFL INFL INT INV	INSTRUMENTATION & CONTROL INTERNATIONAL BUILDING CODE INSIDE DIAMETER INCH INFLUENT INTERIOR OR INTERSECTION INVERT	SS SSMH SSP ST STA STD STL SUPER SY	SANITARY SEWER OR STAINLESS STEEL SANITARY SEWER MANHOLE SPIRAL STEEL PIPE STREET STATION STANDARD STEEL OR STEEL PIPE SUPERNATENT SQUARE YARDS
CIPP CL CLR CMP CMU CO CONC COS CP CPE CPLG	CURED-IN-PLACE PIPE CENTERLINE CLEAR CORRUGATED METAL PIPE CONCRETE MASONRY UNIT CLEANOUT CONCRETE CERTIFICATE OF SURVEY CONTROL POINT CORRUGATED POLYETHYLENE PIPE COUPLING	K KW LB(S) LD LEB LF LT	KILOMETER KILOWATT ANGLE, LONG POUND(S) LOCAL DISCONNECT LARGE END BELL LINEAL FOOT OR LINEAR FEET LEFT	T TBC TBLAY TBM TDW TEMP THD TOA TOC TOC TOC	TELEPHONE TOP BACK OF CURB TOP BACK OF LAYDOWN CURB TEMPORARY BENCH MARK TREATED DISINFECTED WATER TEMPERATURE OR TEMPORARY THREAD TOP OF ASPHALT TOP OF CONCRETE TOP OF GRATE
CPVC CSP CV CY C1D1 DEC	CHLORINATED POLYVINYL CHLORIDE CORRUGATED STEEL PIPE CHECK VALVE CUBIC YARDS CLASS 1 DIVISION 1 DECANT	MAX MC MCC MDT MECH MFR MH	MAXIMUM MECHANICAL COUPLING MOTOR CONTROL CENTER MONTANA DEPT. OF TRANSPORTATION MECHANICAL MANUFACTURER MANHOLE	TOS TOW TP TS TV TW TWAS TYP	TOP OF SIDEWALK TOP OF WALL TEST PIT TECHNICAL SPECIFICATIONS CABLE TELEVISION TREATED WATER THICKENED WASTE ACTIVATED SLUDGE TYPICAL
DEC DEMO DEPT DH DI DIA DIA DIMJ DIP	DEMOLISH DEMOLISH DEPARTMENT DRILL HOLE (SOIL BORING) DUCTILE IRON OR DRAIN INLET DIAMETER DUCTILE IRON MECHANICAL JOINT DUCTILE IRON PIPE	MIN MJ MPT MPWSS MTL MWS	MINIMUM OR MINUTE MECHANICAL JOINT MALE PIPE THREAD MONTANA PUBLIC WORKS STANDARD SPECIFICATIONS MATERIAL MAXIMUM WATER SURFACE	UBC UG UGP UPC	UNIFORM BUILDING CODE UNDERGROUND POWER UNIFORM PLUMBING CODE
DL DR DWAS DWG EA EFF	DRAIN LINE DRAIN OR DIMENSION RATIO DIGESTED WASTE ACTIVATED SLUDGE DRAWING EACH EFFLUENT	N NEC N.I.C. NO. NPT NPW	NORTH NATIONAL ELECTRICAL CODE NOT IN CONTRACT NUMBER NATIONAL PIPE THREAD NON-POTABLE WATER	V VERT VFA VLV VPC VPT VTR	VENT, VOLT OR VALVE VERTICAL VOLATILE FATTY ACID VALVE VERTICAL POINT OF CURVATURE VERTICAL POINT OF TANGENCY VENT THROUGH ROOF
ELEV EOC EOP EOS EPDM EVC	ELEVATION EDGE OF CONCRETE EDGE OF PAVEMENT EDGE OF SIDEWALK ETHYLENE PROPYLENE DIENE M-CLASS RUBBER END VERTICAL CURVE	NTS OAL OC OD OF OHP	NOT TO SCALE OVERALL LENGTH ON CENTER OUTSIDE DIAMETER OUTSIDE FACE OR OVERFLOW OVERHEAD POWER	W W/ WAS WLC WS WSO	WATER OR WEST WITH WITHOUT WASTE ACTIVATED SLUDGE WATER LEVEL CONTROL WATER SURFACE OR WATER STOP WATER SERVICE OUTLET
EW EXT EXIST FAB	EACH WAY EXTERIOR EXISTING FABRICATION	PC PE PH PI PL	POINT OF CURVATURE PLAIN END PHONE POINT OF INTERSECTION PROPERTY LINE OR PLATE	WSP WV WW WWF	WELDED STEEL PIPE WATER VALVE WASTEWATER WELDED WIRE FABRIC
FC FCA FDN FETS FF	FLEXIBLE COUPLING FLANGED COUPLING ADAPTER FOUNDATION FLARED END TERMINAL SECTION FINISHED FLOOR	PLCS PROP PSI PSIG PT PVC PVI PWR	PLACES PROPERTY OR PROPOSED POUNDS PER SQUARE INCH POUNDS PER SQUARE INCH, GAUGE POINT OF TANGENCY POLYVINYL CHLORIDE PLASTIC POINT OF VERTICAL INTERSECTION POWER	X XING YD YPC	USED AS A VARIABLE CROSSING YARD YELLOW PLASTIC CAP

NOTES:

• CONTACT THE ENGINEER FOR ABBREVIATIONS NOT LISTED.

• THIS IS A STANDARD ABBREVIATIONS SHEET. THEREFORE, SOME ABBREVIATIONS MAY APPEAR ON THIS SHEET AND MAY NOT BE UTILIZED ON THIS PROJECT.

Revision Date Bv
 Draft
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 Revision Final Plot Scale Plot Scale <u>1:2</u> Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By P.Montgomery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E. Engineer nderson~ Montgomer ONSULTING ENGINEE 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304 Owner State Of Montana Project Title Montana State Hospital Upgrade Wastewater System Sheet Title Abbreviations Sheet **G-4**

DESIGN INFLUENT WASTEWATER CHARACTERISTICS

Design Year	2040	
Current Average Daily Flow	187,200	GPD
Design Average Daily Flow	237,600	GPD
Design Peak Hour Flow	576,000	GPD

REGULATORY EFFLUENT STANDARDS

BOD ₅	45	mg/L
Total Suspended Solids	30	mg/L
E. Coli - Summer	126	org/100 mL
E. Coli - Winter	630	org/100 mL
Oil & Grease	10	mg/L
* 85% Removal of BOD		

85% Removal of BOD₅ 65% Removal of TSS

MASS LOAD L	IMITS (lbs/da	ay)
	AML	AWL
BOD ₅	89.2	128.8
Total Suspended Solids	59.4	89.2

AMMONIA LIMITS (mg/L)					
	MAR-JUN	JUL-OCT	NOV-FEB		
MDL	29.9	2.8	26.3		
AML	14.9	1.4	13.1		

SUMMARY OF PROJECT IMPROVEMENTS

(Not all-inclusive)

Screening Building

- Precast Concrete Building
- Mechanical Rotary Screen
- Auxiliary Screen
- Composite Sampler
- Controls
- Remote Monitoring System

Main Wastewater Lift Station

- Two New Submersible Pumps
- Check Valves
- Electromagnetic Flow Meter
- Control System

Blower/UV Building

- Precast Concrete Building
- Electromagnetic Flow Meter
- Stainless Steel UV Disinfection Channel
- Wall Mounted Spare UV Light Module
- Mechanical Wiping System
- Bypass Piping
- UV Controls
- Composite Sampler
- Non-Potable Water Basin After UV Channel
- Two Non-Potable Water Pumps with VFDs and Controls
- Check valves, Isolation Valves, and Flow Meters
- Non-Potable Water Piping Distribution System
- Two Hybrid Blowers
- Blower Controls
- Bathroom with Lavatory
- Remote Monitoring System

- Polishing Reactor

Site Landscaping

Plant Security Fencing

Potable Water Extension to the New Buildings

Building

Additive Alternate #1

Additive Alternate #2

- - building

Lagoon Treatment System

• 0.59 MG Membrane Lined Complete Mix Lagoon • 1.17 MG Membrane Lined Partially Mixed Lagoon • 1.23 MG Membrane Lined Partially Mixed Lagoon • Fine Bubble Aeration System

• Insulated Floating Cover for All Three Lagoon Cells Control Structures

Gravel Access Road and Parking Area

Sanitary Sewer Extension to the New Screening

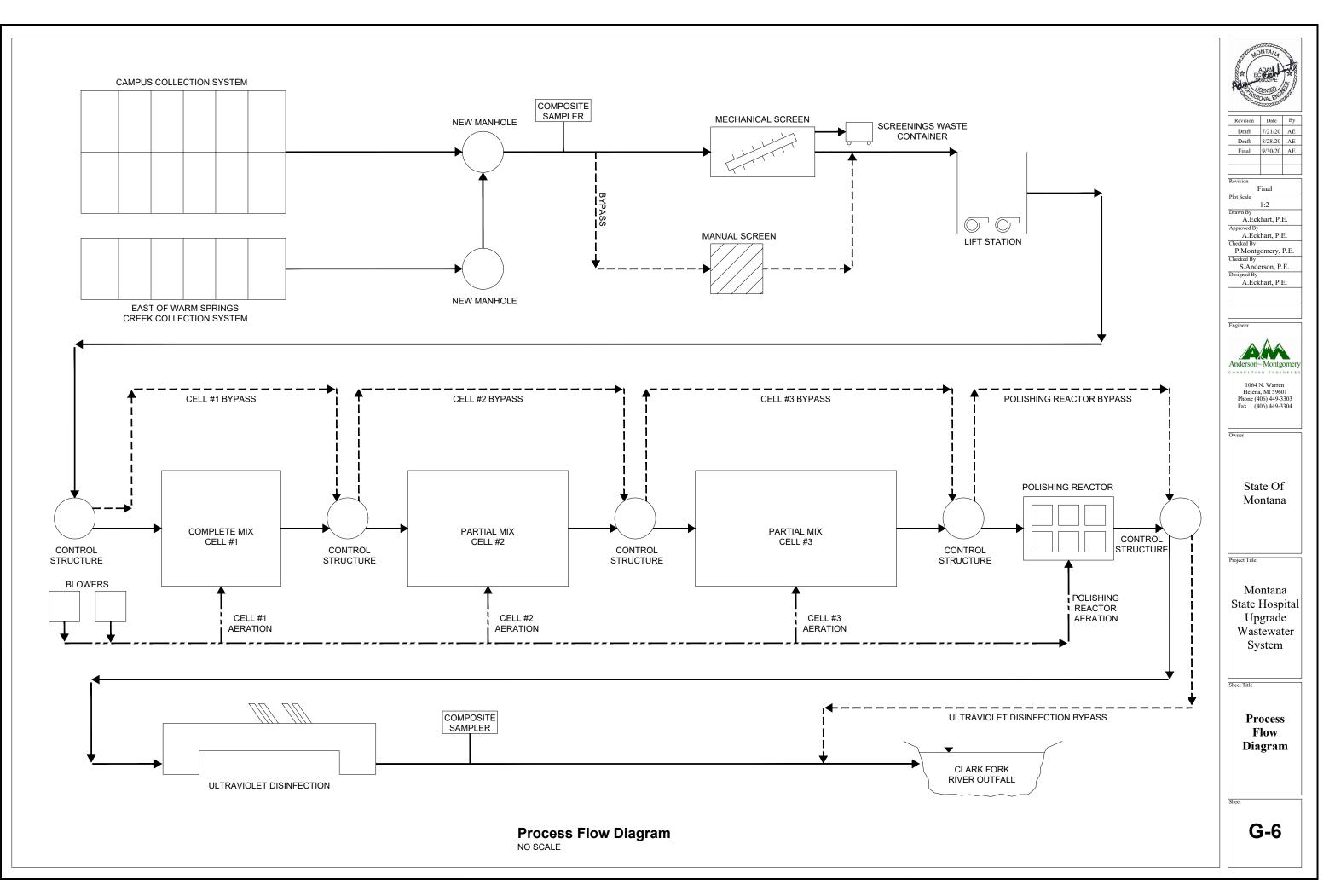
New Sanitary Sewer Outfall

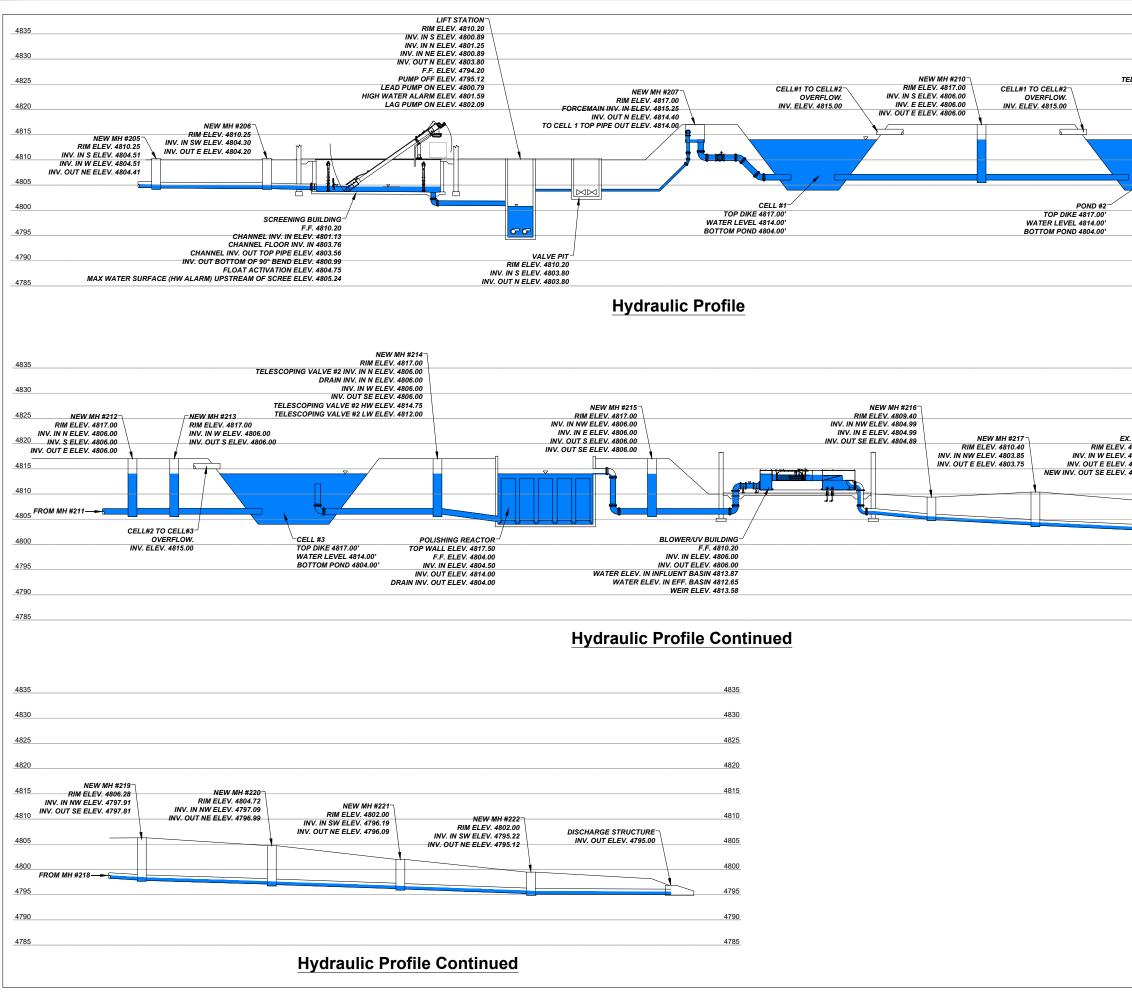
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• Landscaping: including grass seeding around both buildings, trees along the secondary highway and a non-potable water irrigation system

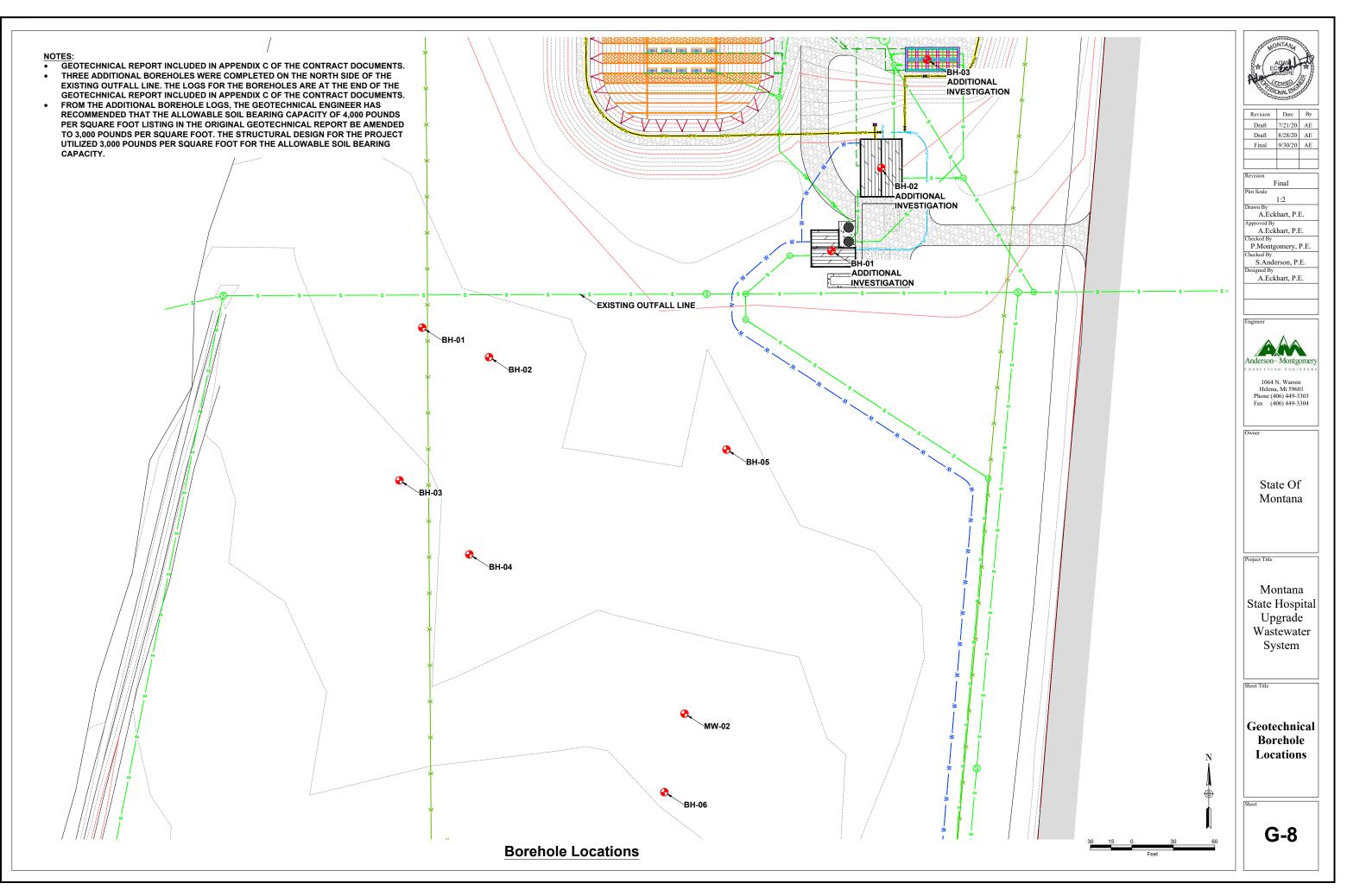
• Asphalt access road and parking area to replace the base bid gravel access road and parking area • Two stage air compressor located in the blower/UV

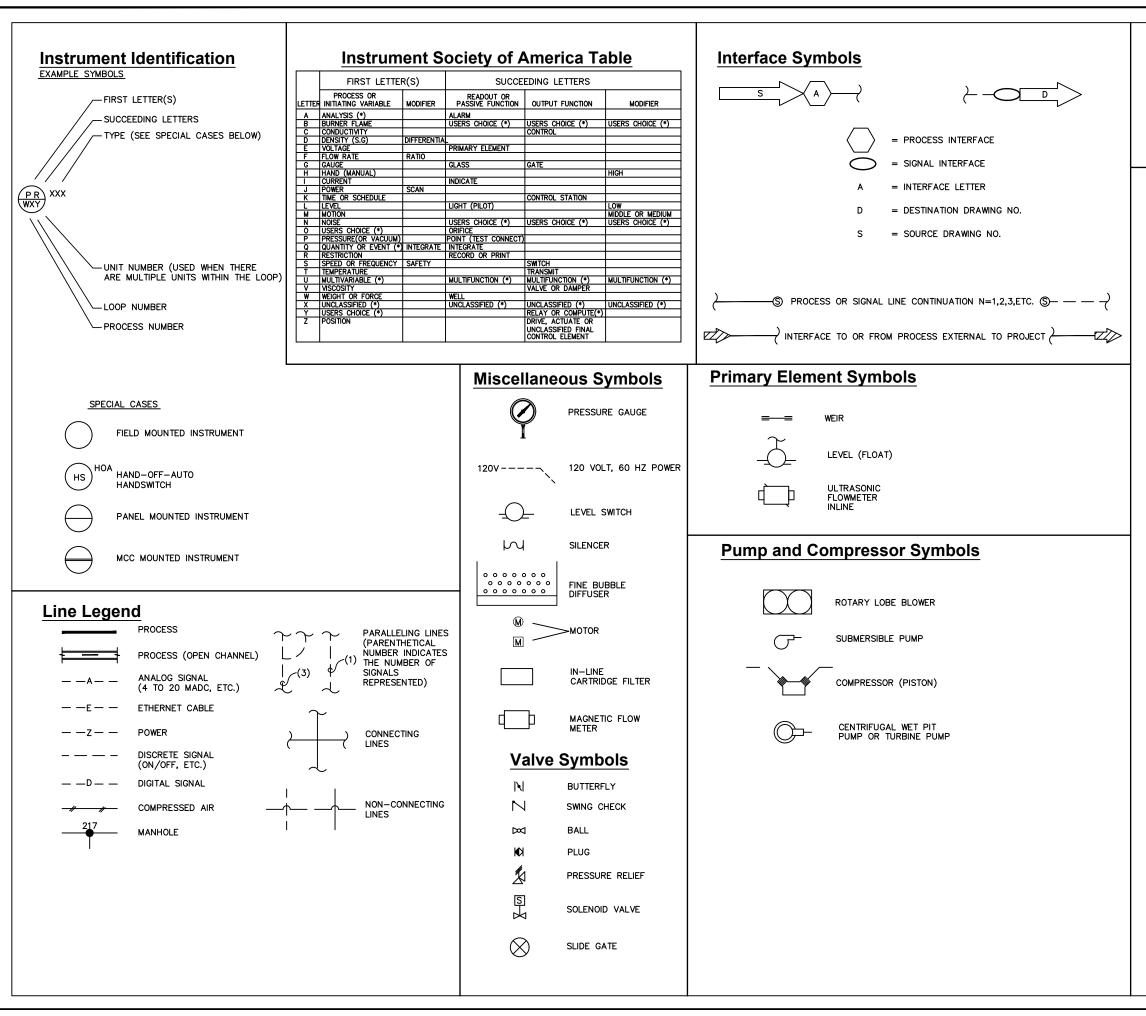
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Revision	Date	By
Draft	7/21/20	AE
Draft	8/28/20	AE
Final	9/30/20	AE
Revision	Final	
Plot Scale		
Drawn By	1:2 khart, P.I	
Approved B	у	
Checked By		
Checked By		
S.And Designed B	derson, P.	E.
A.Ec	khart, P.I	Ξ.
Engineer		
1064 Heler Phone (1~ Montg ING ENGT 4 N. Warrer na, Mt 5960 (406) 449-3 (406) 449-3	N E E R S 1 1 303
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4835	NONTANA
NEW MH #211 4830 RIM ELEV. 4817.00 4825 ELESCOPING VALVE #1 INV. IN S ELEV. 4806.00 4825 DRAIN INV. IN S ELEV. 4806.00 1825 INV. UT E ELEV. 4806.00 1825	
INV. OUT E ELEV. 4806.00 TELESCOPING VALVE #1 HW ELEV. 4814.75 TELESCOPING VALVE #1 LW ELEV. 4812.00 4815	Revision Date By Draft 7/21/20 AE Draft 8/28/20 AE
4810 	Final 9/30/20 AE
CELL#2 TO CELL#3 OVERFLOW. 4800 INV. ELEV. 4815.00	Revision Final Plot Scale 1:2
4795	Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By
4790	P.Montgomery, P.E. Checked By S.Anderson, P.E. Designed By
	A.Eckhart, P.E.
4835	Engineer
4830 4825	Anderson~ Montgomery
X. MH #1 4820 4808.36	1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
NEW MH #218 4802.61 NEW MH #218 4815 4802.61 RIM ELEV. 4805.96 4815 INV. IN NW ELEV. 4800.56 INV. OUT E ELEV. 4800.46 4810	Owner
4805 4805 	State Of Montana
4785	Project Title
	Montana State Hospital Upgrade Wastewater System
	Sheet Title
	Hydraulic Profile
	Sheet
	G-7



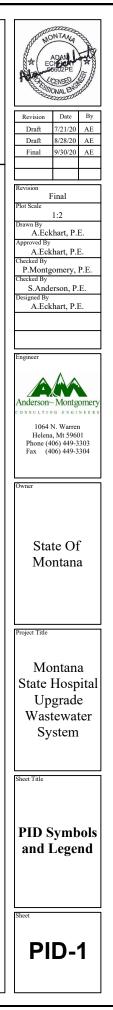


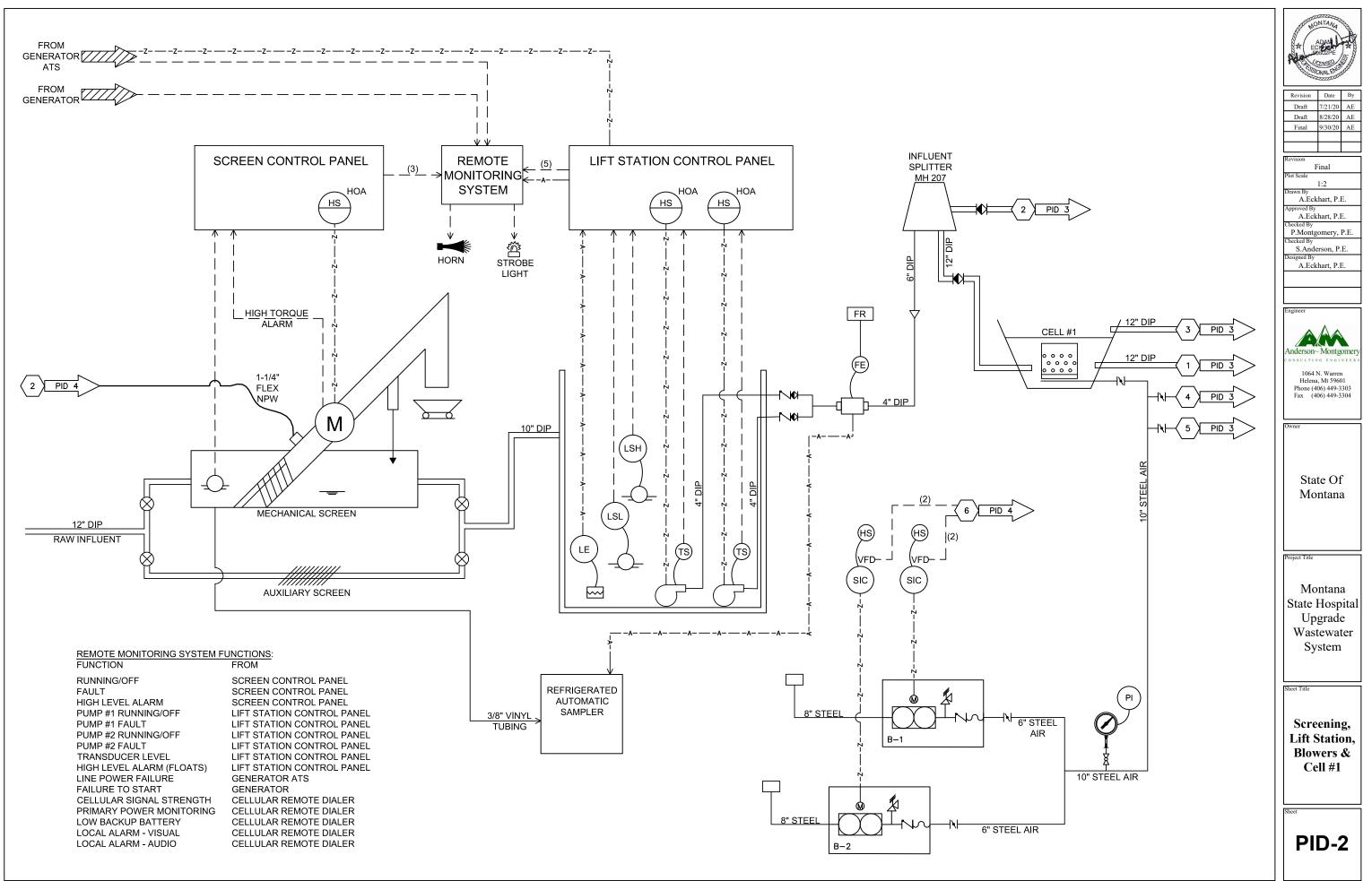
Abbreviations & Letter Symbols

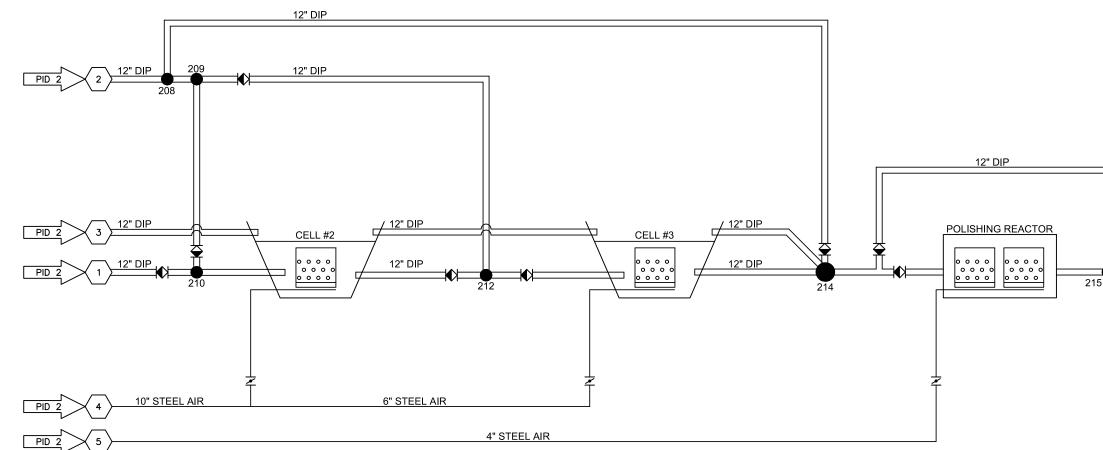
CP	CONTROL PANEL
НМ	HUMAN INTERFACE MODULE
HOA	HAND-OFF-AUTO
мн	MANHOLE
S	SOLENOID
VFD	VARIABLE FREQUENCY DRIVE
DIP	DUCTILE IRON PIPE
HDPE	HIGH DENSITY POLYETHYLENE PIPE
CPVC	CHLORINATED POLYVINYL CHLORIDE PIPE

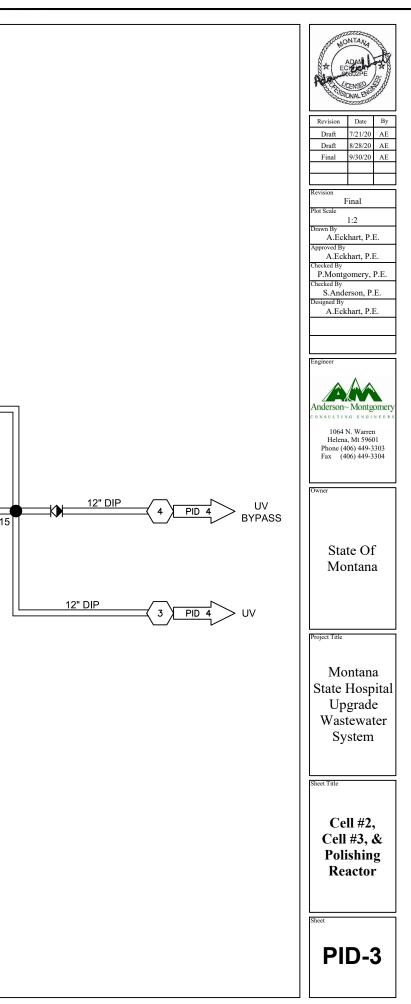
Flow Stream Identification

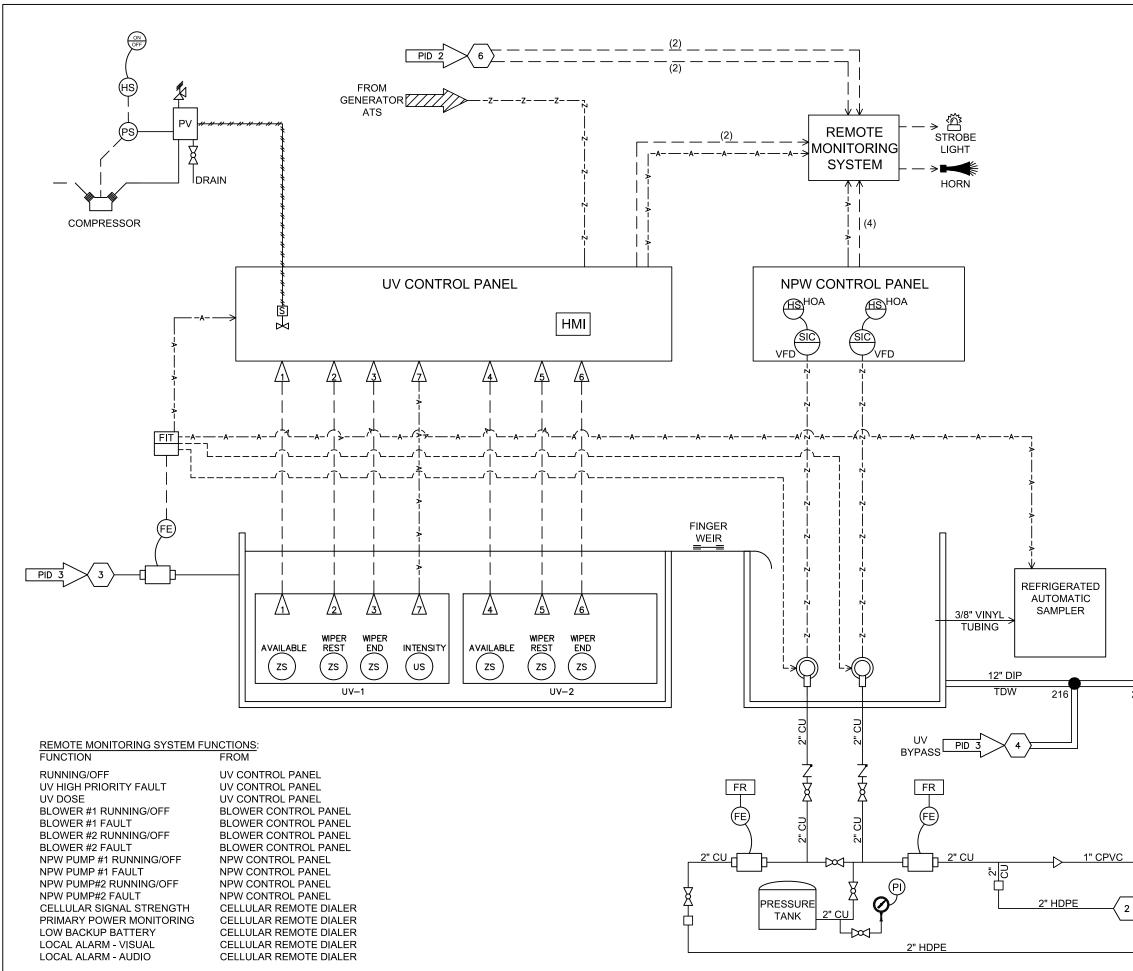
- WW WASTE WATER
- NPW NON-POTABLE WATER
- AIR COMPRESSED AIR
- TW TREATED WATER
- TDW TREATED DISINFECTED WATER











Revision Date Draft 7/2.1/ Draft 8/28/20 AE Final 9/30/20 AE Final Plot Scal 1:2 A.Eckhart, P.E. A.Eckhart, P.E. P.Montgomery, P.E. Checked By S.Anderson, P.E. A.Eckhart, P.E. 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304 State Of Montana Project Title Montana State Hospital Upgrade 217 Wastewater System CLARK FORK Sheet Title RIVER UV Disinfection & Non-Potable TO INTERIOR Water PLUMBING PID 2 PID-4 TO IRRIGATION SYSTEM $\overline{}$ VALVE BOXES

GENERAL NOTES:

- 1. CONTRACTOR TO OBTAIN ALL REQUIRED PERMITS FOR CONSTRUCTION, DEWATERING AND STORMWATER DISCHARGES.
- AS CONSTRUCTED ELEVATIONS SHALL BE WITHIN 0.08' OF ELEVATION SPECIFIED ON THE PLAN DRAWINGS.
 CONTRACTOR SHALL PROTECT AND PRESERVE ALL EXISTING SITE FEATURES (INCLUDING VEGETATION, SURFACES, STRUCTURES, SURVEY MONUMENTATION, ETC.) TO THE GREATEST EXTENT POSSIBLE DURING CONSTRUCTION. ANY DAMAGE TO EXISTING SITE FEATURES SHALL BE REPAIRED TO ORIGINAL OR BETTER CONDITION AT NO ADDITIONAL COST TO THE OWNER.
- CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING SEWER MAIN SIZE, MATERIAL TYPE, MANHOLE SIZE, MATERIALS AND CONDITION PRIOR TO INITIATION OF SEWER SYSTEM REHABILITATION ACTIVITIES.
- 5. CONTRACTOR SHALL BE RESPONSIBLE FOR PROPER DUST CONTROL DURING CONSTRUCTION.
- 6. CONTRACTOR MUST COMPLY WITH MONTANA STATE HOSPITAL REQUIREMENTS FOR CONSTRUCTION CONTRACTORS. SEE SPECIAL PROVISIONS.
- 7. DURING WORK ACTIVITIES, CONTRACTOR MUST STAY AT LEAST 50' FROM THE NEAREST RAILROAD TRACK.

NOTES FOR WATER AND SEWER MAINS:

- 1. THE OWNER AND RESIDENTS SHALL BE NOTIFIED PRIOR TO CHANGE OR DISRUPTION OF WATER OR SEWER SYSTEM OPERATION.
- 2. WATER MAIN PIPING SHALL BE C900 WATER PIPE. THERMAL PIPING SHALL BE DR 11 HDPE PIPE.
- 3. SEWER MAIN PIPING SHALL BE DUCTILE IRON OR SDR-35 PVC SEWER PIPE.
- 4. ALL WATERMAIN AND FORCEMAIN FITTINGS, INCLUDING WYES, REDUCERS AND ELBOWS EQUAL TO OR GREATER THAN 22-1/2° SHALL BE RESTRAINED MECHANICAL JOINT. ALL MECHANICAL JOINT RESTRAINTS SHALL BE "MEGALUG", UNIFLANGE OR EQUAL. JOINT RESTRAINT SHALL BE IN ADDITION TO MEETING THRUST BLOCK REQUIREMENTS IN ACCORDANCE WITH THE PROJECT SPECIFICATIONS AND MPW STANDARD DRAWINGS 02660-1, AND 02660-3.
- 5. TRENCHES FOR THE INSTALLATION OF WATER MAINS AND SEWER MAINS SHALL BE PROPERLY BACKFILLED AS QUICKLY AS POSSIBLE, BUT NO MORE THAT 48-HOURS AFTER INITIAL DIGGING.
- 6. WHEN WORKING NEAR AND/OR EXPOSING EXISTING UTILITIES AND SERVICE LINES, WORKERS SHALL UTILIZE HAND-DIGGING IN ORDER TO AVOID DAMAGE TO THOSE UTILITIES. IF DAMAGE OCCURS, THE COST OF REPAIR AND PENALTIES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
- 7. DISINFECTION OF WATER MAINS SHALL BE IN ACCORDANCE WITH APPENDIX B OF MPWSS.
- 8. EXISTING WATER PIPE IS "TRANSITE" PIPE WHICH CONTAINS ASBESTOS CEMENT. CONTRACTOR SHALL OBSERVE ALL FEDERAL AND STATE REGULATIONS WHEN CUTTING, HANDLING AND DISPOSING THIS PRODUCT.

UTILITY NOTES:

- 1. THE ENGINEER HAS OBTAINED UNDERGROUND UTILITY INFORMATION FROM OWNERS OF THE UNDERGROUND FACILITIES AND INCLUDED THAT INFORMATION AS PART OF THESE PLANS. THIS UTILITY LOCATION INFORMATION IS APPROXIMATE AND MAY BE INCOMPLETE.
- 2. BEFORE BEGINNING AN EXCAVATION, THE CONTRACTOR SHALL NOTIFY, THROUGH ONE-CALL NOTIFICATION CENTER, ALL OWNERS OF UNDERGROUND FACILITIES IN THE AREA OF THE PROPOSED EXCAVATION. THE PHONE NUMBER IS: 1-800-424-5555 OR 811. WEBSITE: WWW.CALLBEFOREYOUDIG.ORG
- 3. AFTER AN OWNER OF AN UNDERGROUND FACILITY HAS LOCATED AND MARKED THE UNDERGROUND FACILITIES, THE CONTRACTOR SHALL DETERMINE IF WEATHER, TIME, OR OTHER FACTORS MAY HAVE AFFECTED LOCATION MARKS, WARRANTING RELOCATION OF THE FACILITIES.
- 4. IF EXCAVATION HAS NOT OCCURRED WITHIN 30 DAYS OF THE LOCATE AND MARK, THE CONTRACTOR SHALL REQUEST THAT THE FACILITY BE RELOCATED AND REMARKED BEFORE EXCAVATING UNLESS OTHER ARRANGEMENTS HAVE BEEN MADE WITH THE UNDERGROUND FACILITY OWNER. THE CONTRACTOR IS RESPONSIBLE FOR ALL COSTS ASSOCIATED WITH RELOCATING AND REMARKING A FACILITY THAT IS NOT EXCAVATED WITHIN 30 DAYS OF THE LOCATE AND MARK.
- 5. THE CONTRACTOR MAY NOT BEGIN EXCAVATING BEFORE THE LOCATING AND MARKING IS COMPLETE OR BEFORE THE CONTRACTOR IS NOTIFIED THAT LOCATING AND MARKING IS UNNECESSARY.
- 6. THE CONTRACTOR SHALL LOCATE AND MARK THE AREA TO BE EXCAVATED IF REQUESTED BY THE UNDERGROUND FACILITY OWNER OR THEIR REPRESENTATIVE. IF THE CONTRACTOR DISCOVERS AN UNDERGROUND FACILITY THAT HAS NOT BEEN LOCATED AND MARKED, THE CONTRACTOR SHALL STOP EXCAVATING IN THE VICINITY OF THE FACILITY AND NOTIFY THE FACILITY OWNER OR THE ONE-CALL NOTIFICATION CENTER. IF THIS OCCURS THE CONTRACTOR SHALL PROCEED WITH OTHER ELEMENTS OF THE PROJECT, AT NO COST TO THE PROJECT OWNER, UNTIL THE UNDERGROUND FACILITY OWNER HAS NOTIFIED THE CONTRACTOR THAT EXCAVATION CAN PROCEED.

SPECIAL MONTANA STATE HOSPITAL CAMPUS RULES:

1. SEE THE SPECIAL PROVISIONS IN THE CONTRACT DOCUMENTS FOR THE SPECIAL MONTANA STATE HOSPITAL CAMPUS RULES.

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RevisionDateByDraft7/21/20AEDraft8/28/20AEFinal9/30/20AE
Revision Final Plot Scale
1:2 Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.
Engineer
Anderson~ Montgomery consulting excinences 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
State Of Montana
Project Title Montana State Hospital Upgrade Wastewater System
Sheet Title Civil Notes

	LOCATIO	N BLOCK	
1/4	SECTION	TOWNSHIP	RANGE
X	13	5N	10W
X X	18	5N	9W
P	RINCIPAL MER	IDIAN MONTAN	A
DE	ER LODGE CO	UNTY, MONTAI	NA

SURVEY	CONTROL	POINT	TABLE

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
2	722108.517	1137859.479	4814.014	FOUND ELI RPC
60	725678.589	1137559.584	4795.045	SET MAG NAIL
61	724093.994	1137329.146	4802.818	SET MAG NAIL
63	722651.294	1137151.223	4810.763	SET MAG NAIL
64	721867.567	1136919.967	4813.496	SET MAG NAIL
65	722756.018	1136523.837	4810.5	SET NAIL
66	721360.121	1136175.661	4821.632	SET MAG NAIL
67	721476.442	1136739.984	4817.335	SET ELI RPC
606	722139.157	1136186.695	4816.65	FOUND REBAR
1000	722669.469	1137673.399	4807.279	CL MANHOLE
				•

* MONTANA STATE PLAN COORDINATES (MTSP) NAD83 * VERTICAL DATUM IS NAVD88 * WARM SRPINGS DATUM. * WARM SPRINGS DATUM COORDINATES WERE OBTAINED BY SCALING MTSP COORDINATES TO GROUND BY A COMBINED SCALE FACTOR OF 1.0007 AND ROTATING AND TRANSLATING TO FOUND POINTS #606 AND #1000

POINT

2

60

61

63

64

65

66

67

606

1000

NORTHING

9475.303

13032.7729

11439.0246

9989.2841

9196.2728

10068.5461

8658.6968

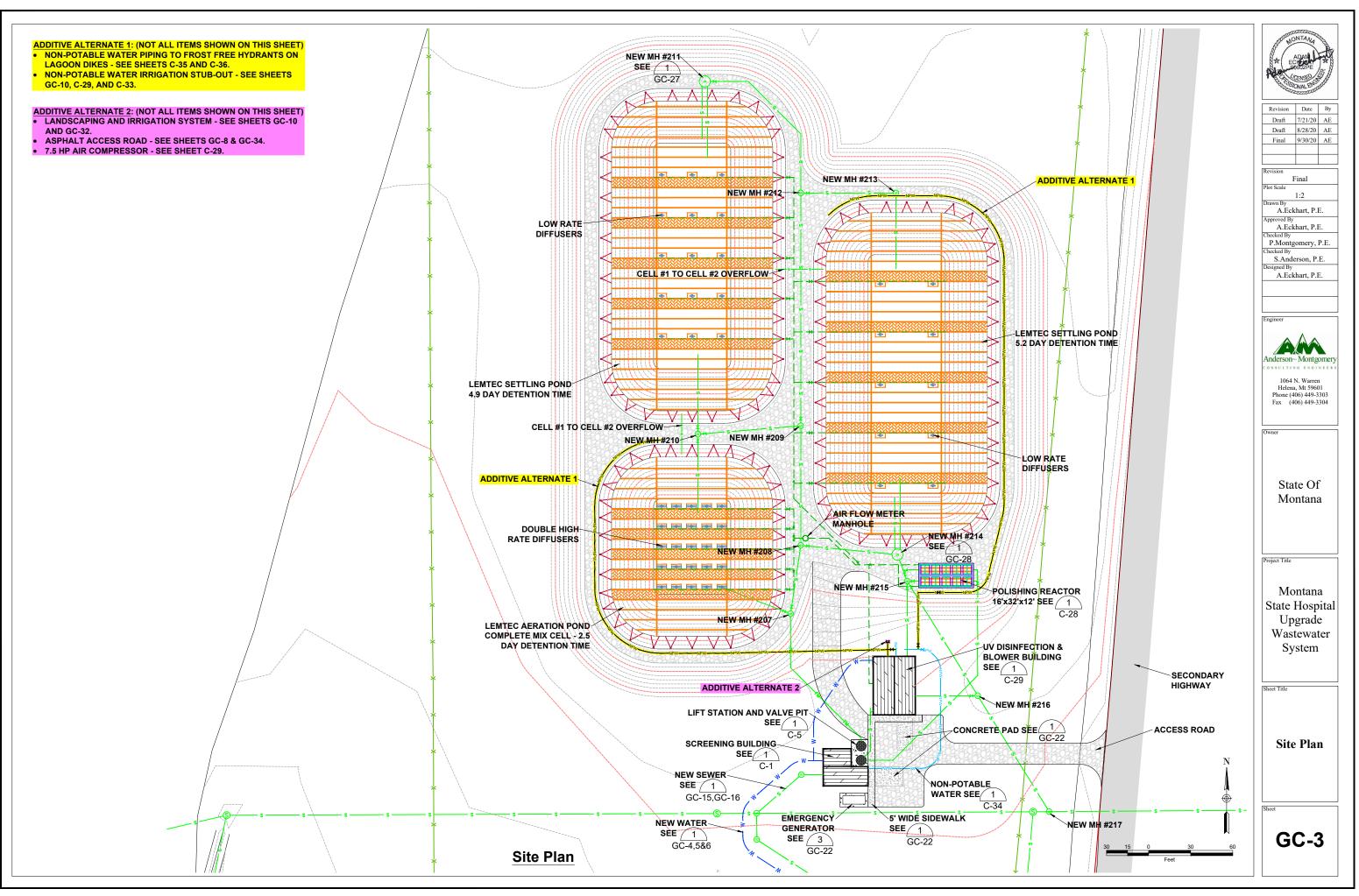
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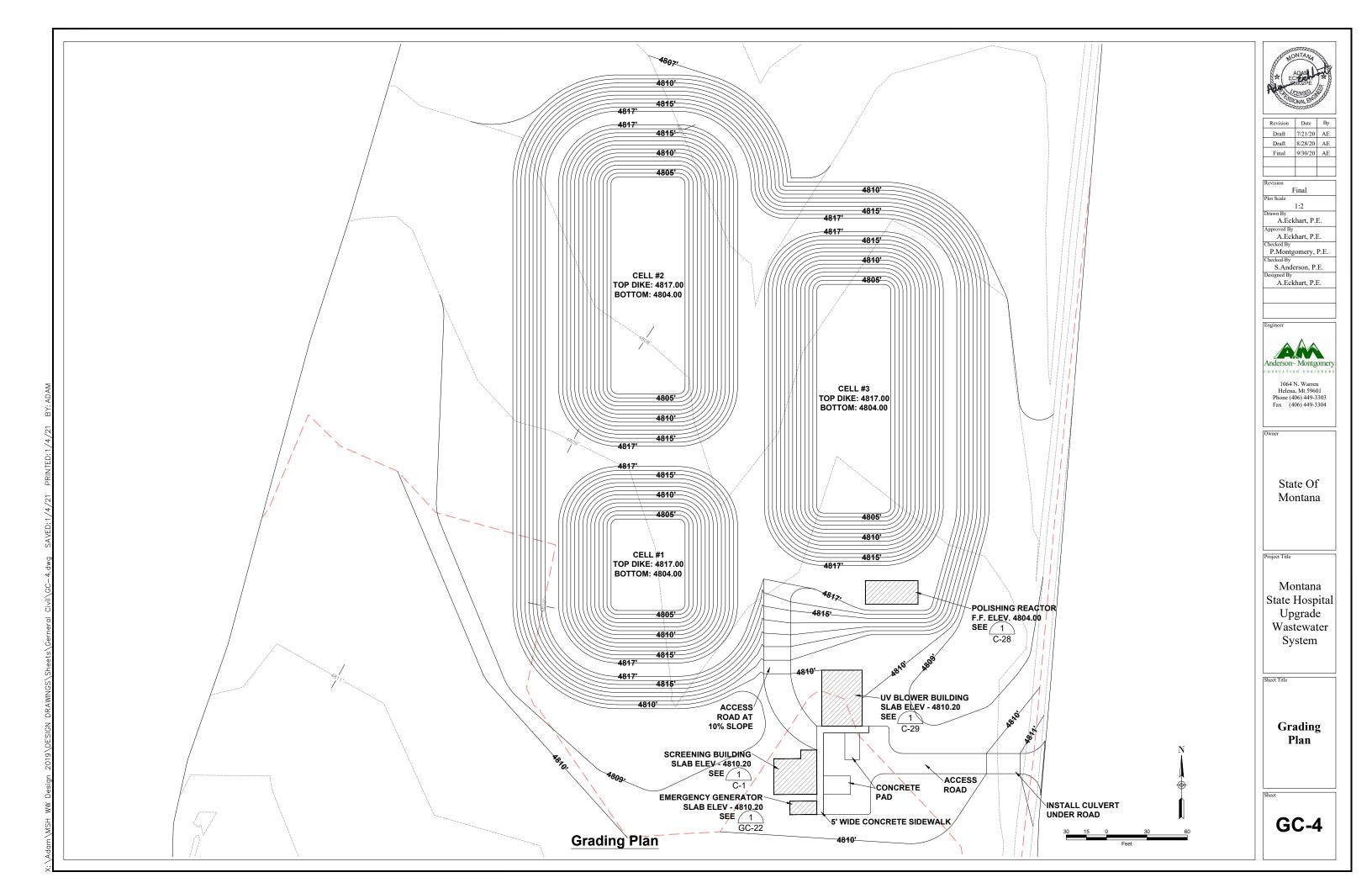
9438.0849

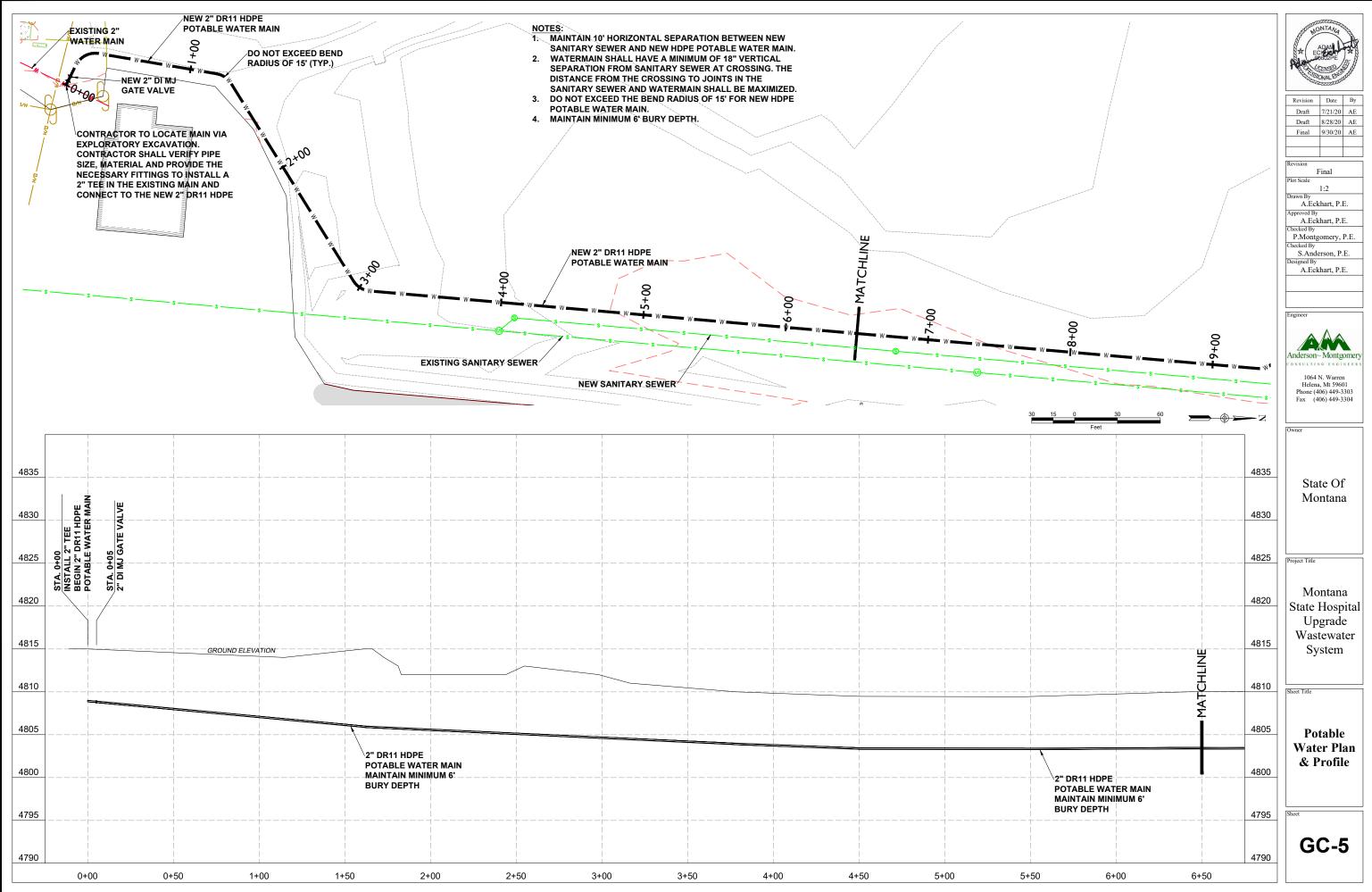
10028.6382

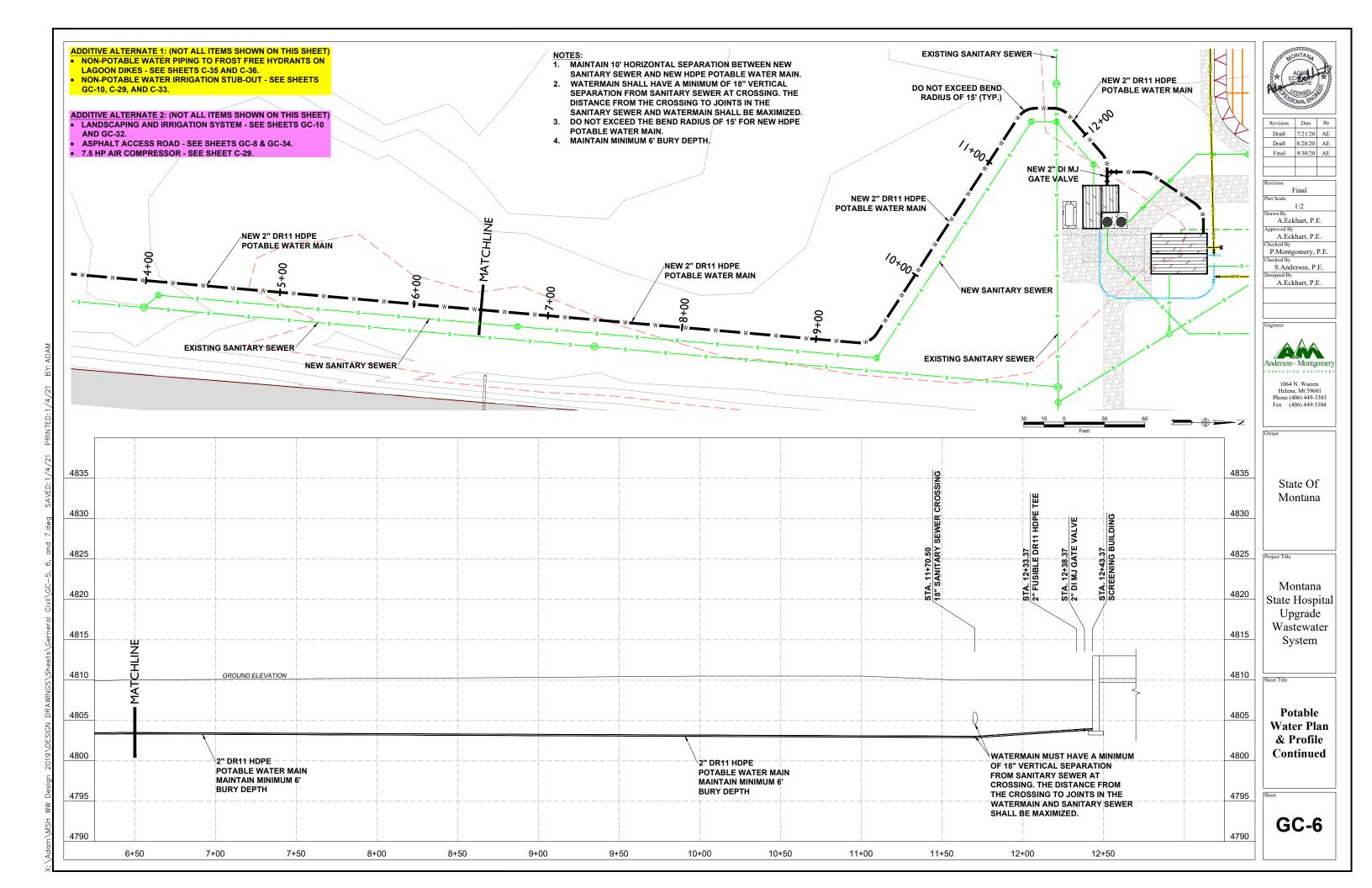
IRVEY CONTRO	DL POINT TABL	E
EASTING	ELEVATION	DESCRIPTION
12185.7758	4815.1188	FOUND ELI RPC
11741.1021	4796.1365	SET MAG NAIL
11574.9694	4803.915	SET MAG NAIL
11455.5894	4811.8655	SET MAG NAIL
11256.1616	4814.6004	SET ELI RPC
10824.0323	4811.6023	SET NAIL
10532.5217	4822.7421	SET MAG NAIL
11092.0572	4818.4421	SET ELI RPC
10511.9538	4817.7567	FOUND REBAR
11976.9642	4808.3791	CL MANHOLE
	EASTING 12185.7758 11741.1021 11574.9694 11455.5894 11256.1616 10824.0323 10532.5217 11092.0572 10511.9538	12185.7758 4815.1188 11741.1021 4796.1365 11574.9694 4803.915 11455.5894 4811.8655 11256.1616 4814.6004 10824.0323 4811.6023 10532.5217 4822.7421 11092.0572 4818.4421 10511.9538 4817.7567

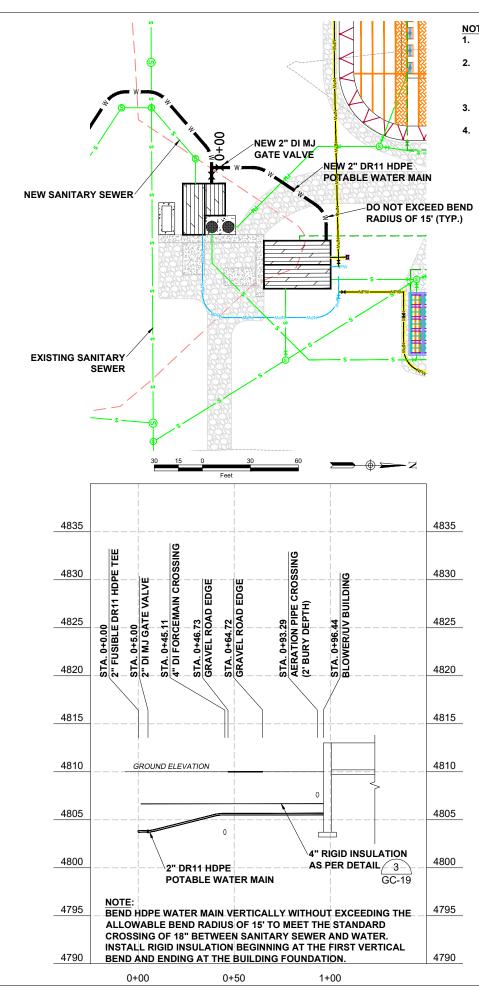
HONTAN HONTAN COLORED
Revision Date By Draft 7/21/20 AE Draft 8/28/20 AE Final 9/30/20 AE
Revision Final Plot Scale 1:2
1:2 Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By P.Montgomery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.
Engineer
Anderson-Montgomery consulting in a first state 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
State Of Montana
Project Title
Montana State Hospital Upgrade Wastewater System
Sheet Title Location Block and Survey Control Coordinates
GC-2











NOTES:

MAINTAIN 10' HORIZONTAL SEPARATION BETWEEN NEW SANITARY SEWER AND NEW HDPE POTABLE WATER MAIN.

- WATERMAIN SHALL HAVE A MINIMUM OF 18" VERTICAL SEPARATION FROM SANITARY SEWER AT CROSSING. THE DISTANCE FROM THE CROSSING TO JOINTS IN THE
- SANITARY SEWER AND WATERMAIN SHALL BE MAXIMIZED. 3. DO NOT EXCEED THE BEND RADIUS OF 15' FOR NEW HDPE POTABLE WATER MAIN.
- MAINTAIN MINIMUM 6' BURY DEPTH WHERE POSSIBLE. IF 6' BURY DEPTH CANNOT BE MAINTAINED INSTALL 4" RIGID INSULATION AS PER DETAIL

GC-19

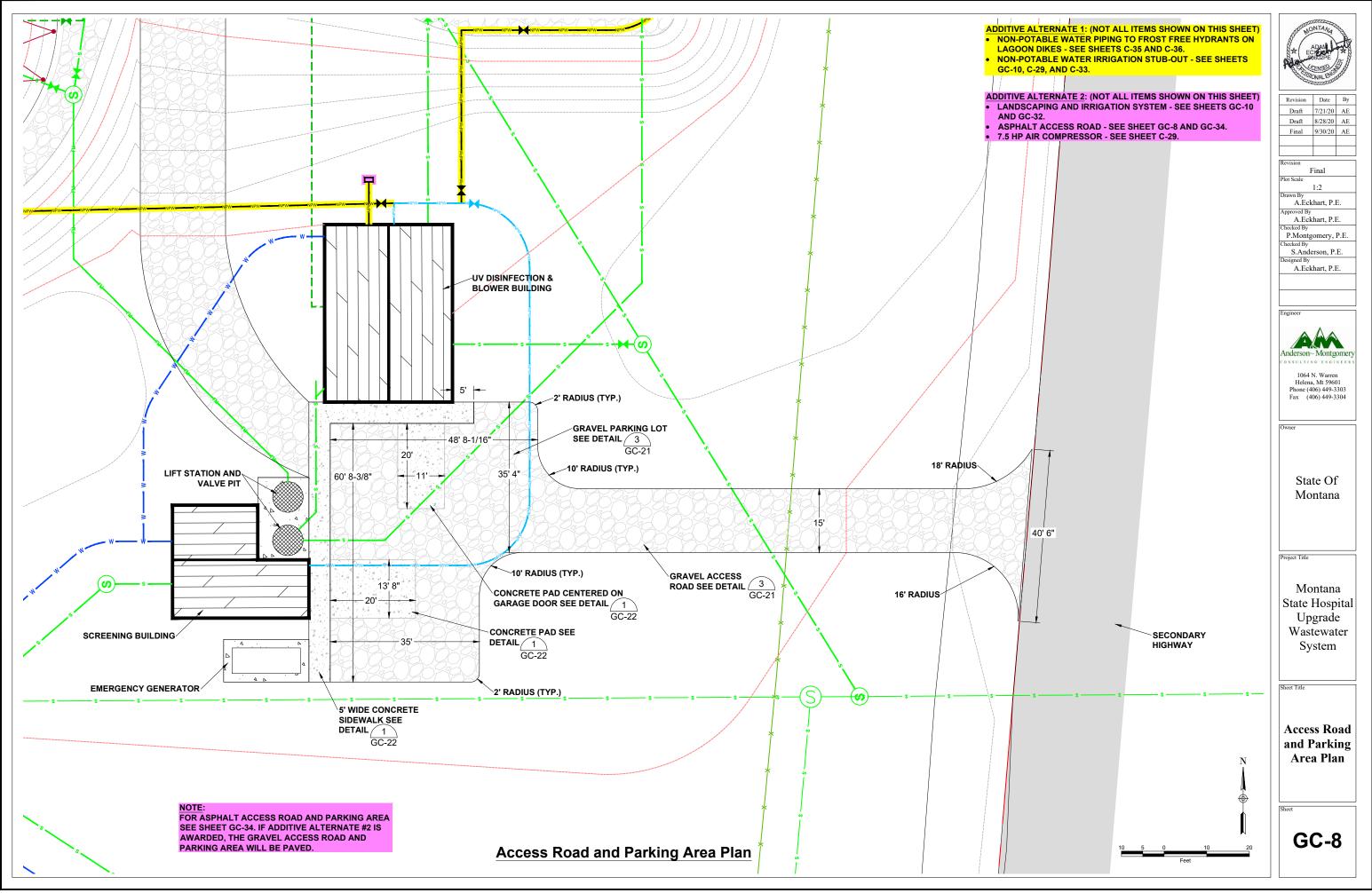


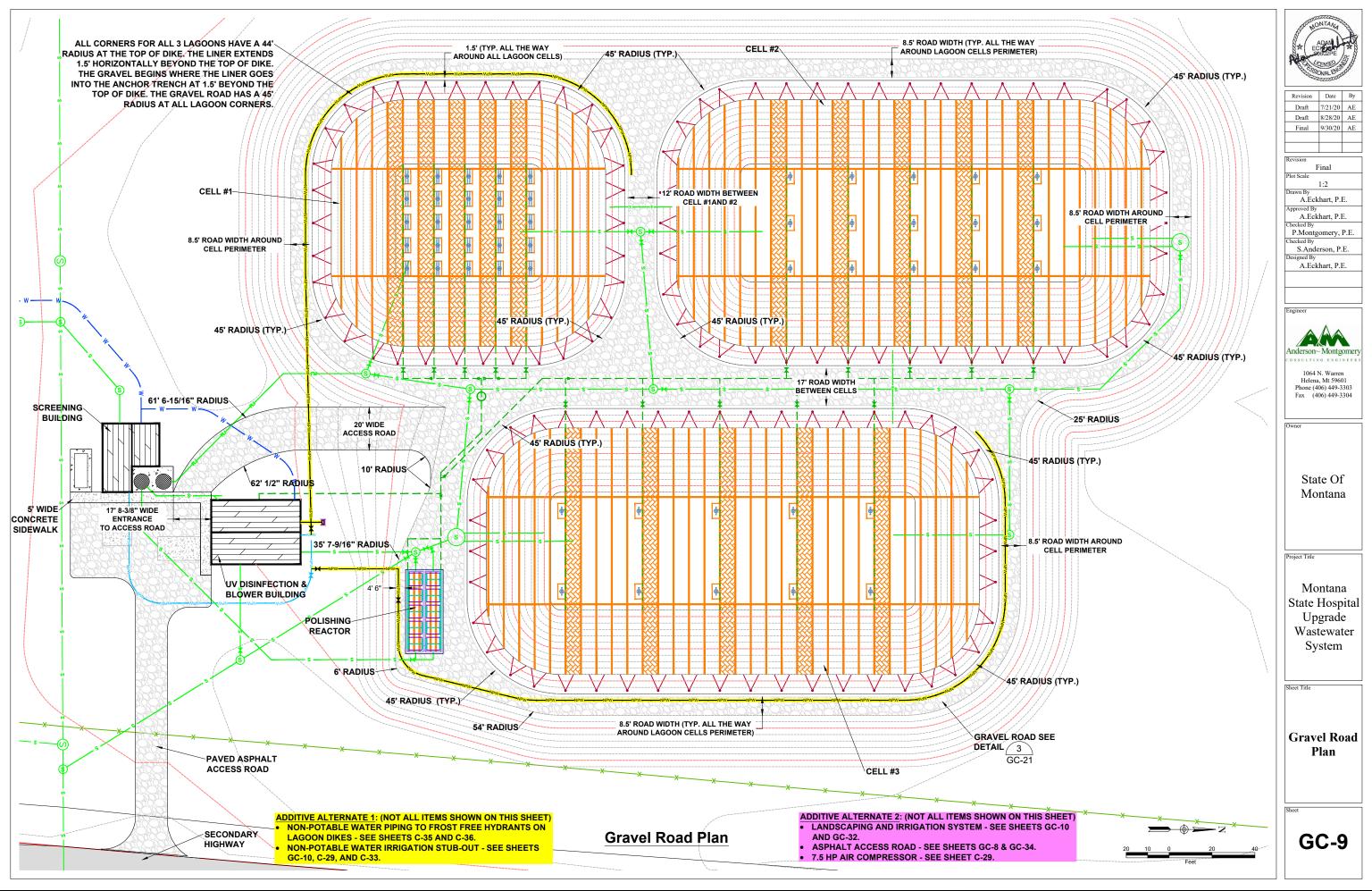
ADDITIVE ALTERNATE 1: (NOT ALL ITEMS SHOWN ON THIS SHEET) NON-POTABLE WATER PIPING TO FROST FREE HYDRANTS ON LAGOON DIKES - SEE SHEETS C-35 AND C-36. NON-POTABLE WATER IRRIGATION STUB-OUT - SEE SHEETS GC-10, C-29, AND C-33.

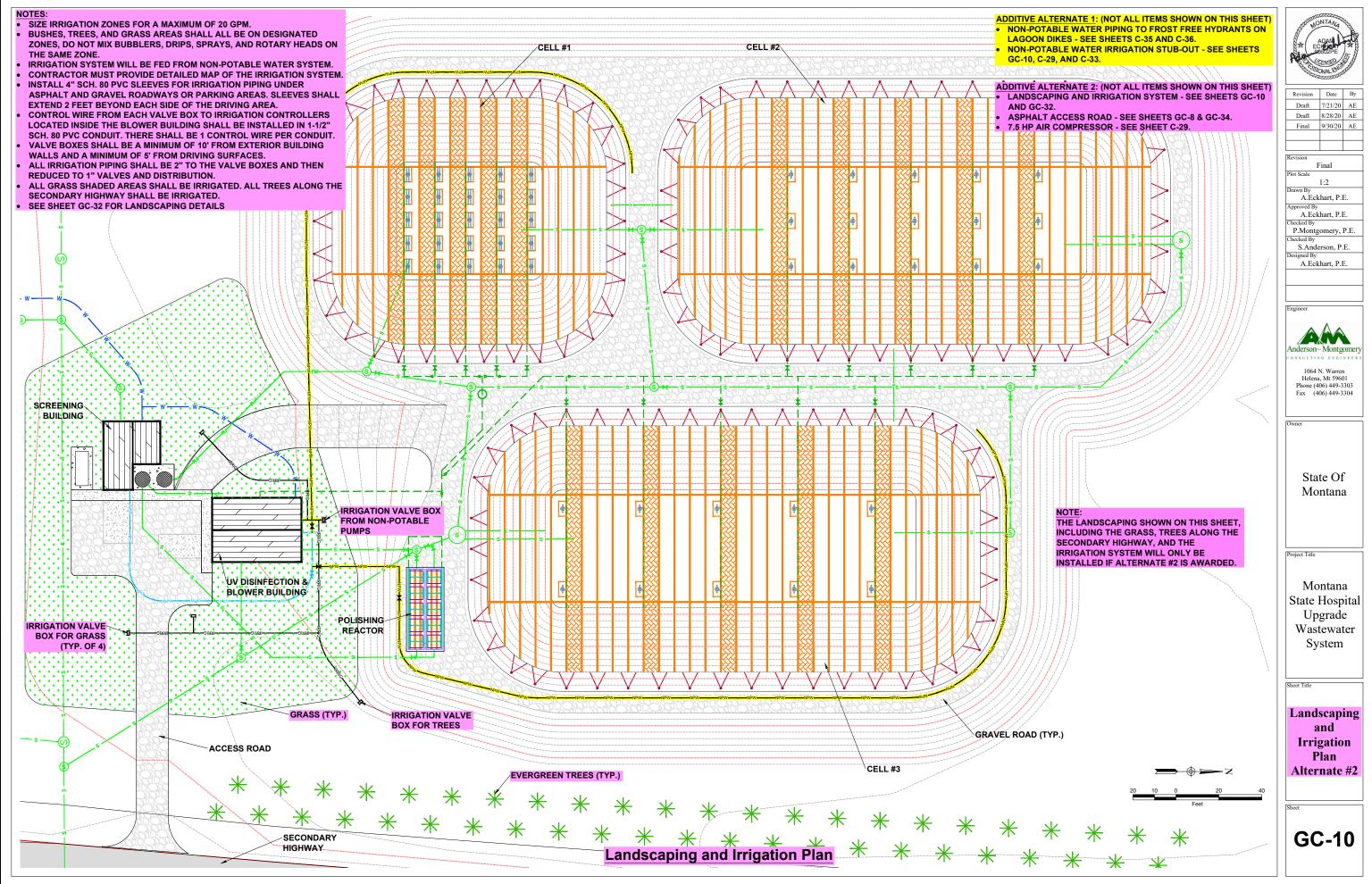
ADDITIVE ALTERNATE 2: (NOT ALL ITEMS SHOWN ON THIS SHEET) LANDSCAPING AND IRRIGATION SYSTEM - SEE SHEETS GC-10 AND GC-32. ASPHALT ACCESS ROAD - SEE SHEETS GC-8 & GC-34.

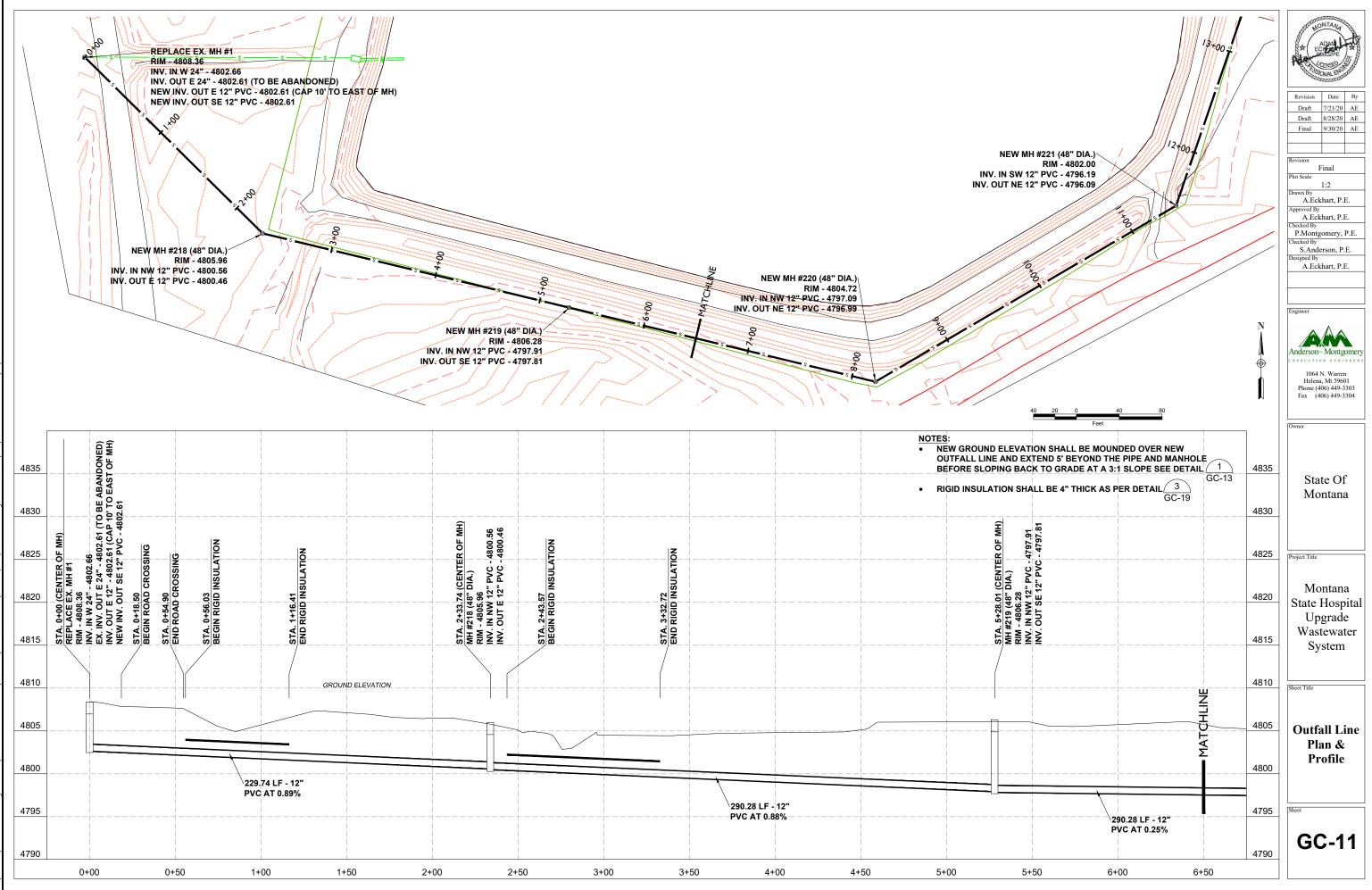
• 7.5 HP AIR COMPRESSOR - SEE SHEET C-29.

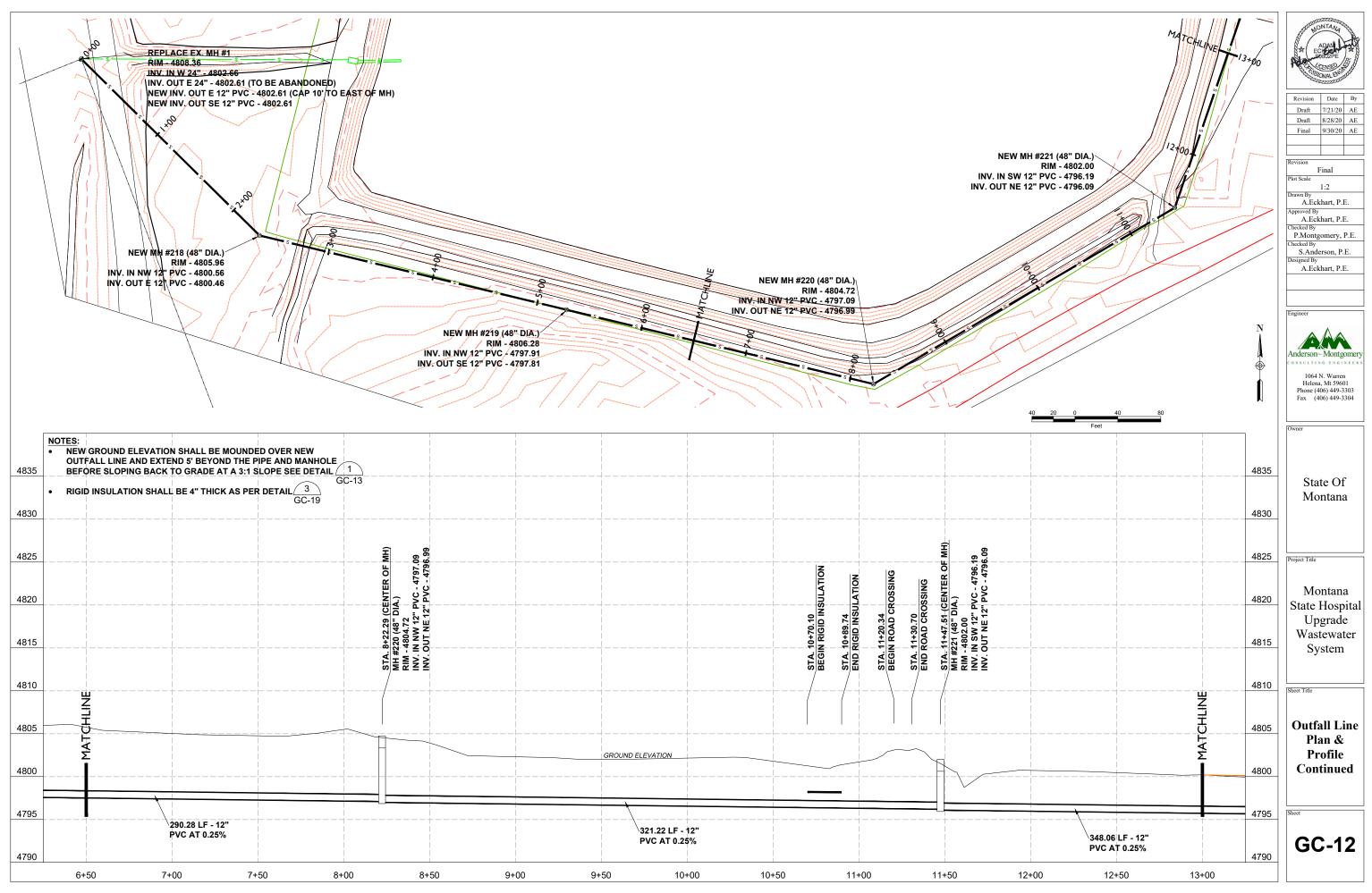


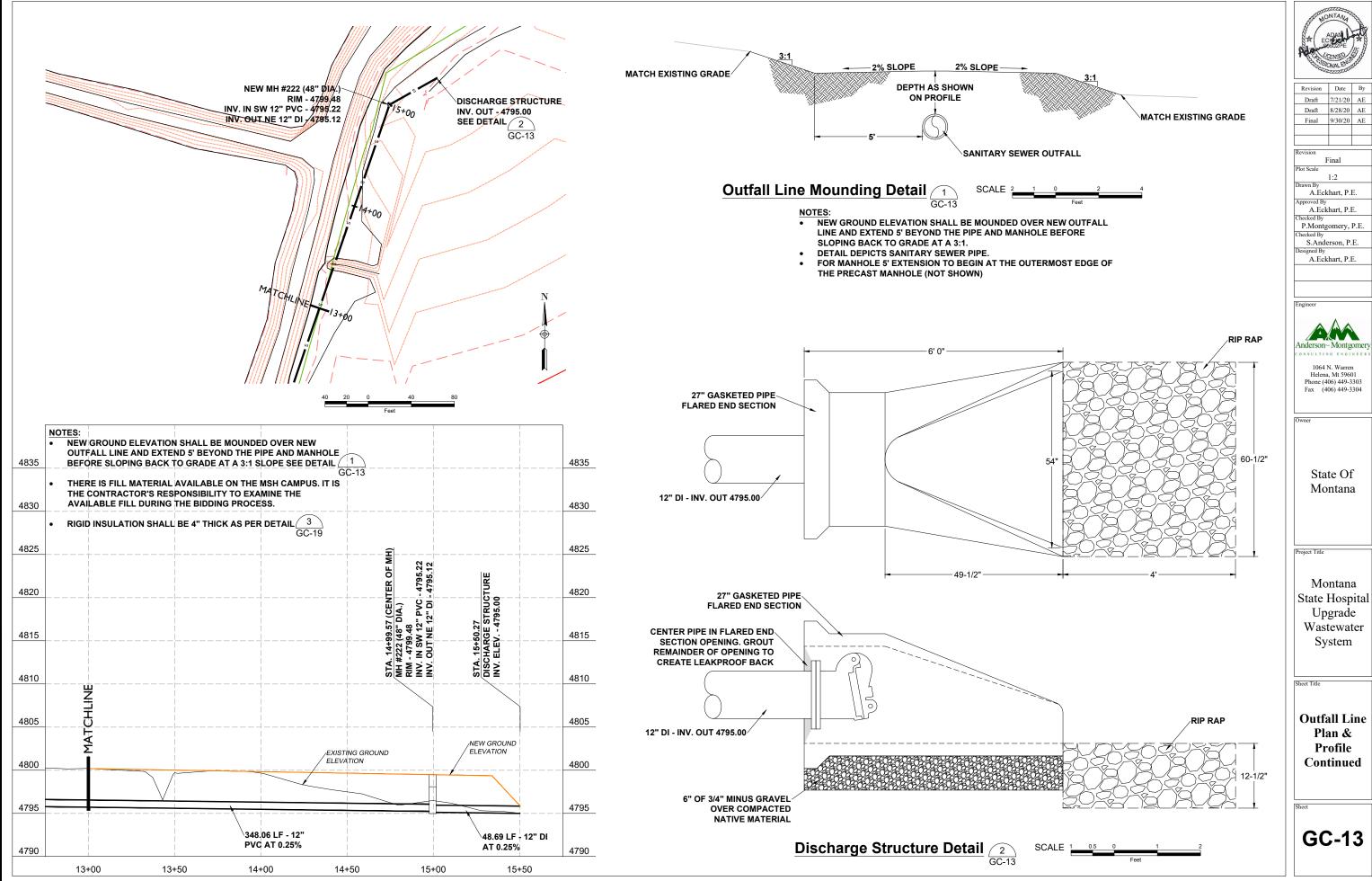


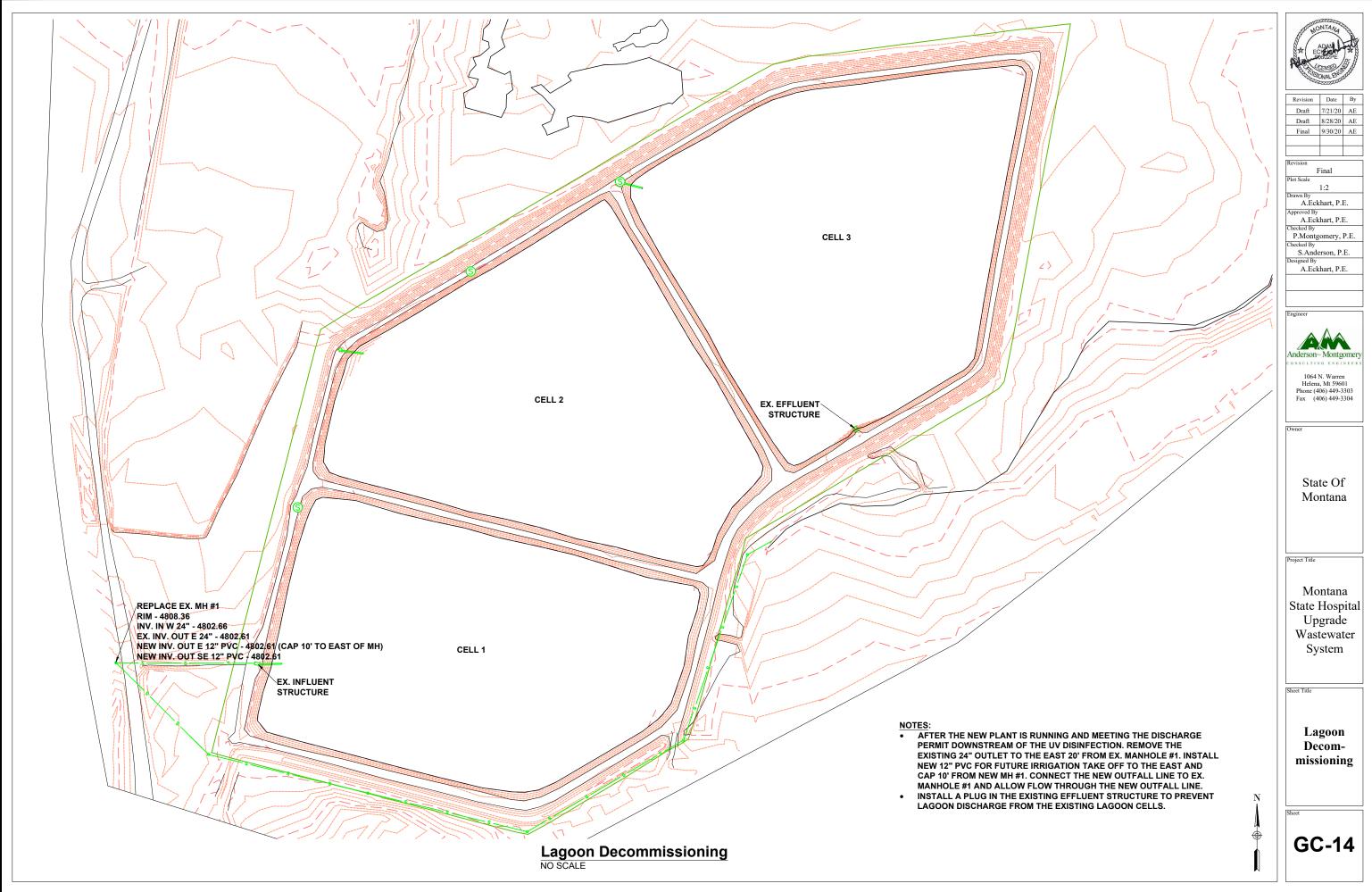


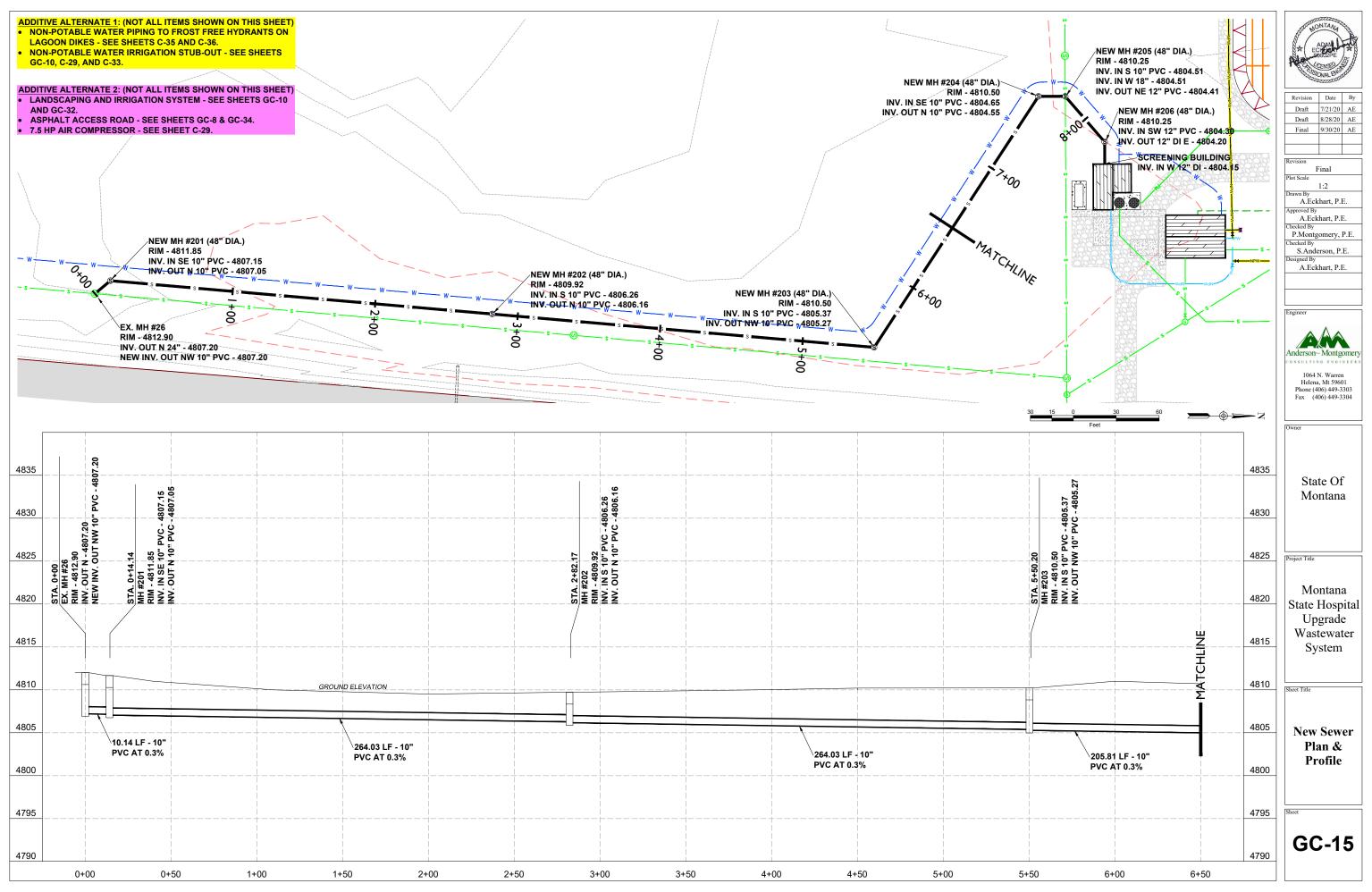


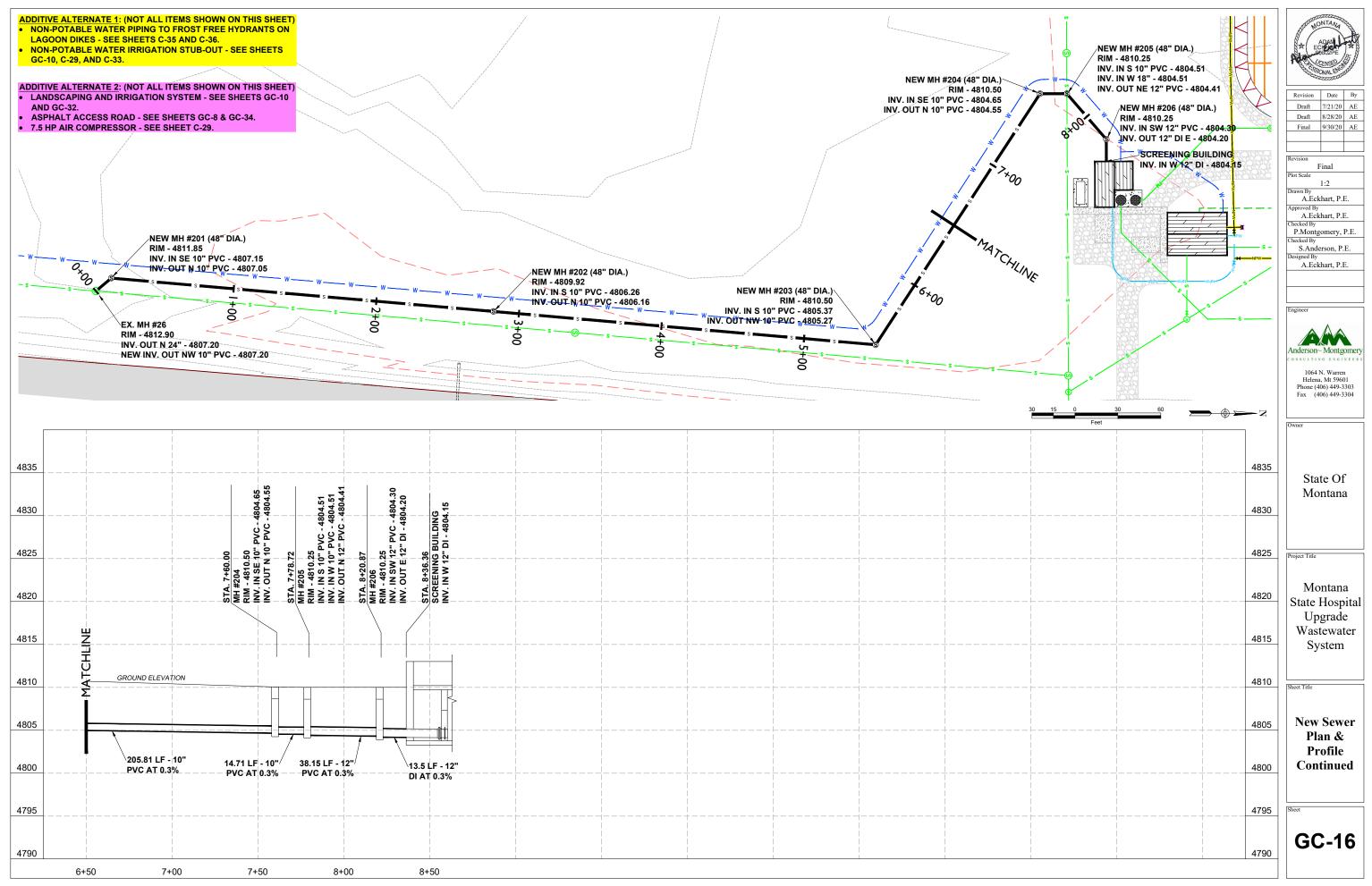


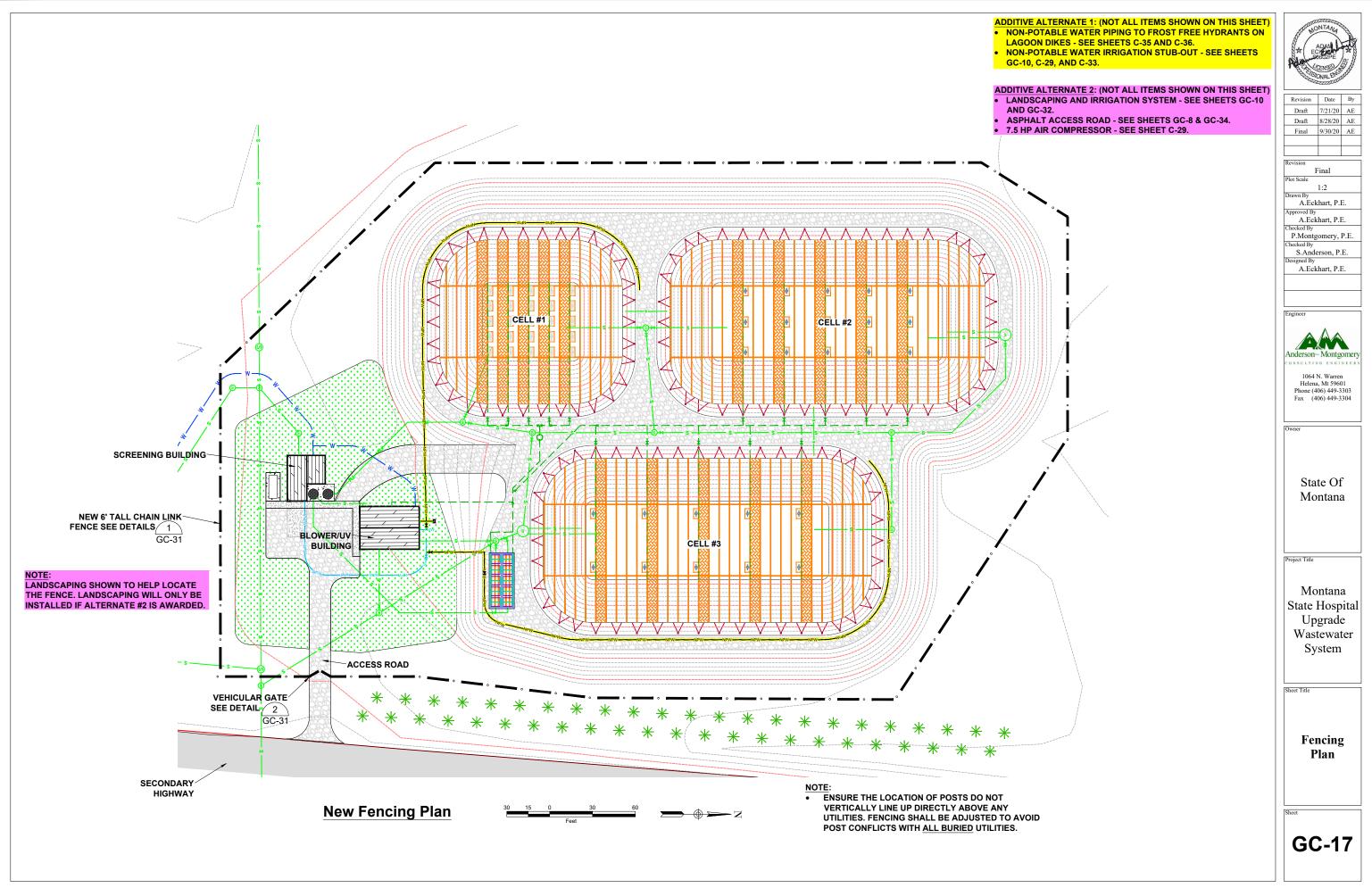


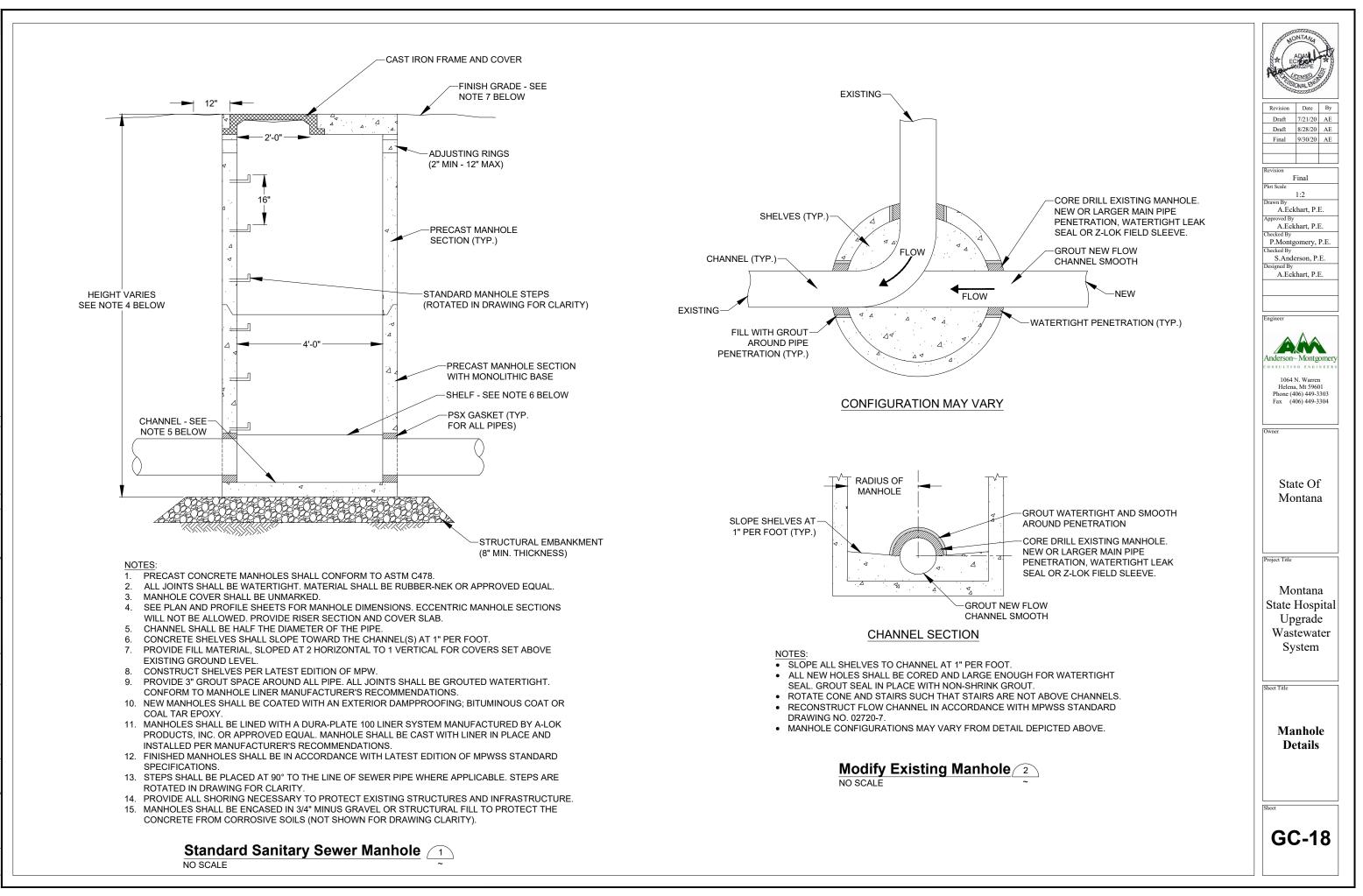


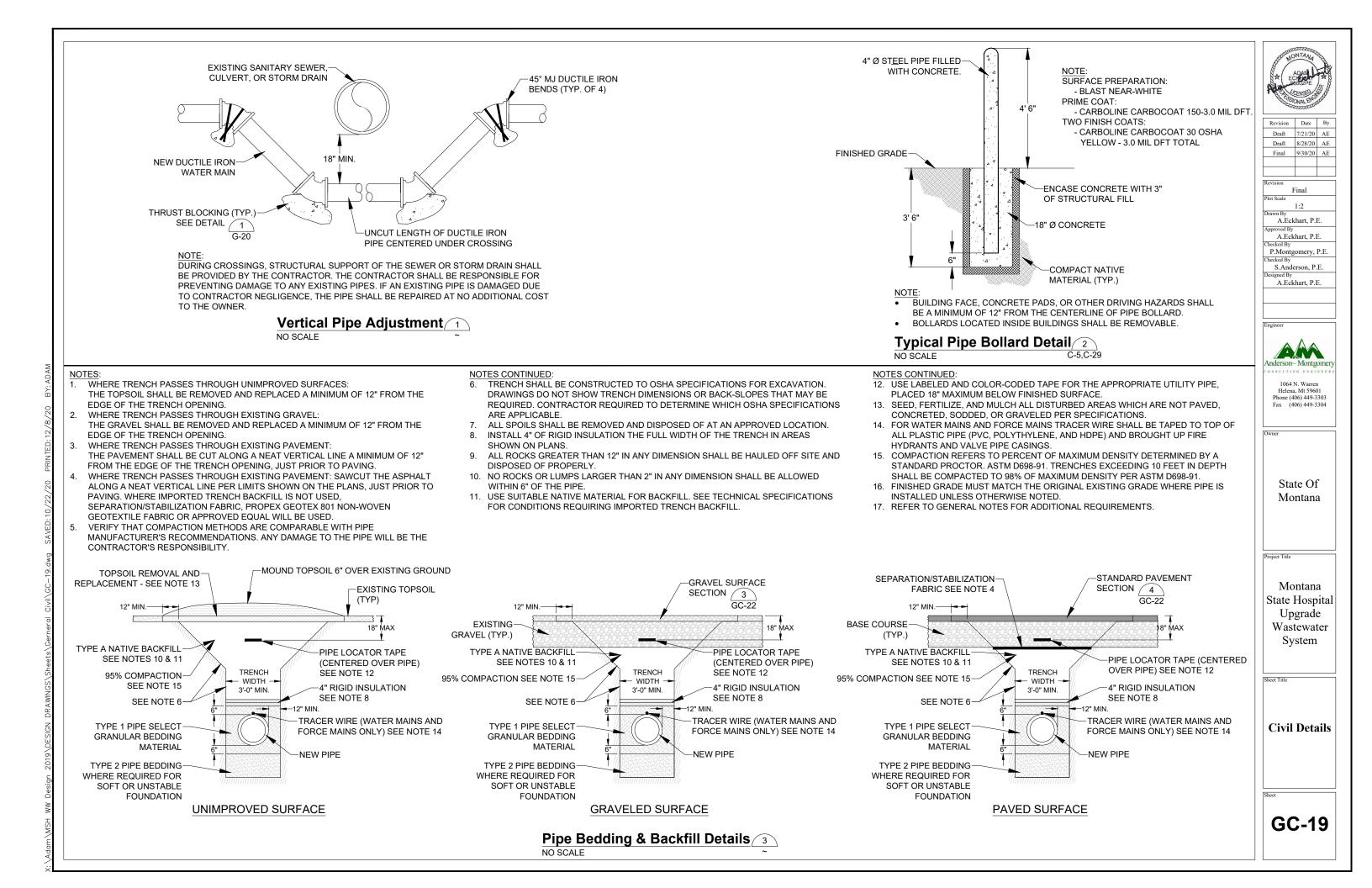












NOTES:

- 1. KEEP CONCRETE CLEAR OF JOINT AND JOINT ACCESSORIES
- 2. POUR THRUST BLOCKING AGAINST 3/4" MINUS GRAVEL OR STRUCTURAL FILL. 3/4" MINUS GRAVEL OR STRUCTURAL FILL SHALL BE AGAINST UNDISTURBED EARTH.
- 3. REQUIRED VOLUMES AND BEARING AREAS SHALL BE AS SHOWN IN THE TABLE AND ADJUSTED, IF NECESSARY, TO CONFORM TO THE TEST PRESSURE(S) AND ALLOWABLE SOIL BEARING STRESS OF 2,000 LBS/SQFT.
- THRUST BLOCK VOLUMES FOR VERTICAL BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURE OF 150 PSIG AND 4 THE WEIGHT OF CONCRETE = 4,050 LBS PER CUBIC YARD. TO COMPUTE VOLUMES FOR DIFFERENT TEST PRESSURES USE THE FOLLOWING EQUATION:
 - ACTUAL VOLUME = (TEST PRESSURE/150) X (TABLE VOLUME).
- BEARING AREAS FOR HORIZONTAL BEND THRUST BLOCKS ARE BASED ON TEST PRESSURE OF 150 PSIG AND AN ALLOWABLE SOIL BEARING 5 STRESS OF 2,000 LBS/SQFT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES US THE FOLLOWING EQUATION: $B_1 = B(13.33)(P_1 / 2000)$ WHERE:
 - $P_1 = ACTUAL TEST PRESSURE, PSIG$
 - **B** = COMPUTED BEARING AREA
 - **B = BEARING AREA FROM TABLE**
- VERTICAL BENDS HAVING DOWNWARD RESULTANT THRUSTS AND HORIZONTAL BENDS, HAVE THE SAME THRUST BLOCK REQUIREMENTS. BEARING AREAS, VOLUMES, AND SPECIAL BLOCKING DETAILS SHOWN ELSEWHERE IN THESE PLANS TAKE PRECEDENCE OVER THIS 7
- STANDARD DETAIL THRUST BLOCK BEARING AREA SHALL NOT BE LESS THAN 1.0 SQFT. 8.
- TEST PRESSURES ARE INDICATED IN THE SPECIFICATIONS AND THE ALLOWABLE SOIL BEARING STRESS IS 2,000 LBS/SQFT. 9
- 10. THE USE OF RESTRAINED JOINT SYSTEMS WILL BE ACCEPTED AS AN ALTERNATIVE TO CONVENTIONAL CONCRETE THRUST BLOCKING.
- 11. CONTRACTOR SHALL PROVIDE THRUST BLOCKING FOR ALL BURIED FITTINGS AND VALVES.
- 12. ALL THRUST BLOCKING CONCRETE SHALL BE ENCASED IN 3/4" MINUS GRAVEL OR STRUCTURAL FILL TO PROTECT THE CONCRETE FROM THE CORROSIVE SOILS.

VOLUME OF	THRUST BL (VERTICAL		BIC YARDS
FITTING SIZE	E	BEND ANGLI	E
(INCHES)	45°	22-1/2°	11-1/4°
4	0.8	0.3	0.1
6	2.0	0.8	0.3
8	3.0	1.1	0.4
10	4.5	1.7	0.7
12	5.4	2.4	1.0
14	8.6	3.2	1.3
16	11.1	4.2	1.7
18	14.1	5.3	2.2
20	17.3	6.6	2.7
24	24.2	9.2	3.8

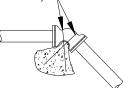
	BEARING ARI	EA OF THRUS	T BLOCKS I	N SQFT. (H	ORIZONTAL	BENDS)	
FITTING SIZE	TEE, WYE, PLUG, OR	90° BEND, PLUGGED	TEE, PLUC	GGED RUN	E	BEND ANGL	E
(INCHES)	CAP	CROSS	A ₁	A ₂	45°	22-1/2°	11-1/4°
4	1.3	1.8	1.3	1.8	1.0	1.0	
6	3.0	4.2	3.0	4.2	2.3	1.2	1.0
8	5.3	7.6	5.3	7.6	4.1	2.1	1.0
10	8.3	11.8	8.3	11.8	6.4	3.3	1.6
12	12.0	17.0	12.0	17.0	9.2	4.7	2.4
14	16.3	23.1	16.3	23.1	12.5	6.4	3.2
16	21.4	30.2	21.4	30.2	16.3	8.3	4.2
18	27.0	32.0	27.0	32.0	20.7	10.5	5.3
20	33.4	47.2	33.4	47.2	25.5	13.0	6.5
24	40.3	55.0	40.3	55.0	35.7	18.0	9.0

EACH AREA (A/2) IS HAVE OF TABULATED TOTAL AREA

** RESTRAINED PLUG

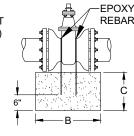
VERTI	CAL BEND R	EBAR
FITTING SIZE	ROD SIZE	EMBEDMENT
12" AND LESS	#6	30"
14" - 16"	#8	36"
18" - 20"	#10	36"
24"	#11	42"

NOTE **EPOXY COATED REBAR OVER FITTING** AND EMBEDDED IN CONCRETE (SEE TABLE FOR SIZES)

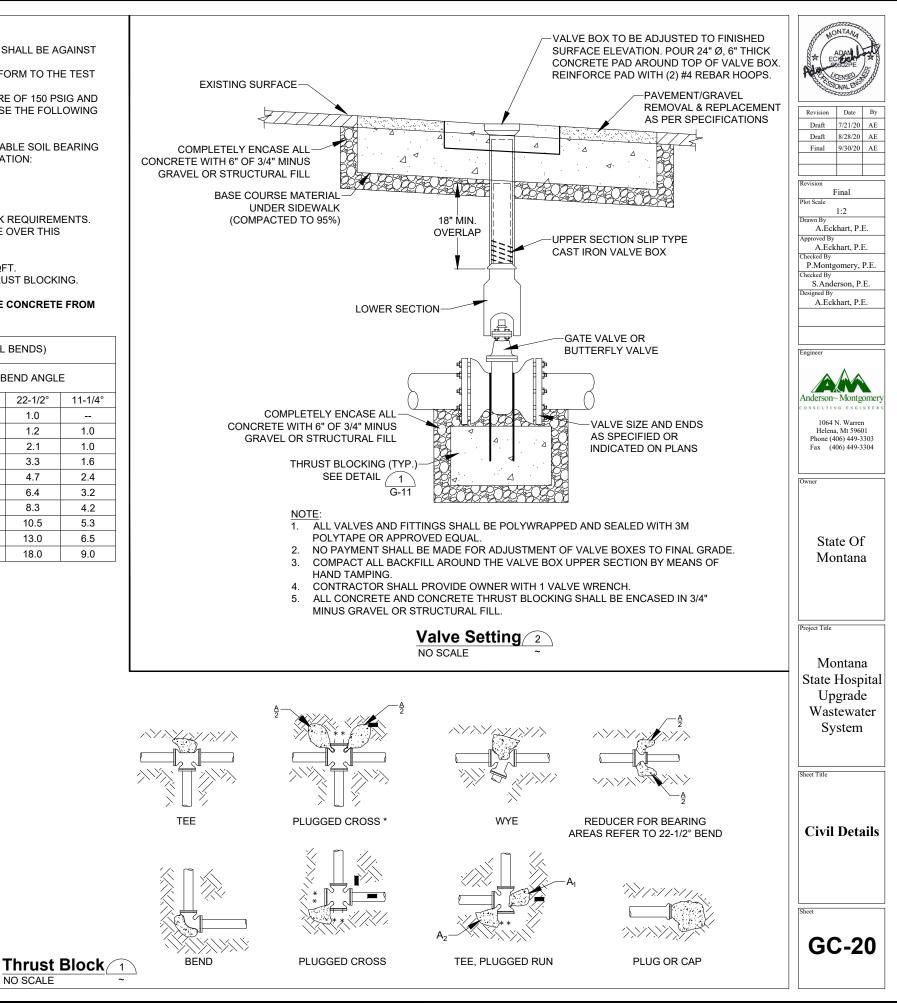


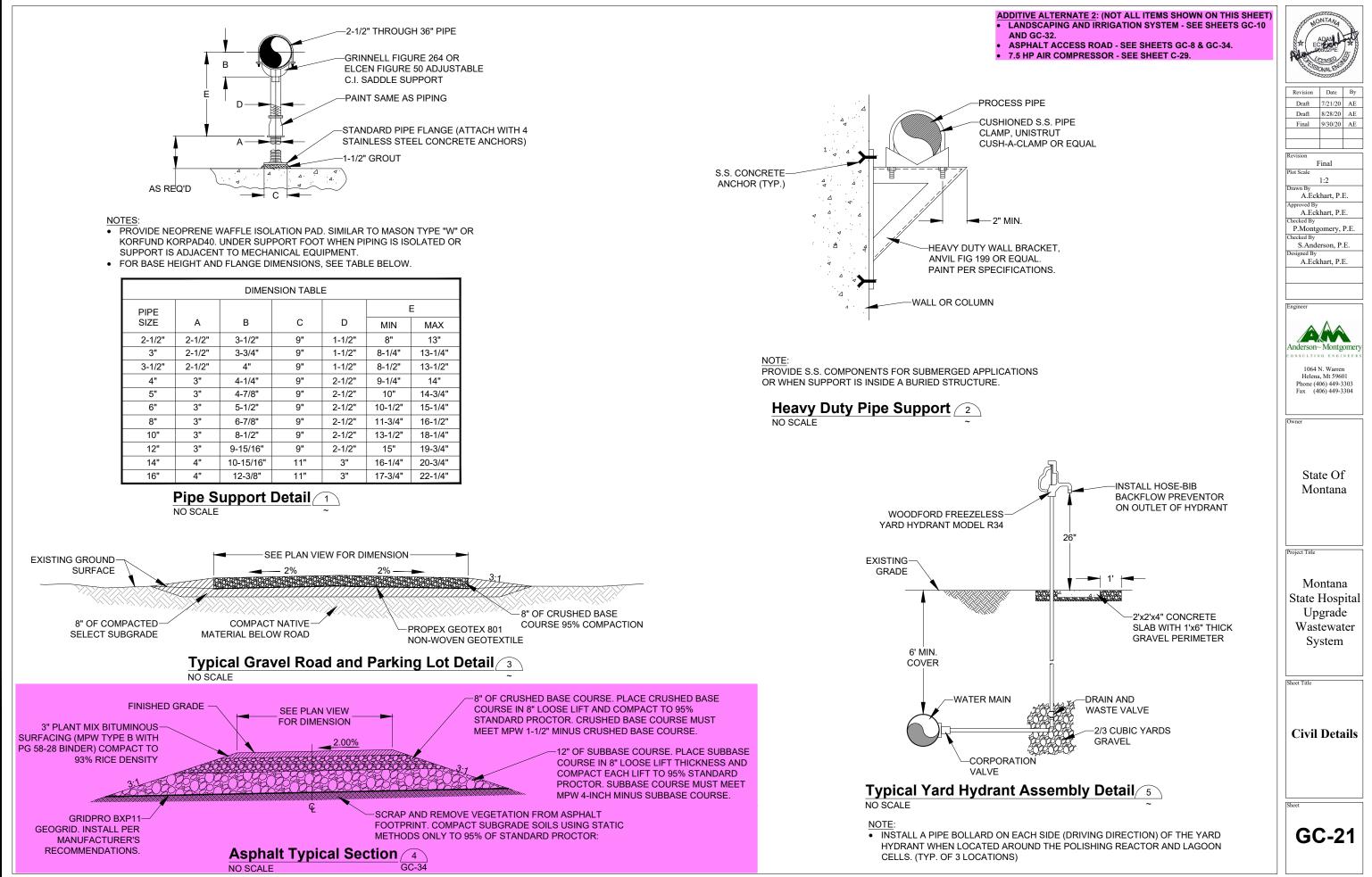
	VALVE THRUST BLOCK DIMENSIONS						
VALVE REBAR			100 PSI		150 PSI		
SIZE	SIZE	Α	В	С	Α	В	С
4"	#6	2.0'	2.0'	2.0'	2.0'	2.0'	2.0'
6"	#6	2.0'	2.0'	2.0'	2.0'	2.0'	2.0'
8"	#6	2.0'	2.0'	2.0'	2.0'	2.0'	2.0'
10"	#6	2.0'	2.0'	2.0'	2.5'	2.5'	2.0'
12"	#6	2.3'	2.0'	2.0'	3.0'	3.0'	2.7'
14"	#8	2.3'	2.0'	2.3'	3.4'	3.0'	3.0'
16"	#9	3.0'	3.0'	2.9'	4.3'	3.0'	3.0'
18"	#10	3.7'	3.0'	3.0'	5.4'	3.0'	3.0'
20"	#10	3.9'	3.3'	3.3'	5.7'	3.3'	3.3'
24"	#11	4.3'	4.0'	4.0'	6.4'	4.0'	4.0'
NOTE:							

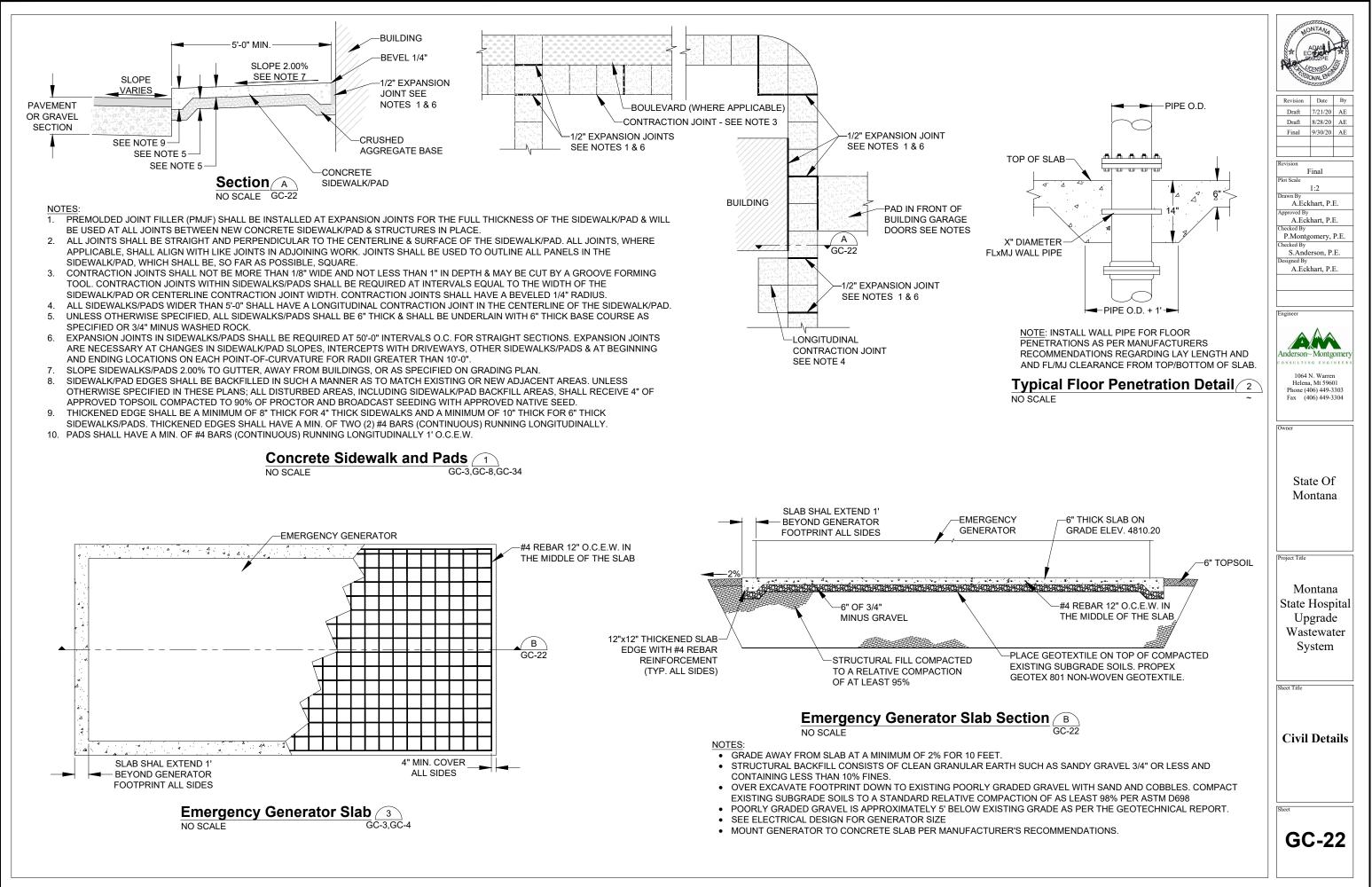
DIMENSION 'A' IS WIDTH OF THRUST BLOCK (PERPENDICULAR TO PAGE)

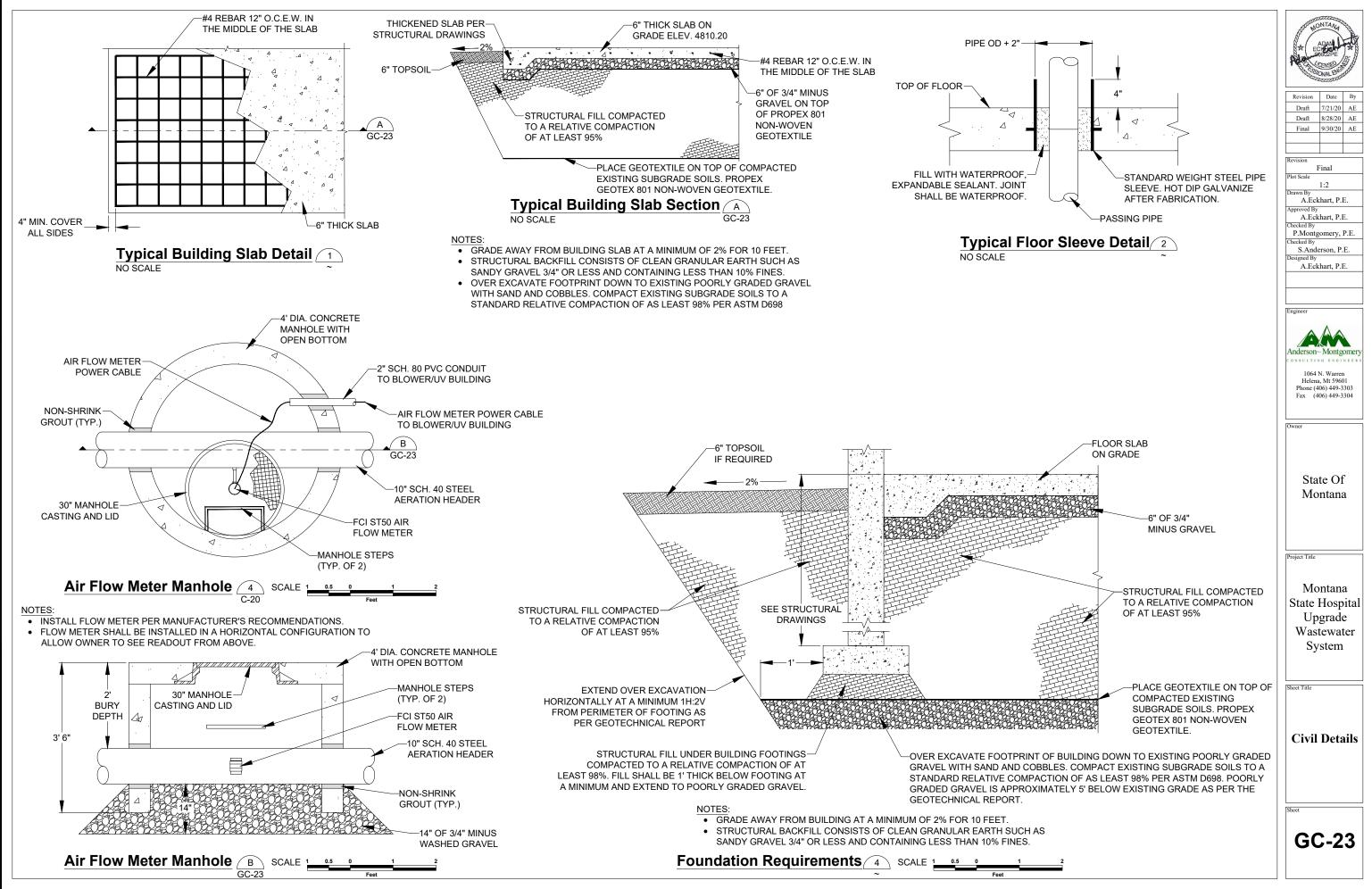


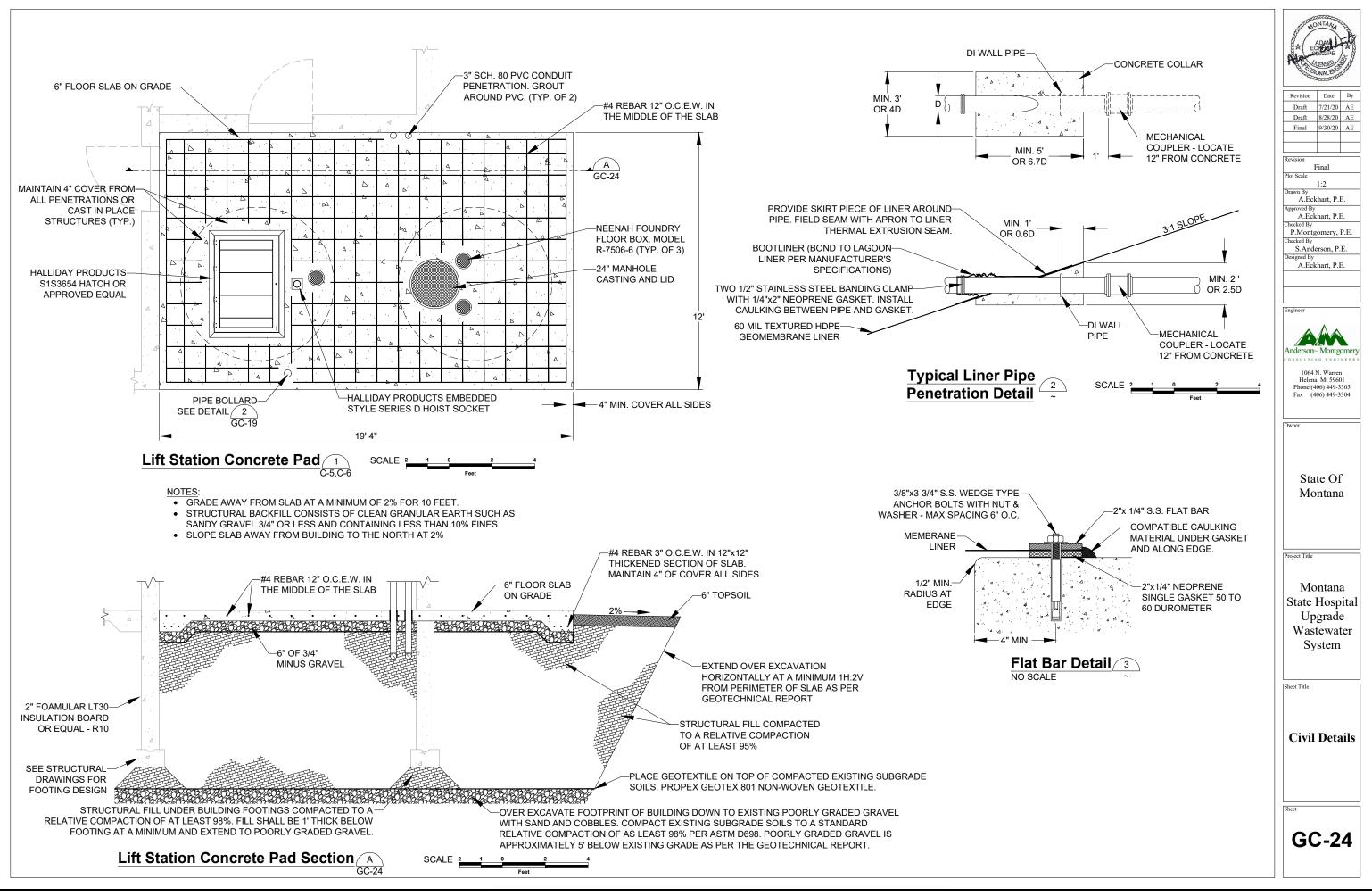
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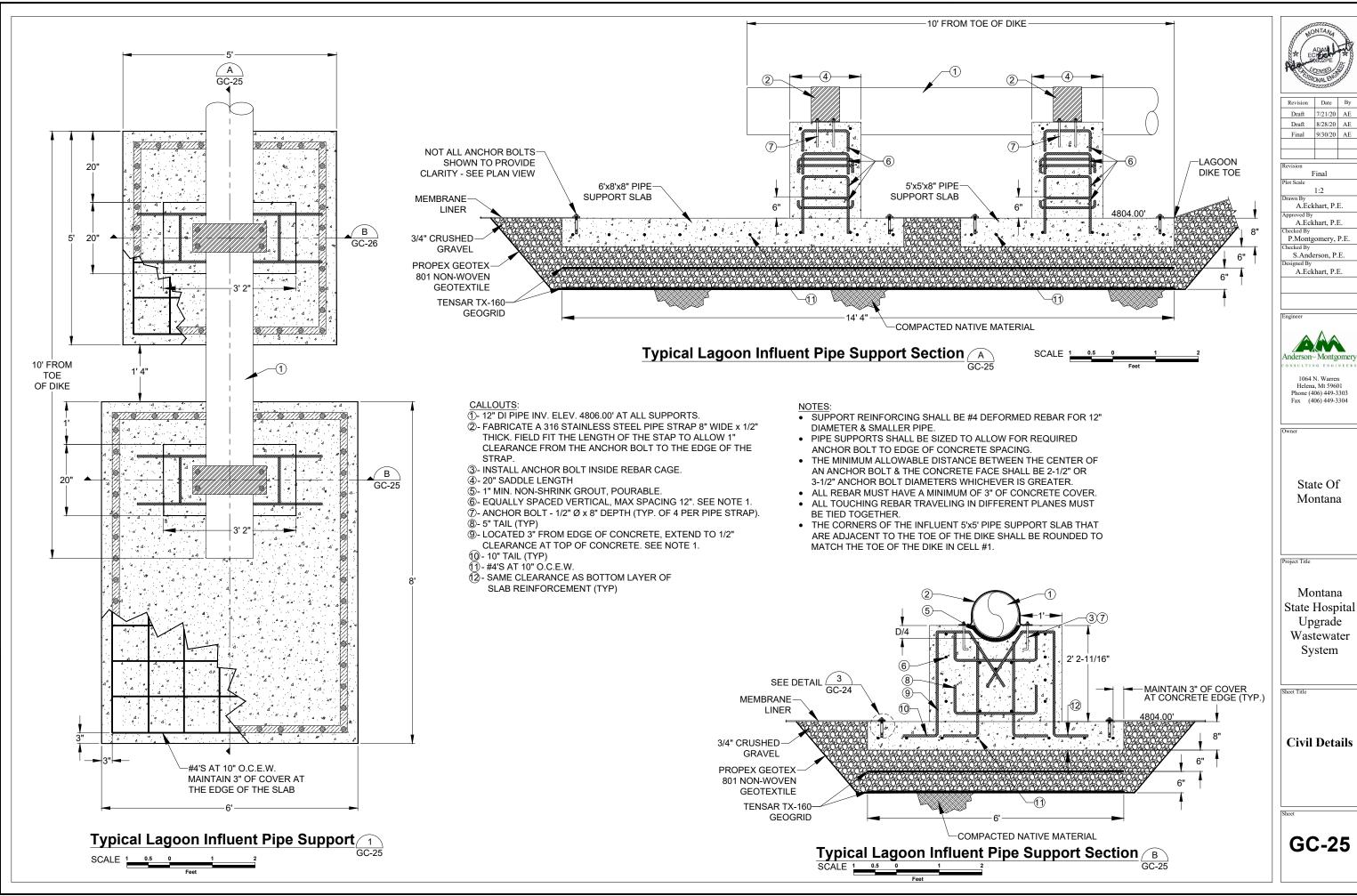


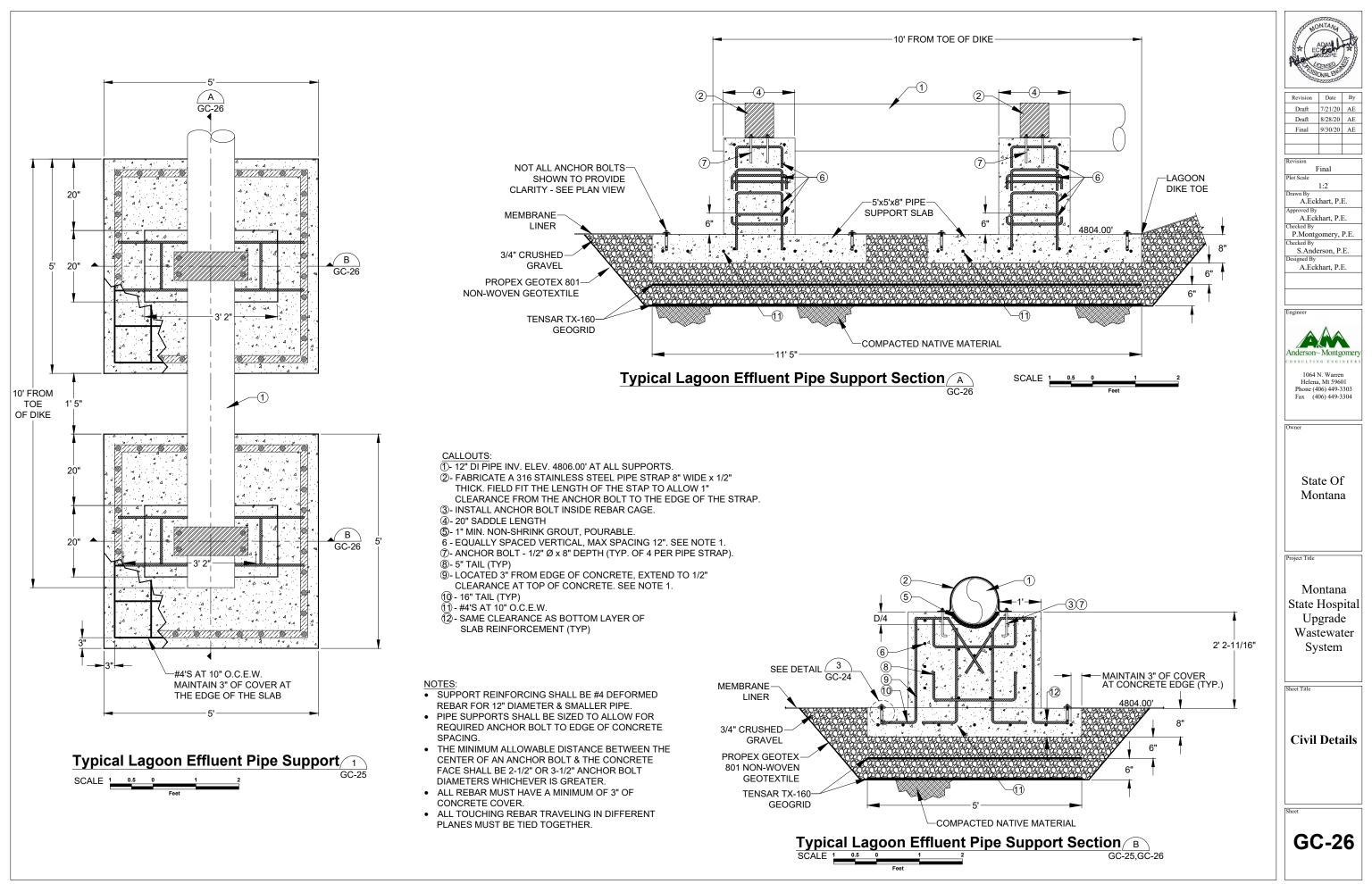


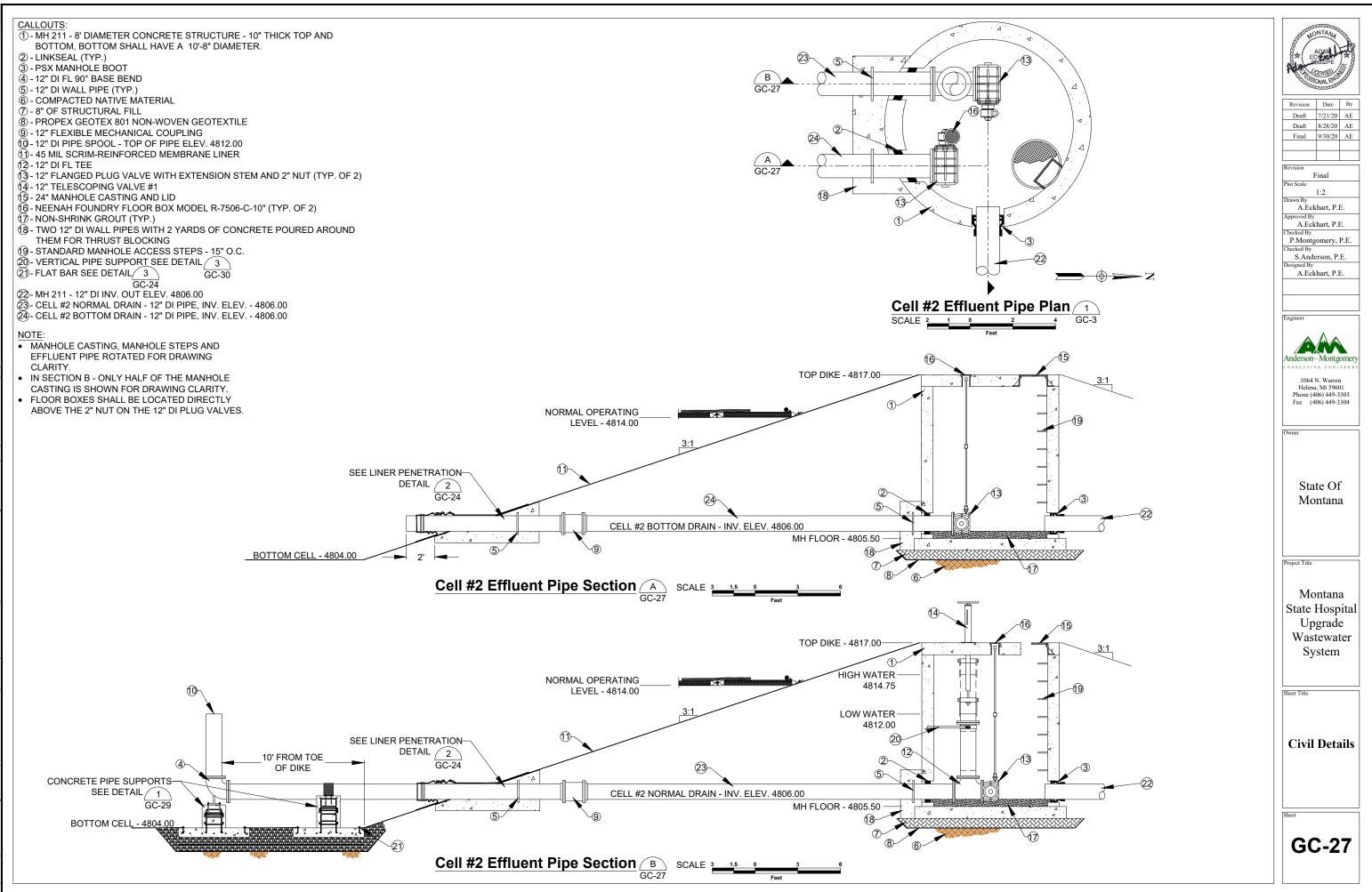


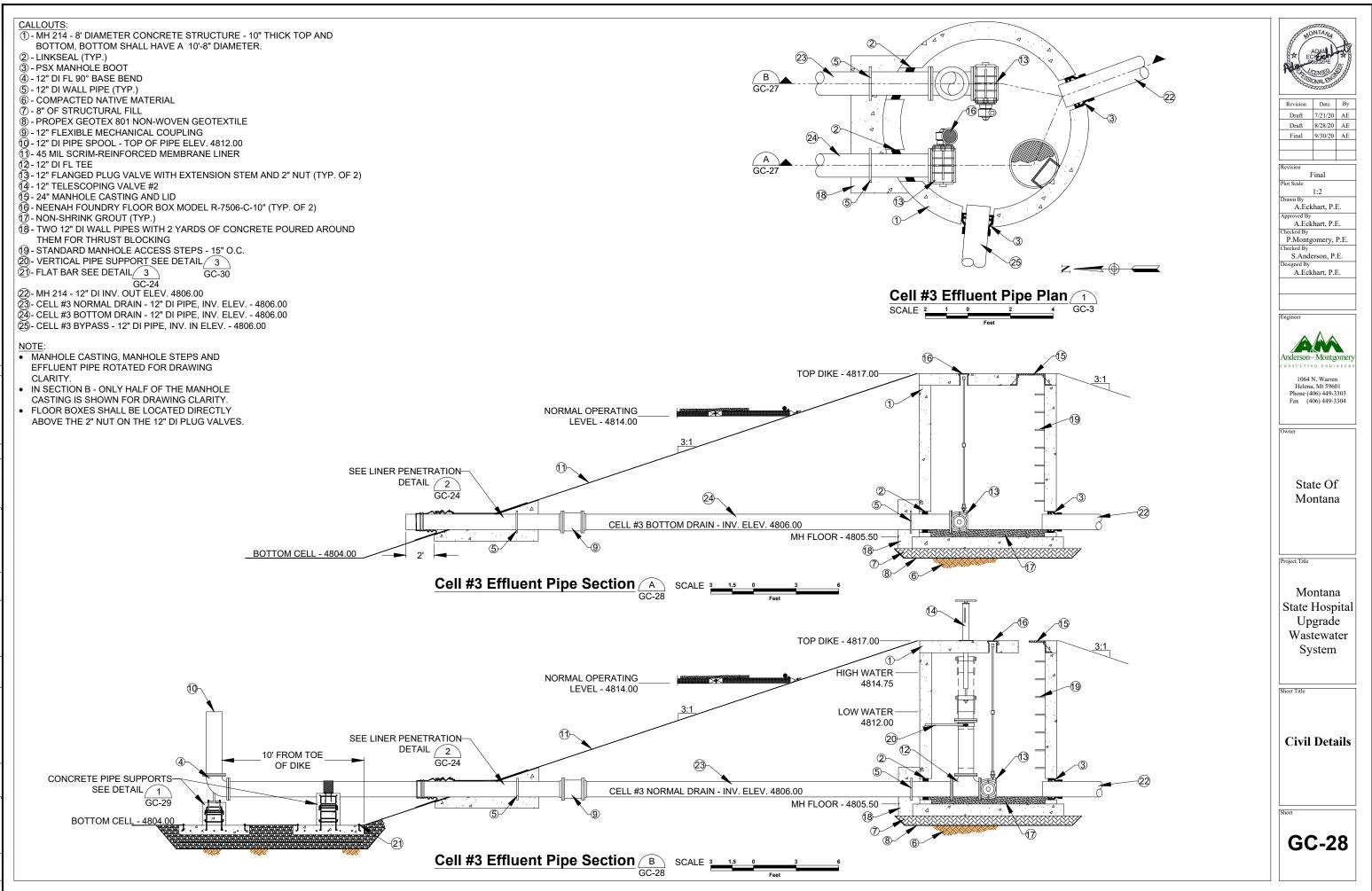


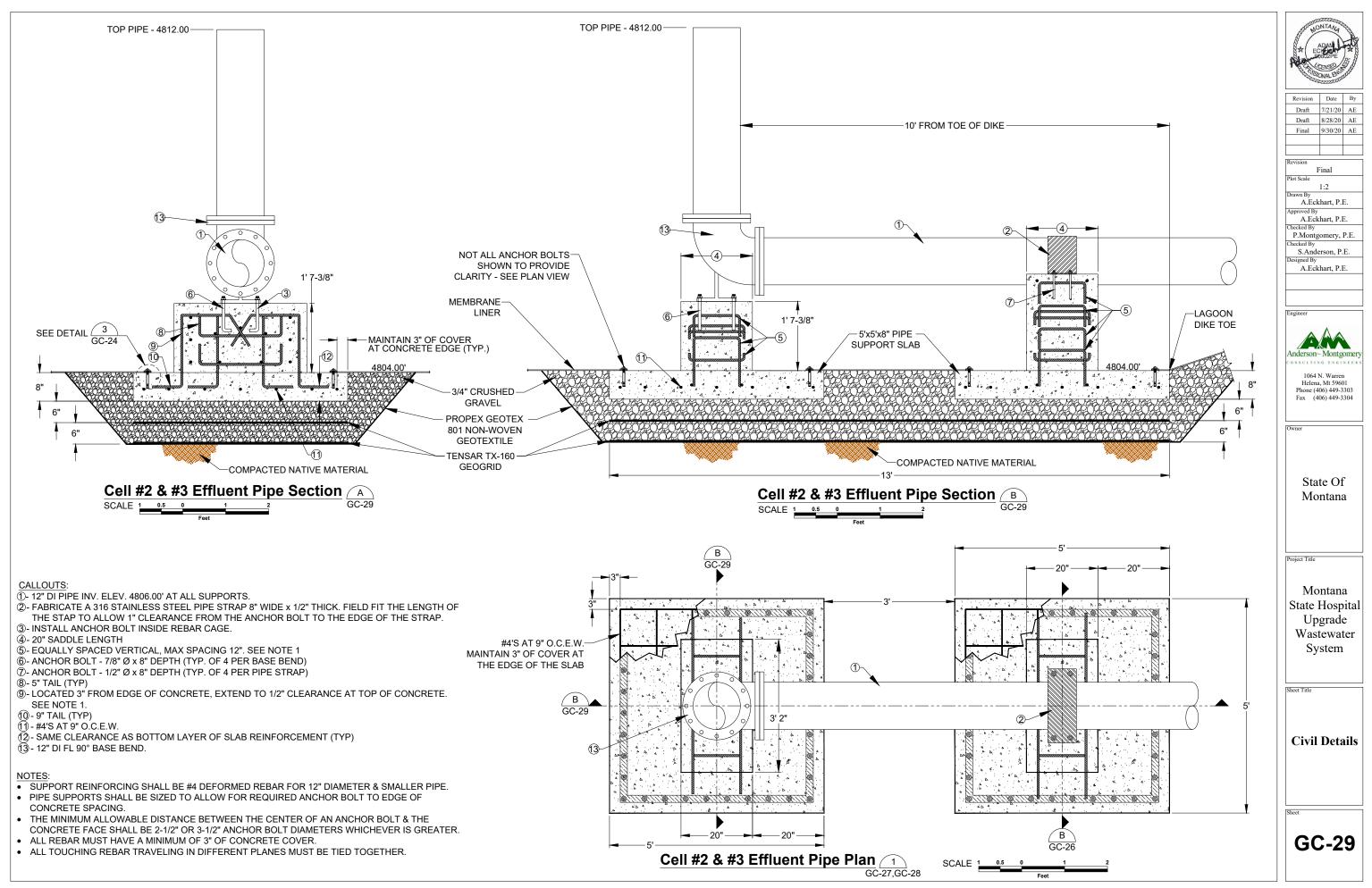


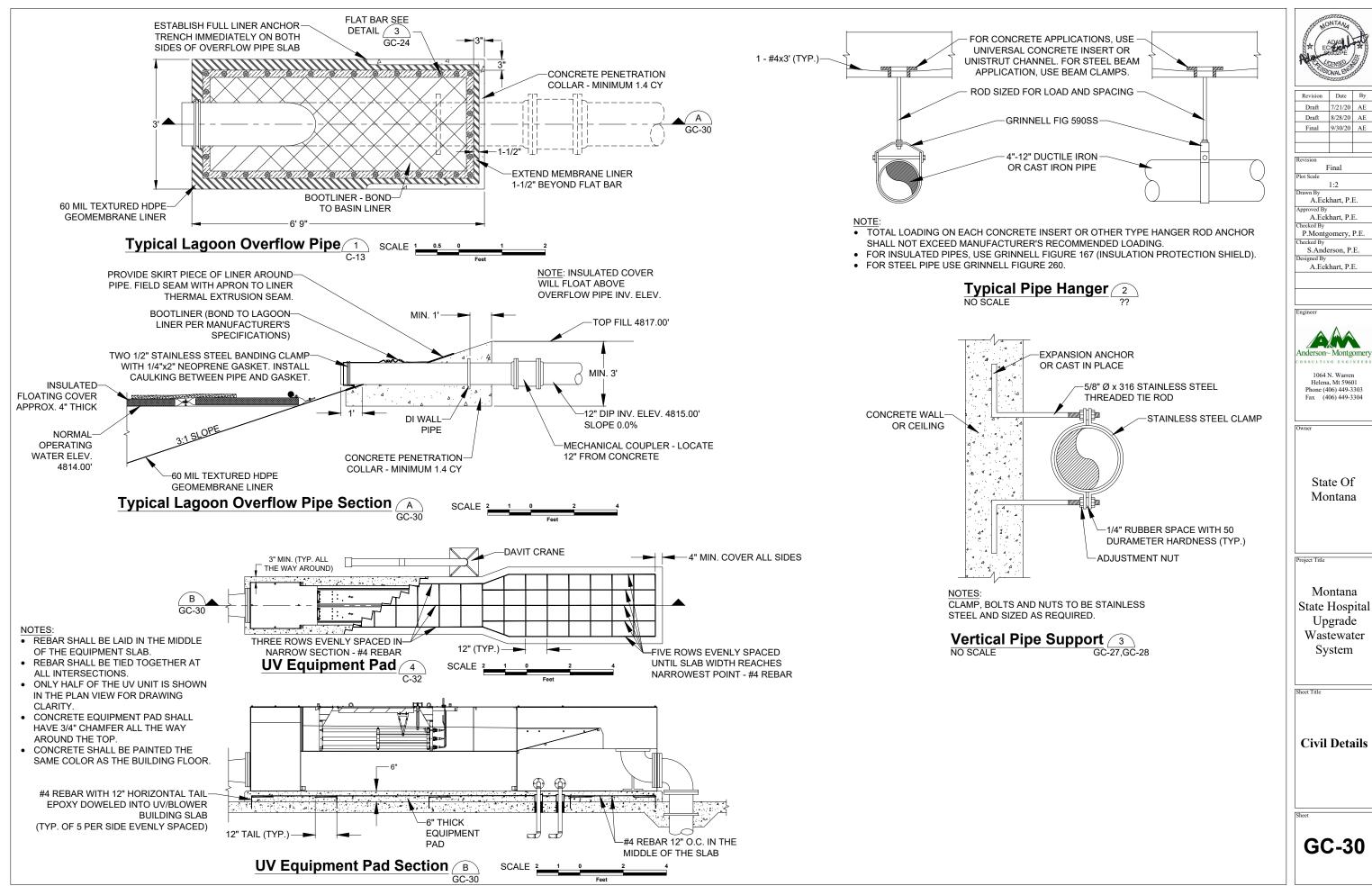


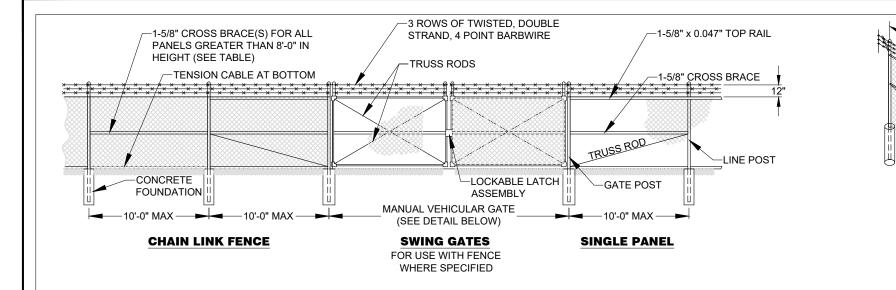




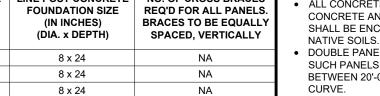








	CHAIN LINK FENCE MINIMUM REQUIREMENTS				
FENCE HEIGHT (FEET)	TERMINAL POST DIM. (IN INCHES) (O.D. x WALL THICKNESS)	LINE POST DIM. (IN INCHES) (O.D. x WALL THICKNESS)	TERMINAL POST CONCRETE FOUNDATION SIZE (IN INCHES) (DIA. x DEPTH)	LINE POST CONCRETE FOUNDATION SIZE (IN INCHES) (DIA. x DEPTH)	NO. OF CROSS BRACES REQ'D FOR ALL PANELS. BRACES TO BE EQUALLY SPACED, VERTICALLY
UP TO 4	2-3/8 x 0.042	1-5/8 x 0.047	10 x 24	8 x 24	NA
OVER 4 TO 5	2-3/8 x 0.042	1-7/8 x 0.055	10 x 24	8 x 24	NA
OVER 5 TO 6	2-3/8 x 0.042	1-7/8 x 0.065	10 x 24	8 x 24	NA
OVER 6 TO 8	2-3/8 x 0.110	2-3/8 x 0.095	10 x 36	10 x 36	NA
OVER 8 TO 10	2-7/8 x 0.160	2-3/8 x 0.130	12 x 40	10 x 40	1
OVER 10 TO 12	2-7/8 x 0.160	2-Z7/8 x 0.120	12 x 42	12 x 42	1
OVER 12 TO 16	4 x 0.230	4 x 0.230	18 x 60	18 x 60	2



Chain Link Fence Details

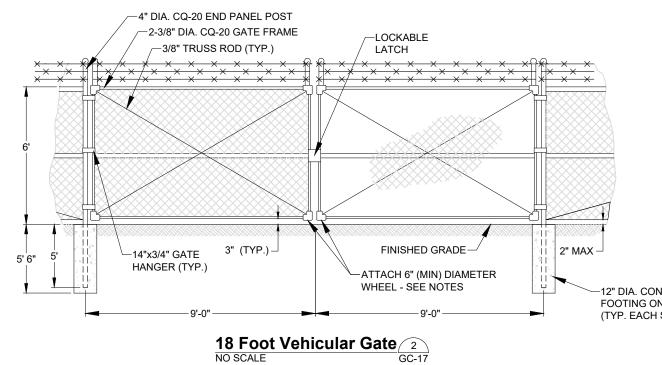


DOUBLE PANEL

PULL POST & CORNER POST BRACING

• SEE TECHNICAL SPECIFICATIONS FOR MATERIALS.

- CONTRACTOR SHALL ATTACH FABRIC TO POSTS USING WIRE TIES.
- CONCRETE GATE POST ENCASEMENTS SHALL MEET MANUFACTURER'S REQUIREMENTS.
- INSTALL COPPER CLAD GROUNDING RODS EVERY 500'-0".
- GAPS NO GREATER THAN 2" WILL BE PERMITTED IN ALL LOCATIONS.
- A LATCH ASSEMBLY LOCKING DEVICE IS REQUIRED FOR ALL GATE INSTALLATIONS.



NO SCALE

NOTES:

10:0" (Typ.)

NOTES:

GC-17

CORNER

BRACE

POST

- INSTALL LOCKABLE SLIDING GATE LATCH PER MANUFACTURER'S RECOMMENDATIONS.
- CONTRACTOR SHALL ATTACH A 6" (MIN) DIAMETER WHEEL ASSEMBLY TO THE END OF EACH GATE. THE CONTRACTOR SHALL GET APPROVAL FOR THE PROPOSED ASSEMBLY PRIOR TO FABRICATION.
- GATE SHALL BE CENTERED OVER THE ACCESS ROAD.

12" DIA. CONCRETE FOOTING ON END PANELS (TYP. EACH SIDE OF GATE) TOP RAIL

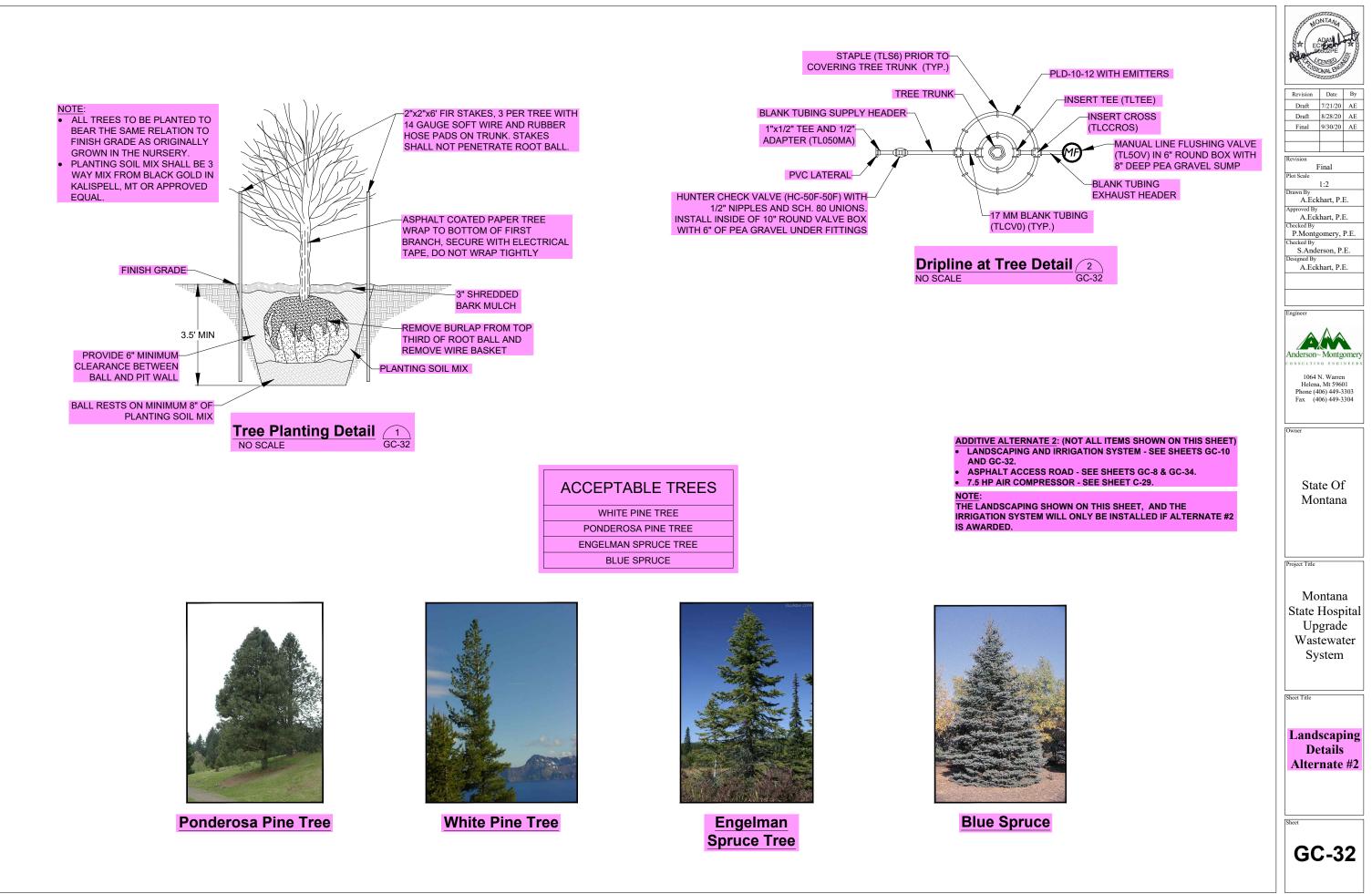
-LINE POST

TENSION CABLE AT BOTTOM

• A SINGLE PANEL SHALL BE PLACED AT EVERY END OF CHAIN LINK FENCE. • TENSION BANDS ON TERMINAL POSTS TO BE INSTALLED AT 12" SPACING ON CENTER. ALL CONCRETE SHALL BE MADE USING 3/4" AGGREGATE AND 602 POUNDS OF CEMENT PER CUBIC YARD OF CONCRETE AND SHALL HAVE A SLUMP OF 5" WITH COMPRESSIVE STRENGTH OF 3,000 PSI. ALL CONCRETE SHALL BE ENCASED IN A MINIMUM OF 4" OF STRUCTURAL FILL TO ISOLATE THE CONCRETE FROM THE

 DOUBLE PANELS SHALL BE INSTALLED NO MORE THAN 300'-0" APART ON TANGENT AND USED FOR PULLING. SUCH PANELS SHALL BE PLACED AT EACH CORNER SHAPER THAN 5 DEGREES AND BE EVENLY SPACED BETWEEN 20'-0" OF CENTRAL ANGLE (10'-0" DEFLECTION) APART, BUT NO MORE THAN 250'-0" APART ON ANY

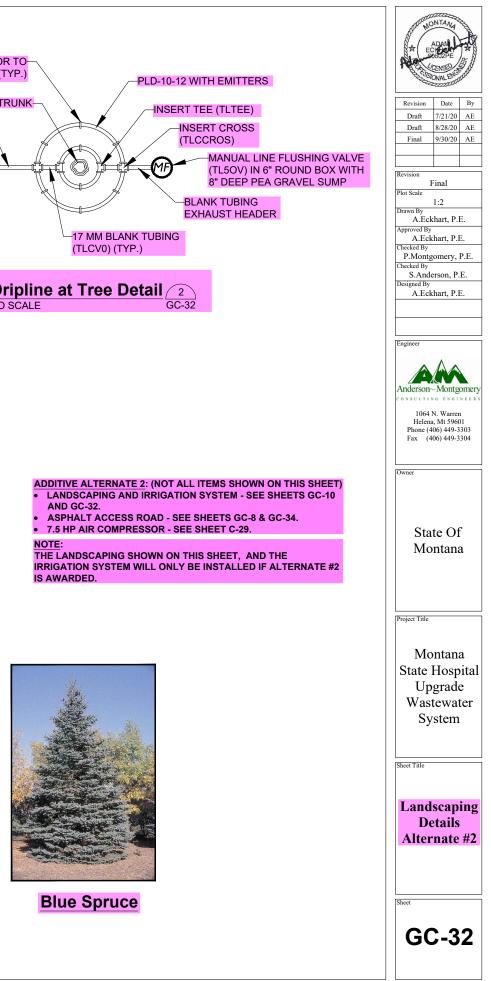
Revision Date By				
Draft Draft	7/21/20 8/28/20	AE AE		
Final	9/30/20			
Revision Final Plot Scale 1:2				
Drawn By A.Eckhart, P.E.				
Approved By A.Eckhart, P.E. Checked By P.Montgomery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.				
A.Eck	hart, P.I	E.		
Engineer				
Anderson~ Montgomery consulting engineers 1064 N. Warren				
Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304				
Owner				
State Of Montana				
Project Title				
Montana State Hospital Upgrade Wastewater System				
Sheet Title				
Fence Details				
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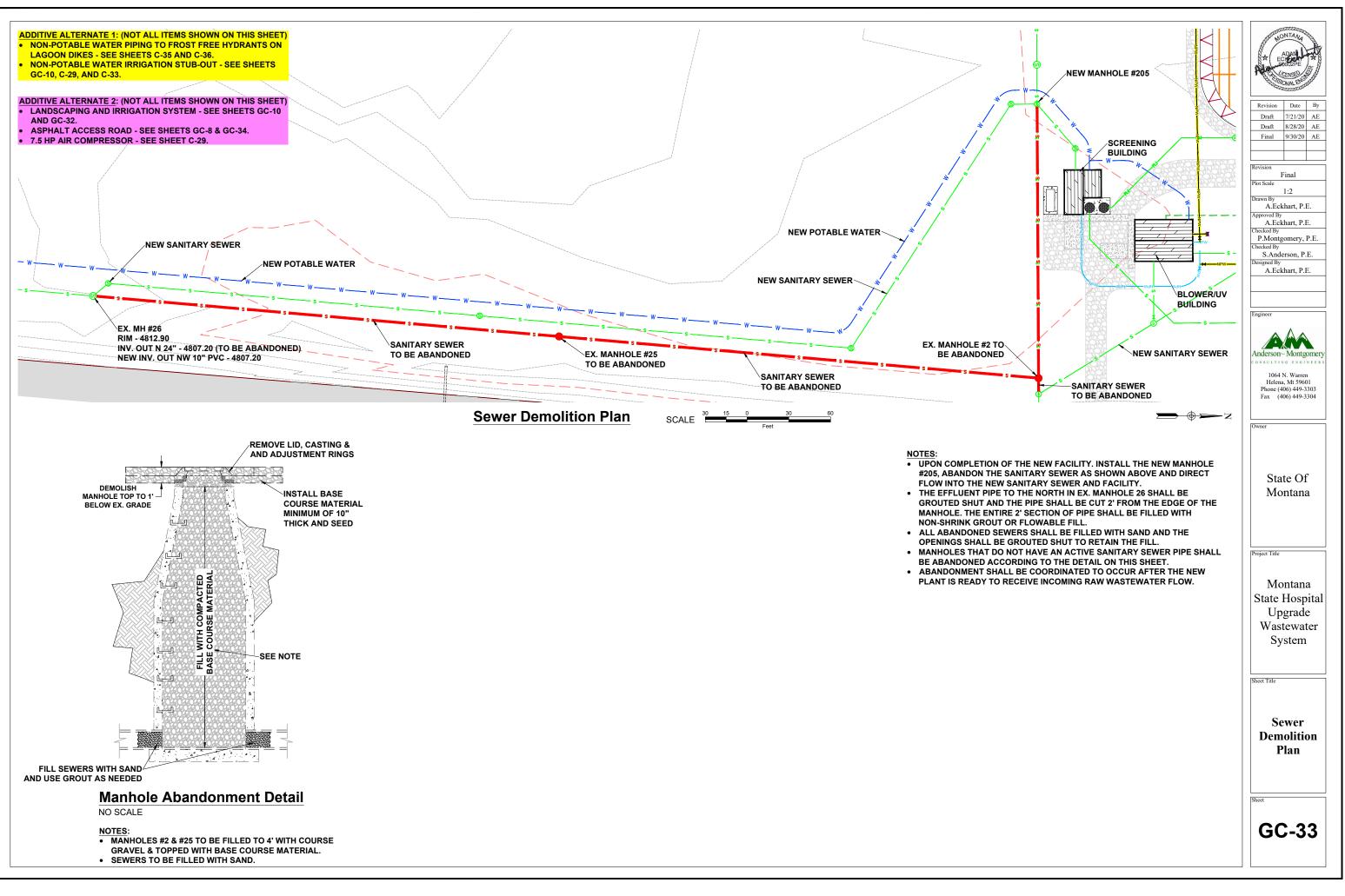


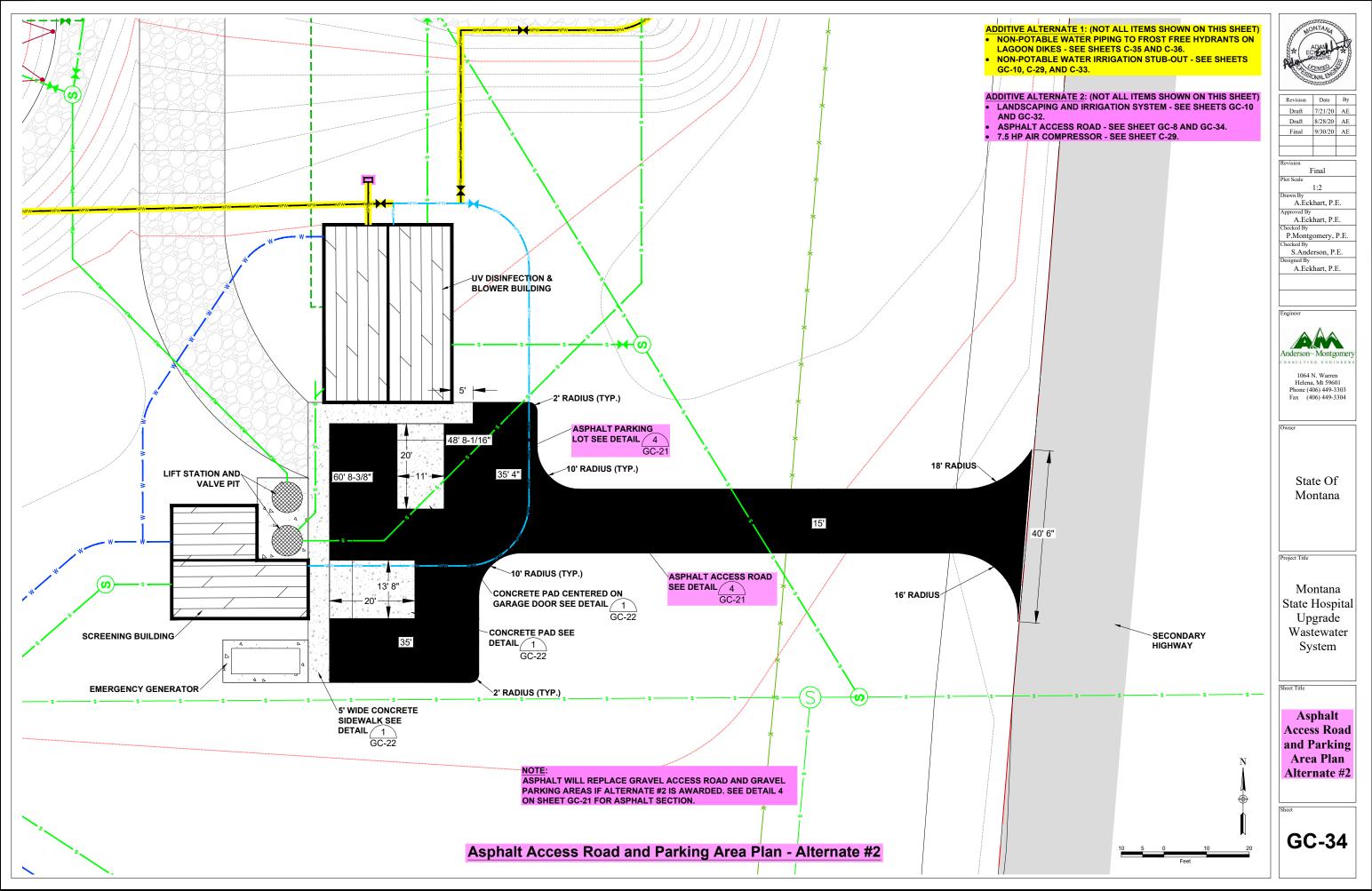


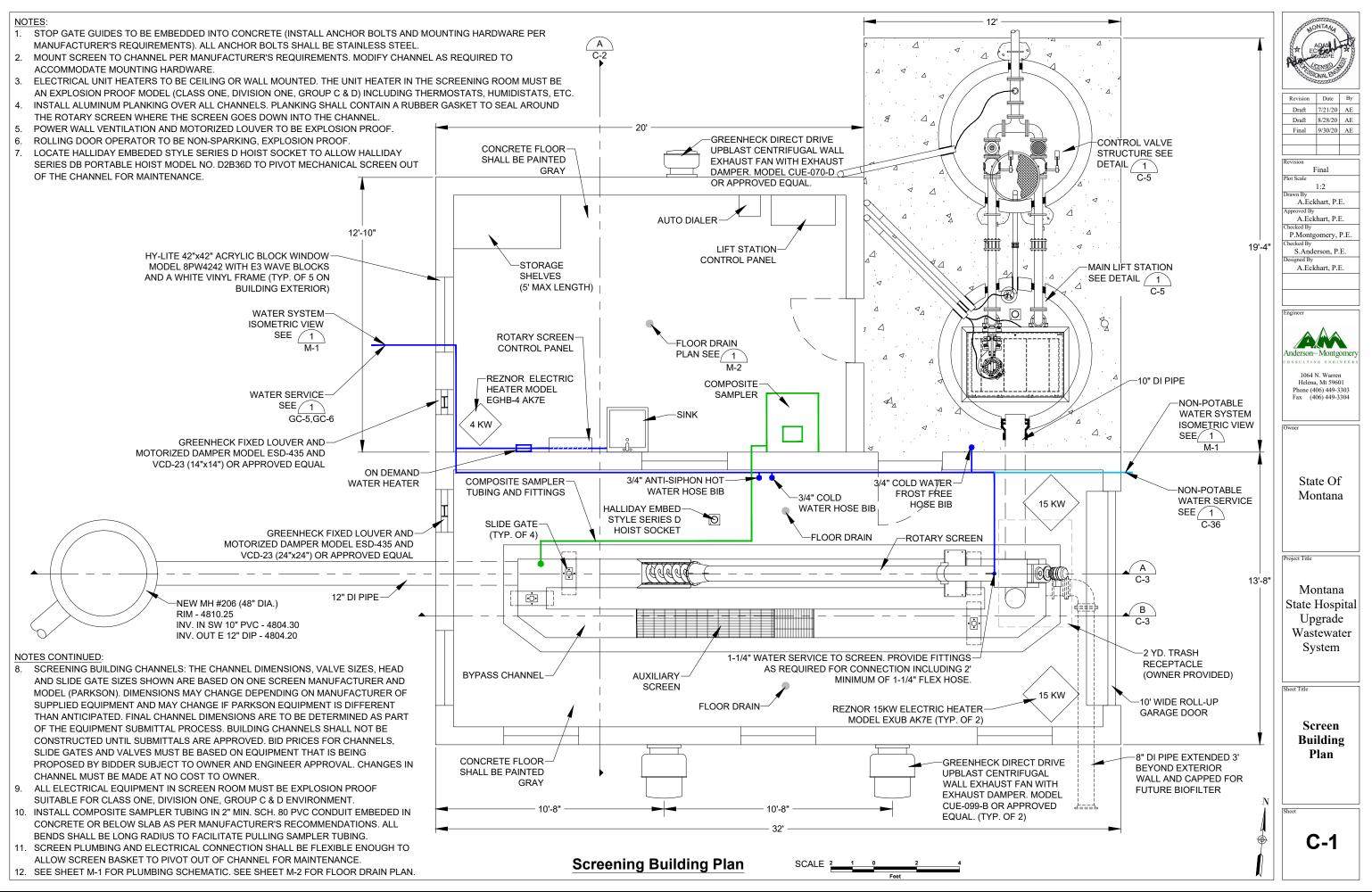




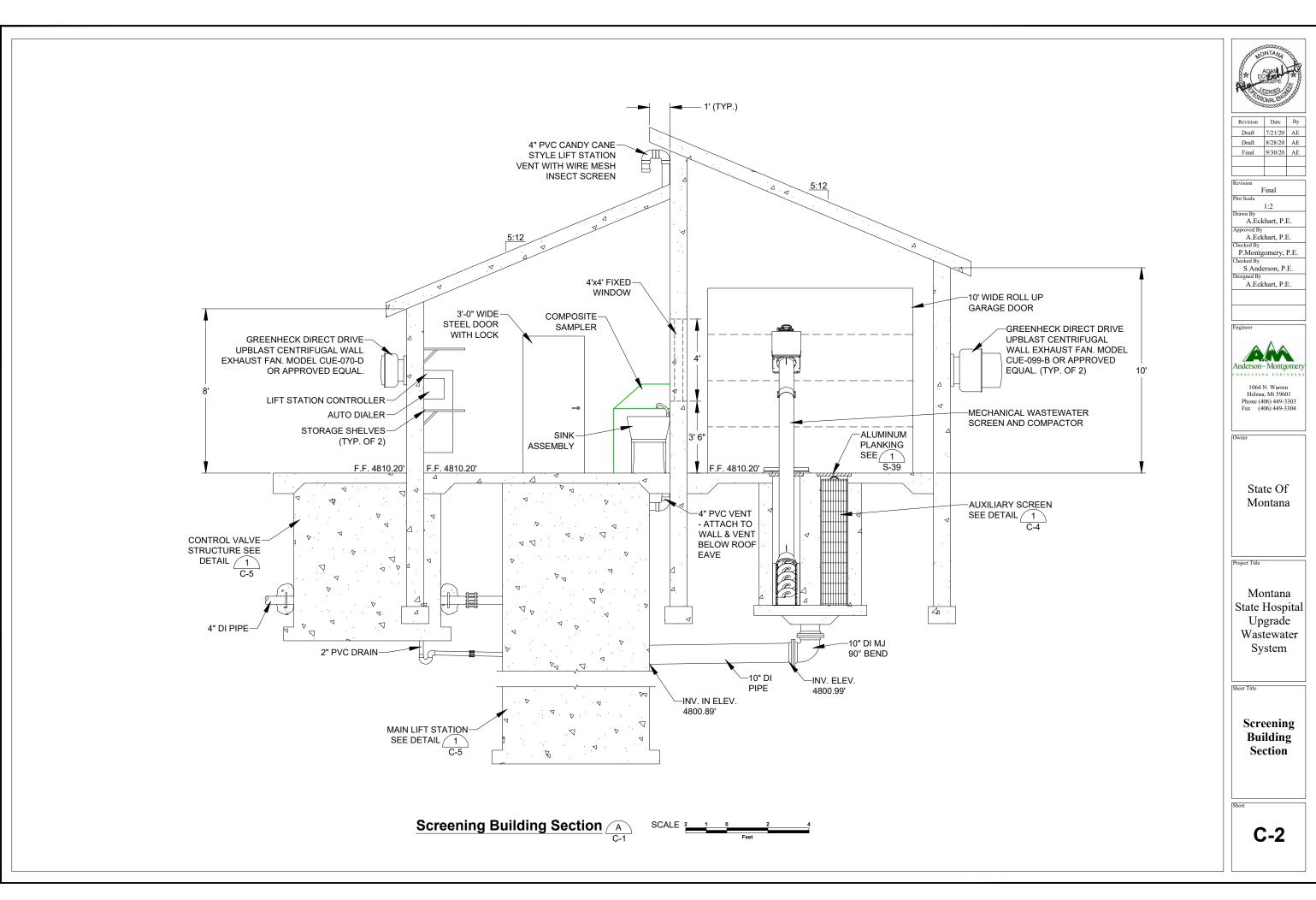


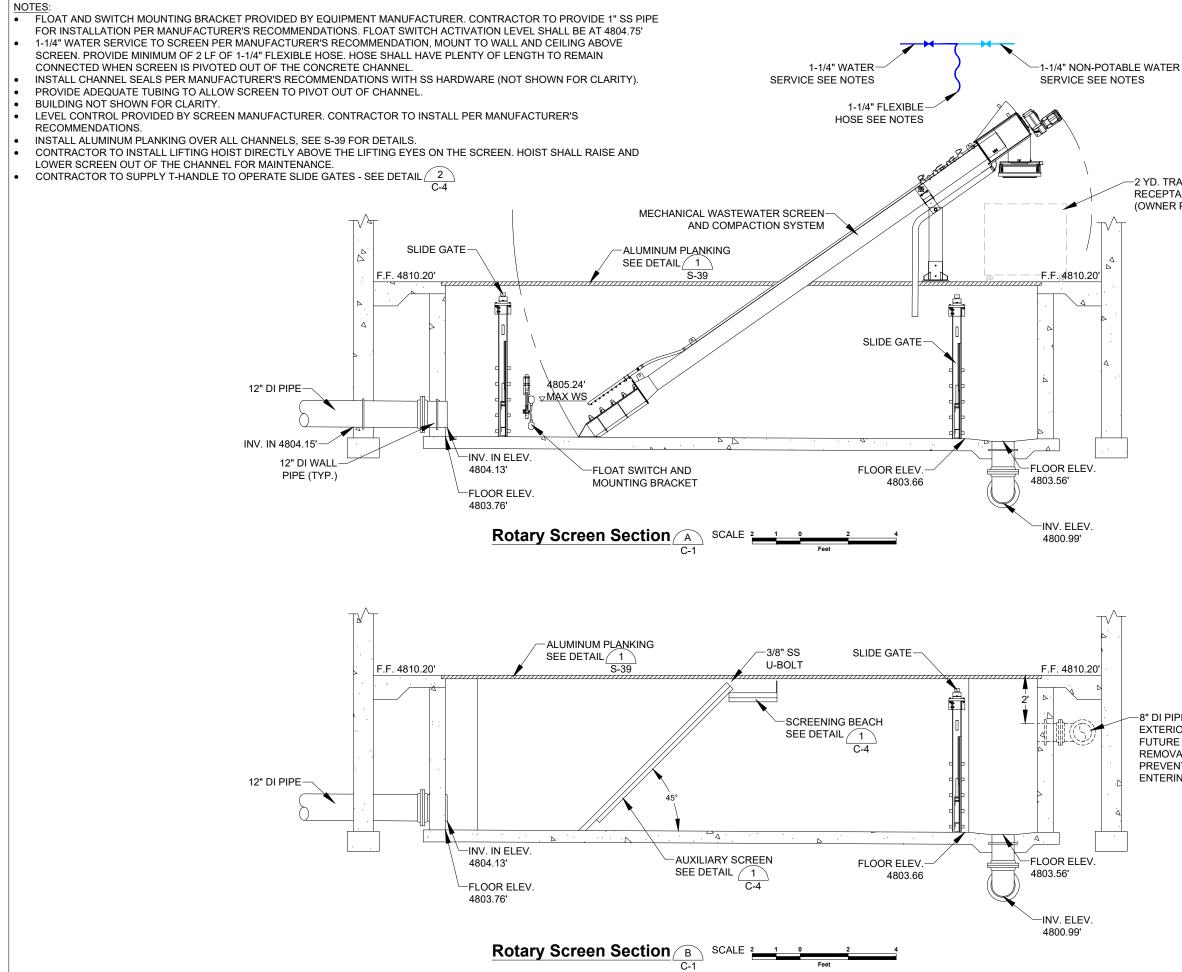






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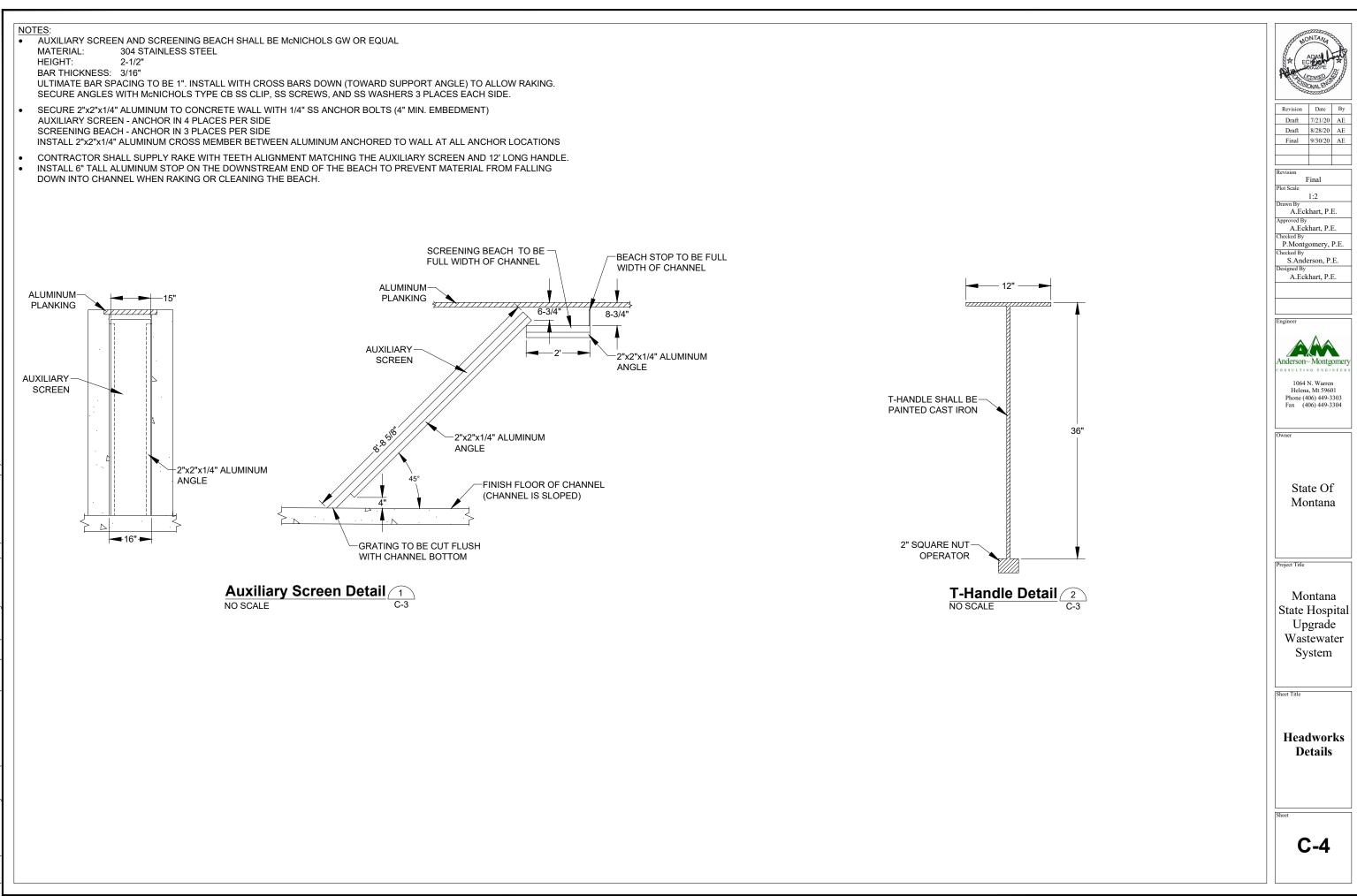


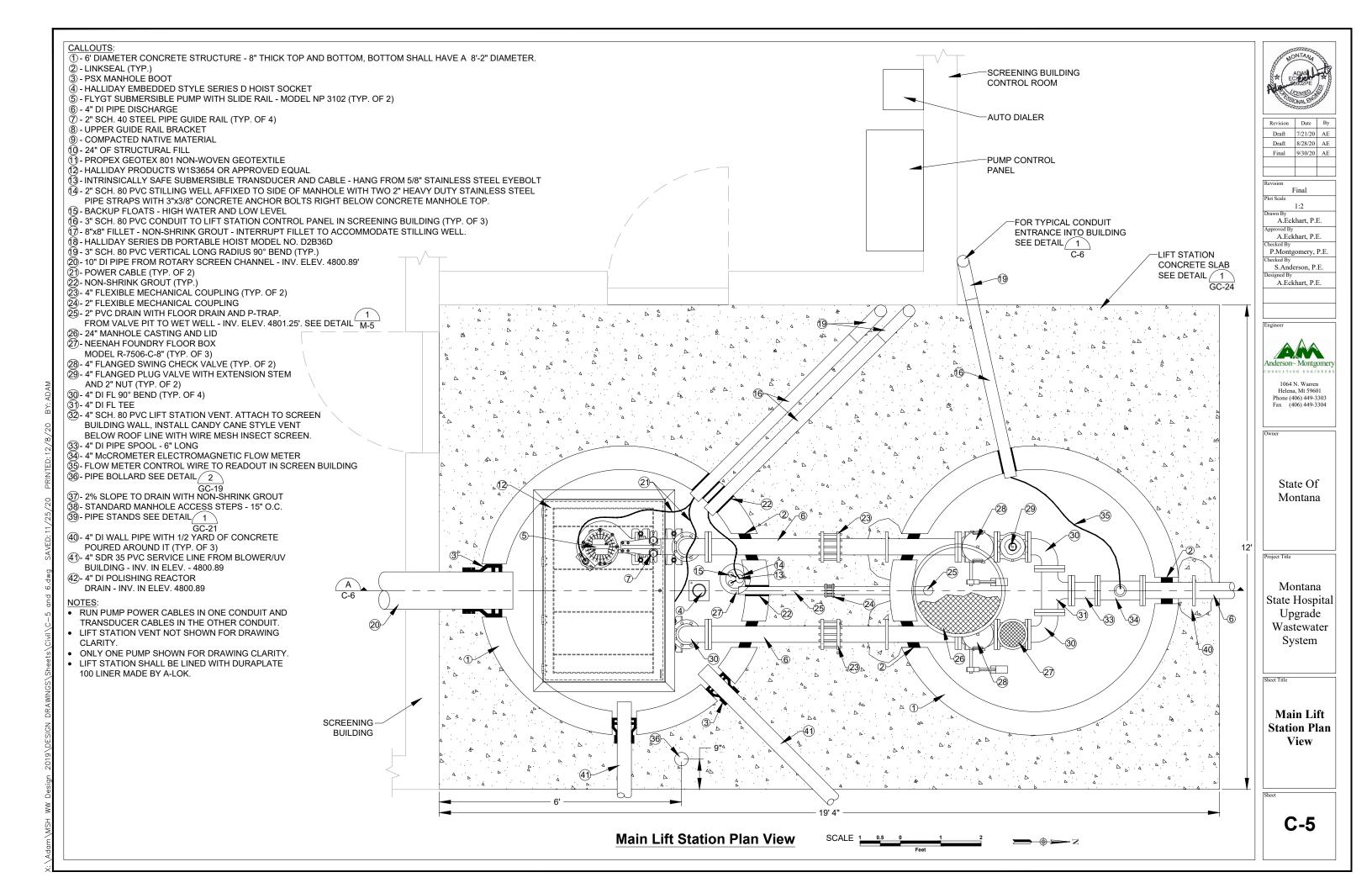


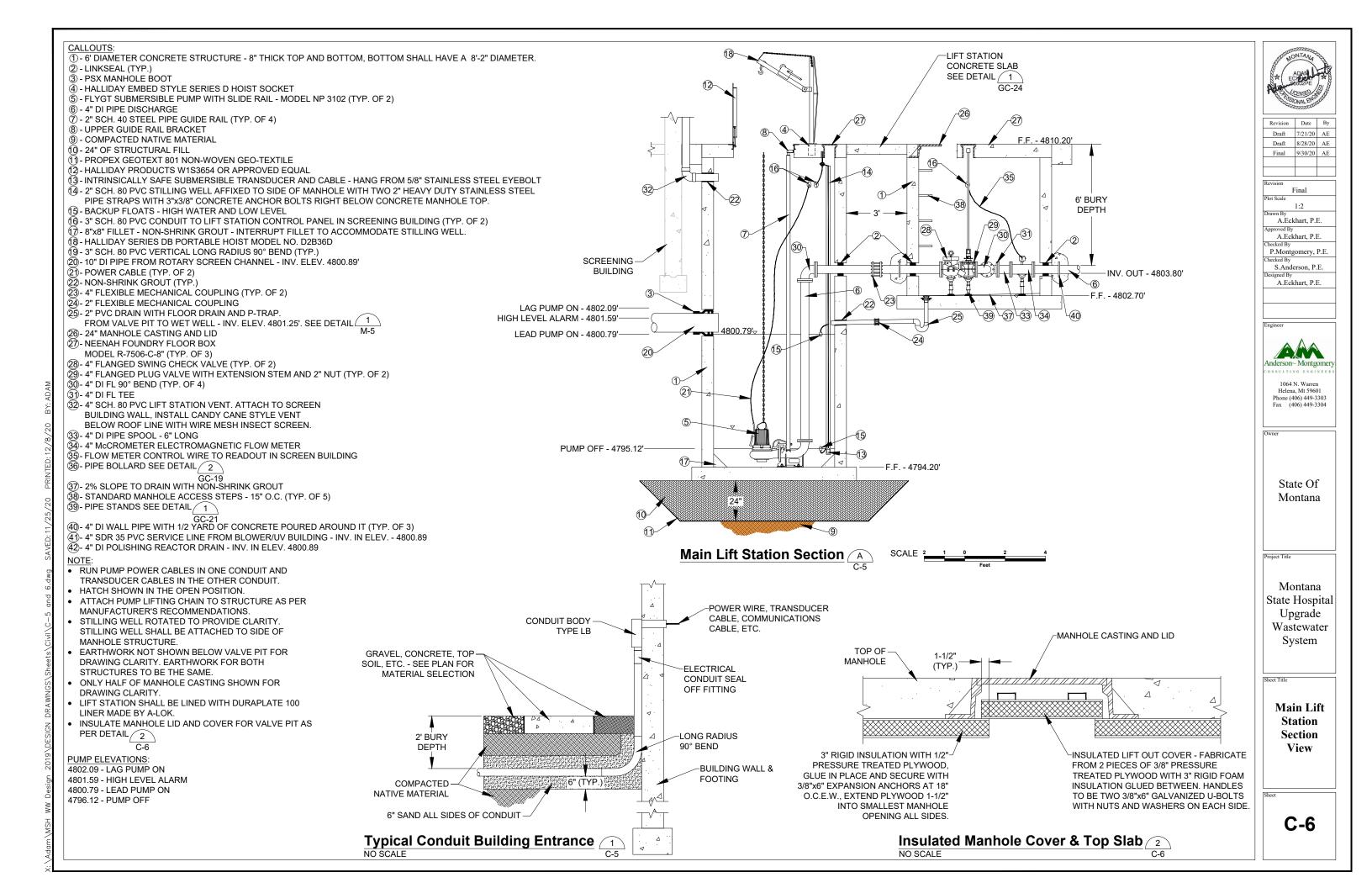
2 YD. TRASH RECEPTACLE (OWNER PROVIDED)

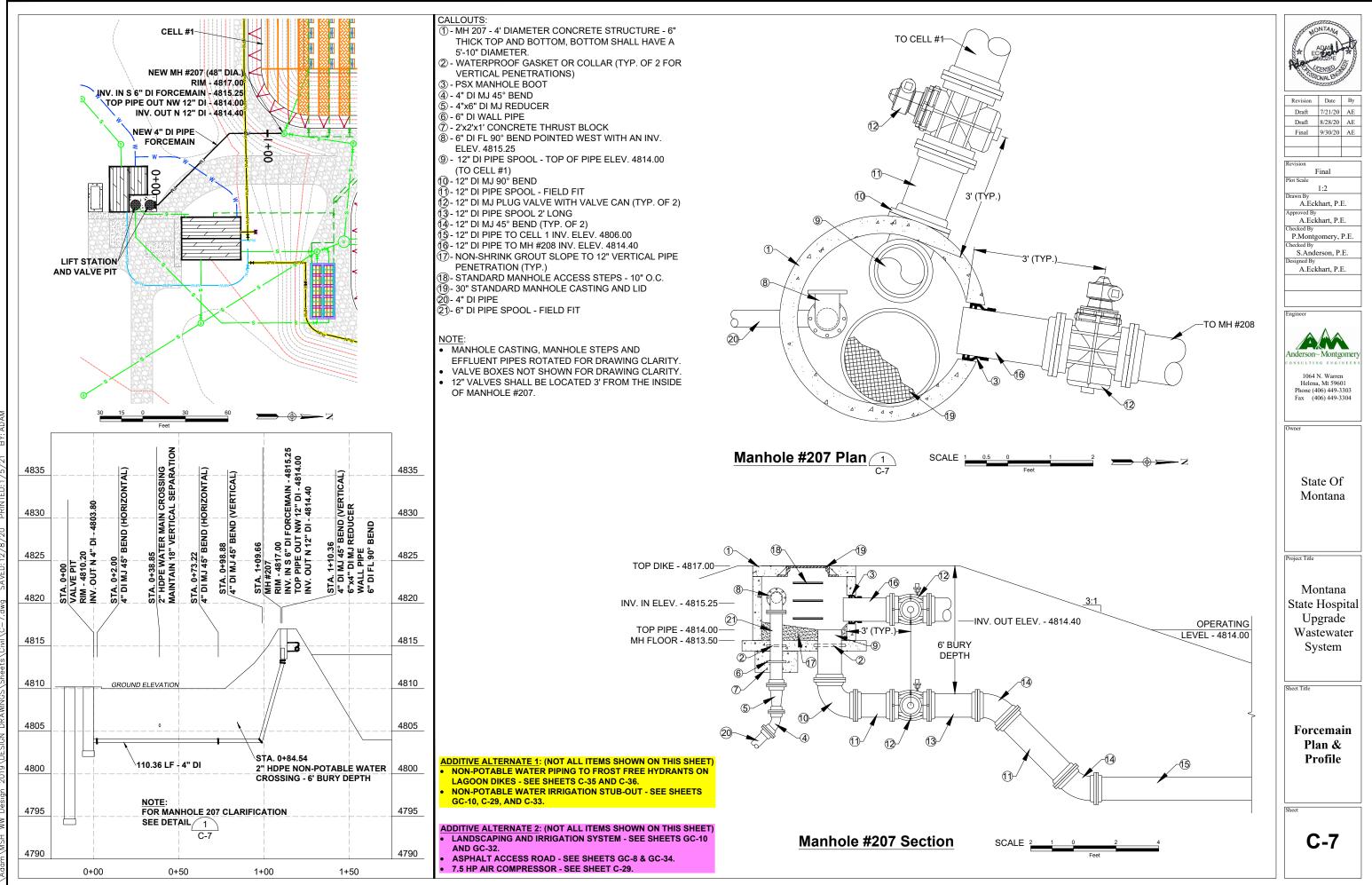
8" DI PIPE - EXTEND 3' BEYOND EXTERIOR WALL AND CAP FOR FUTURE BIOFILTER. INSTALL REMOVABLE PLUG IN PIPE TO PREVENT GAS FROM ENTERING THE PIPE.

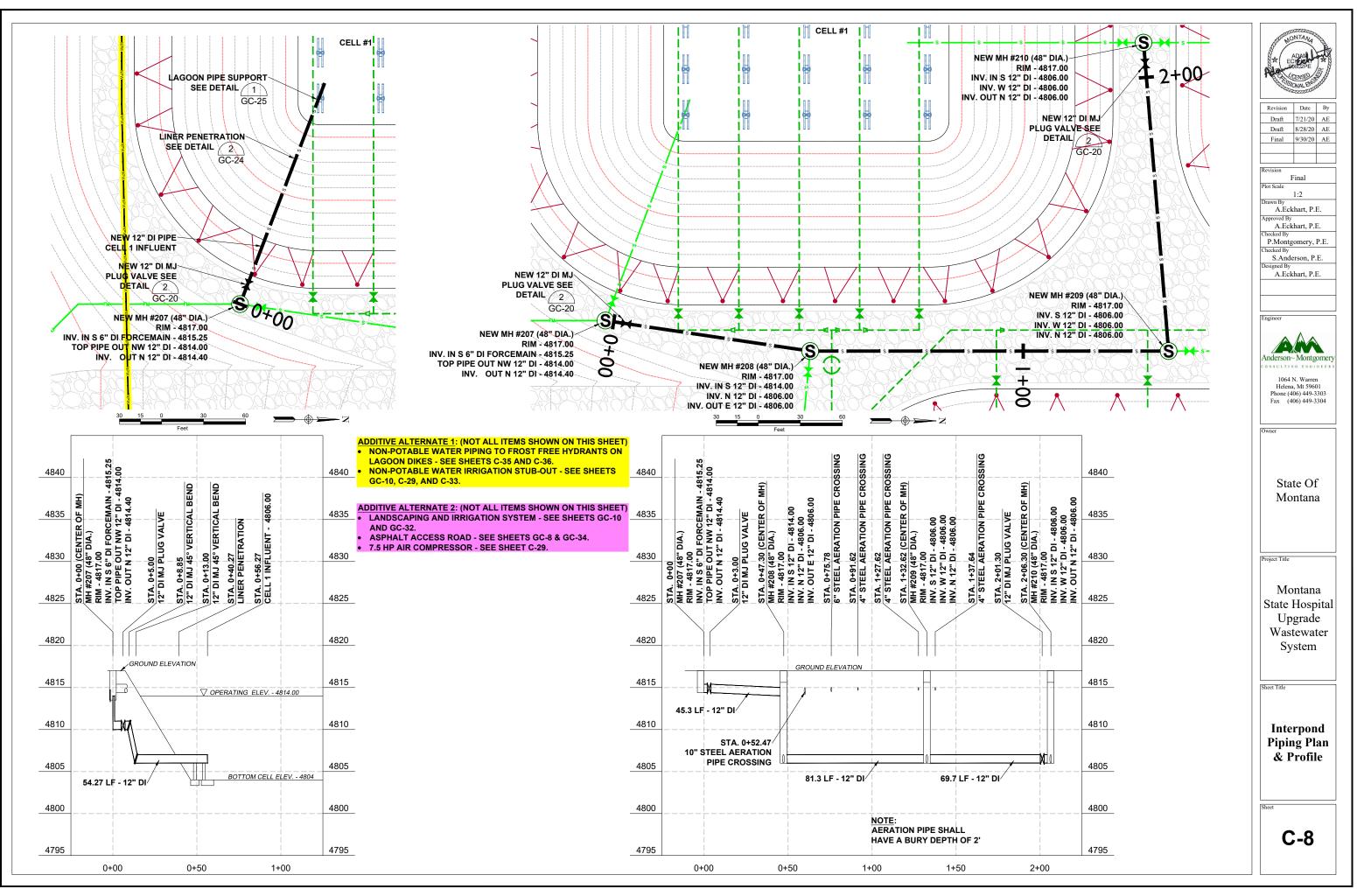
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Final	9/30/20	AE
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Approved By	chart, P.I	-
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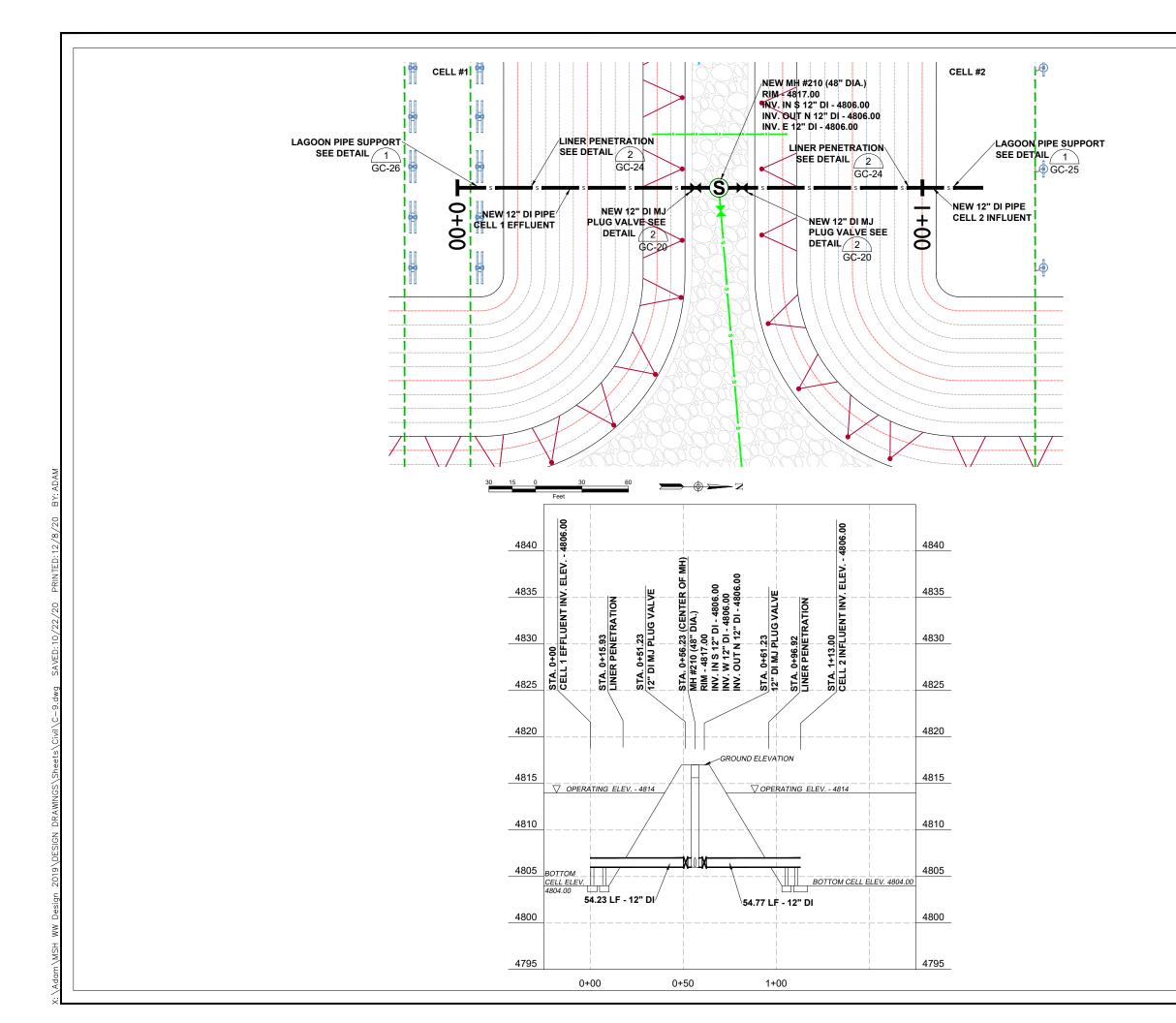




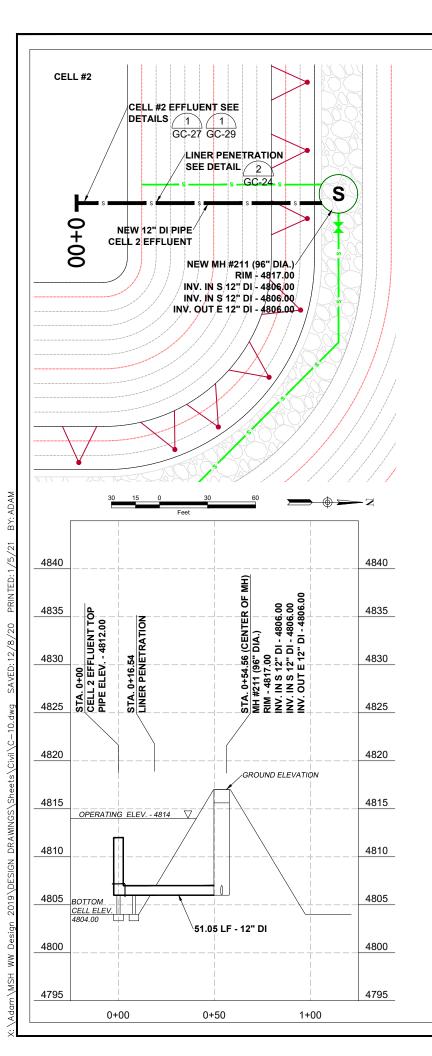


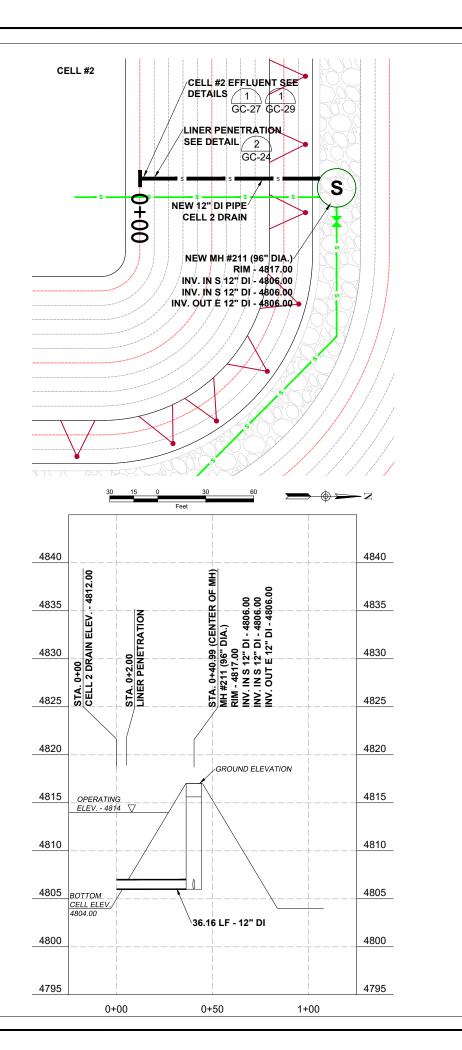


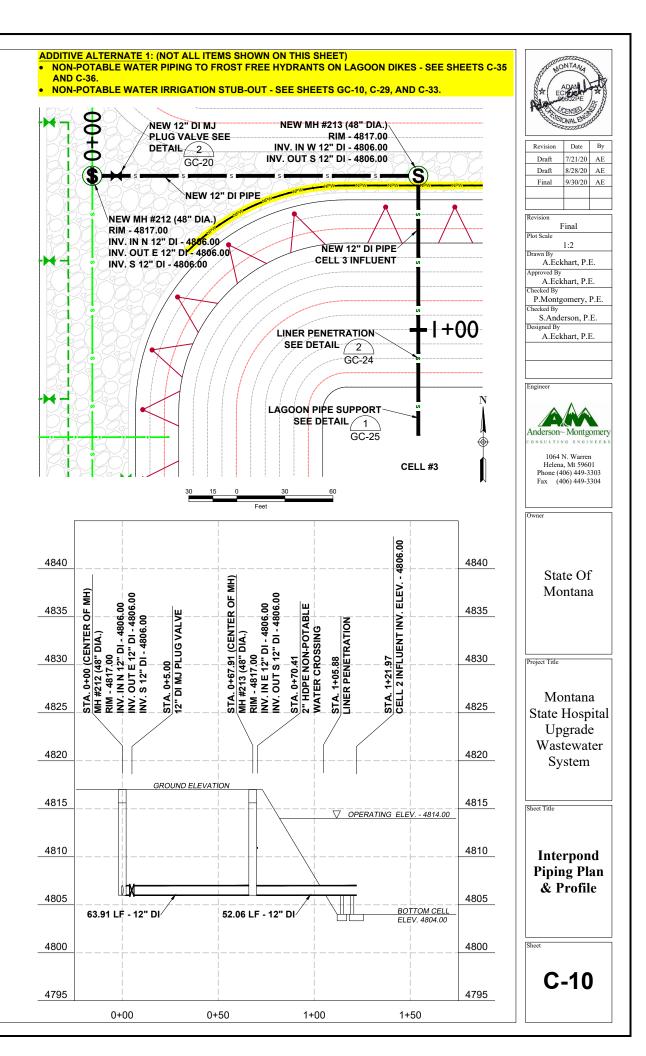


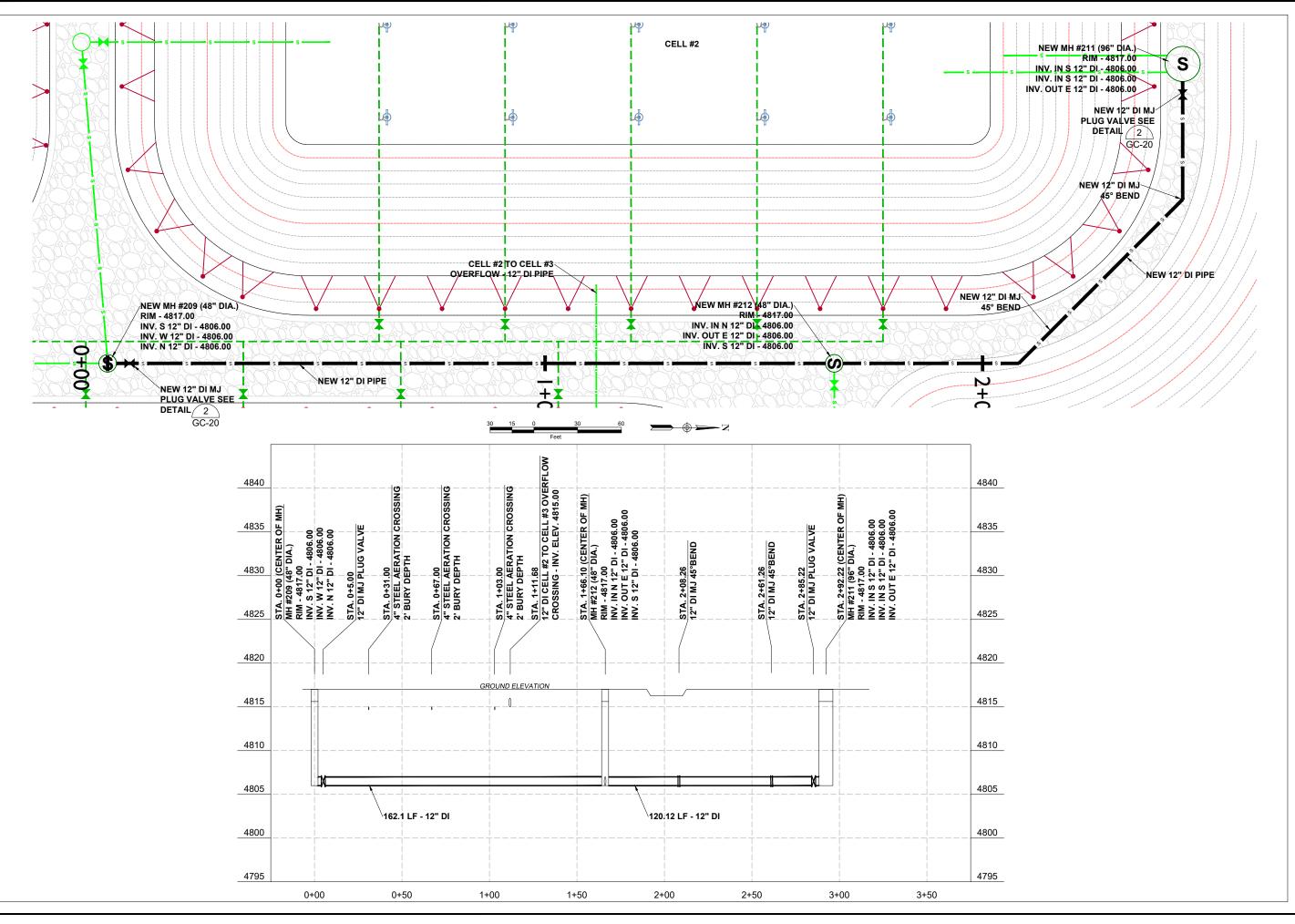


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Revision Final Plot Scale 1:2 Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.				
Engineer Anderson-Montgomery consultate engineers 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304				
State Of Montana				
Project Title Montana State Hospital Upgrade Wastewater System				
Sheet Title Interpond Piping Plan & Profile				
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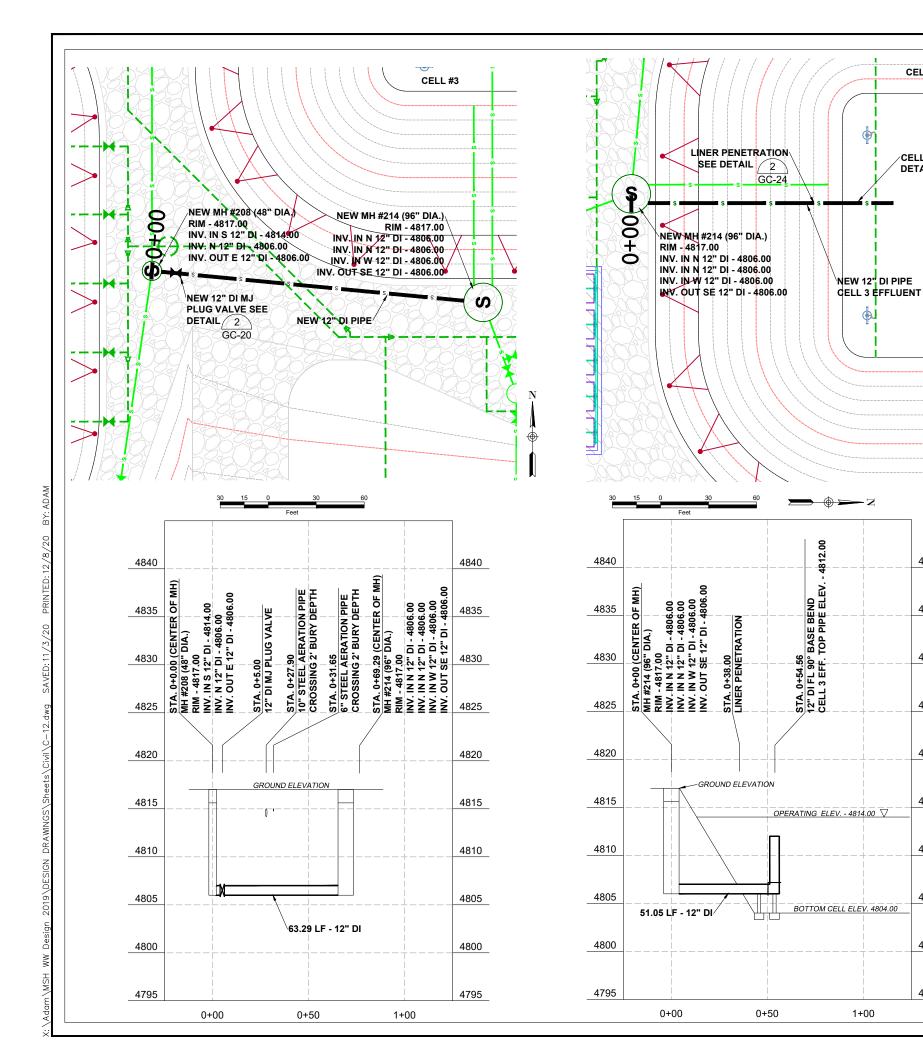


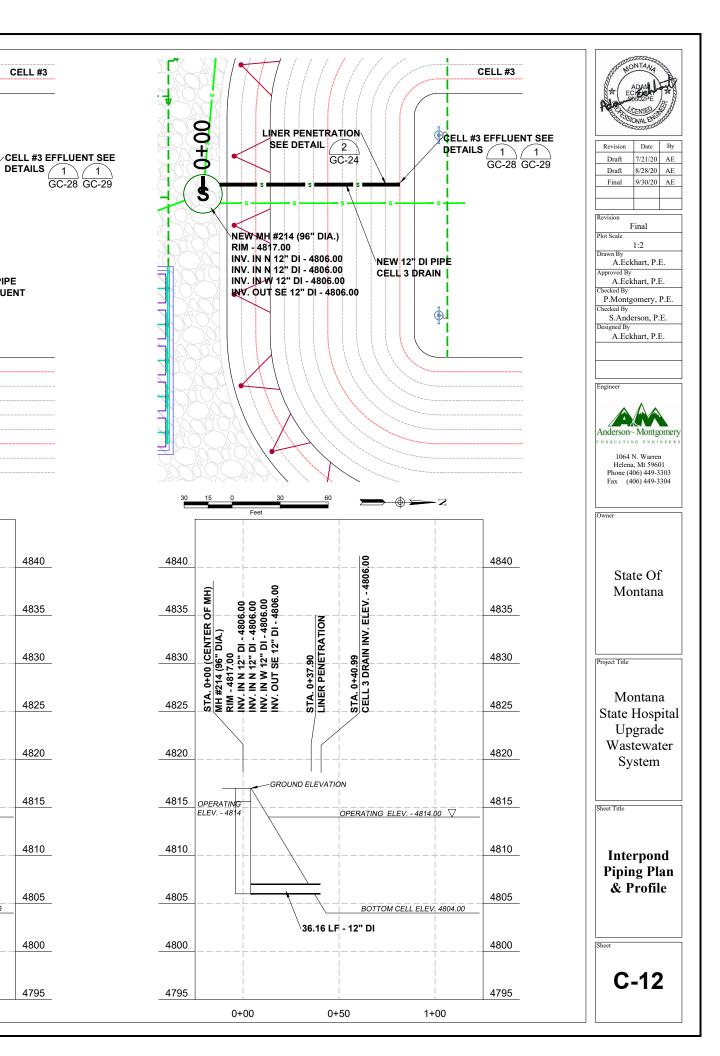




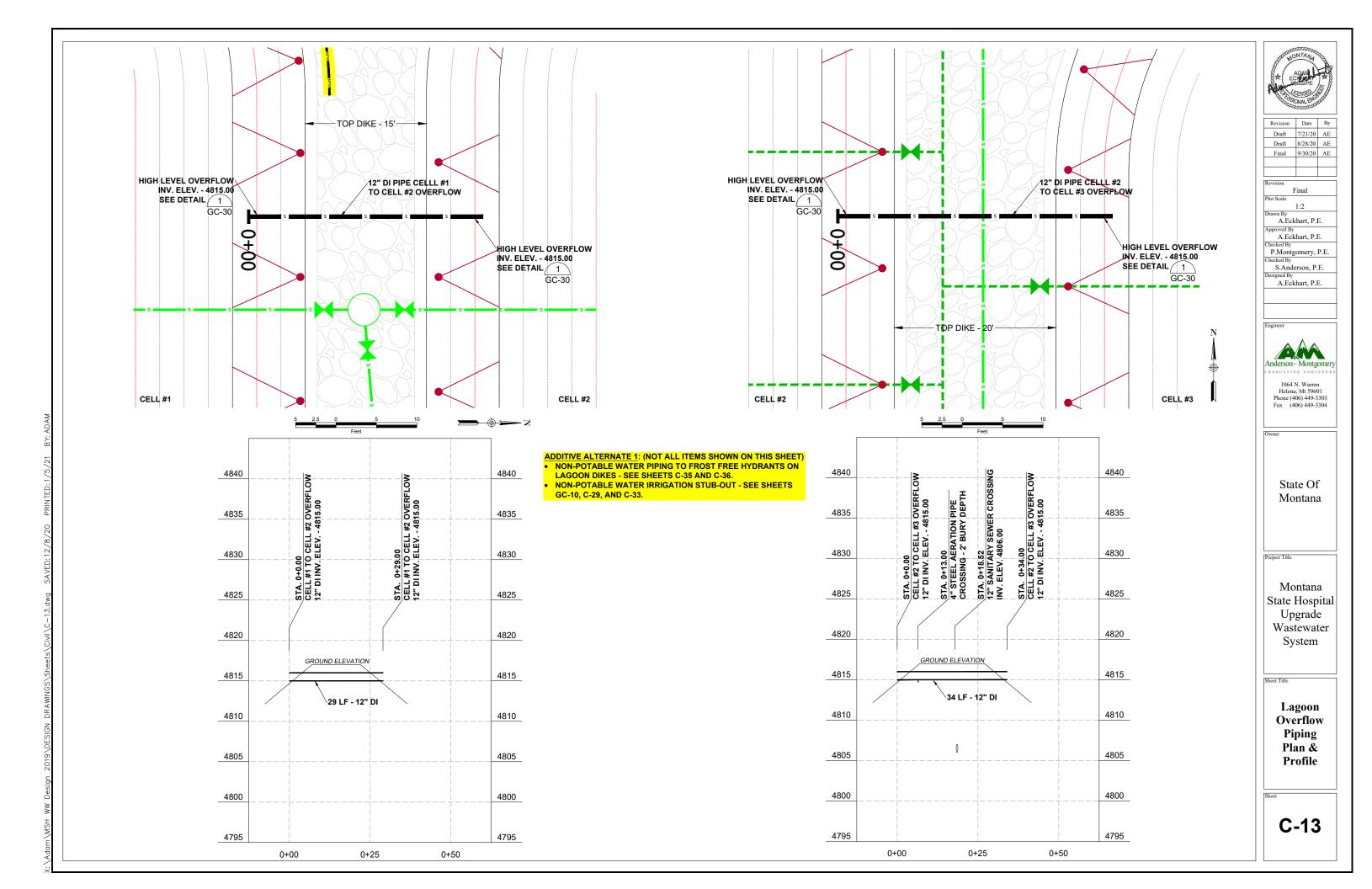


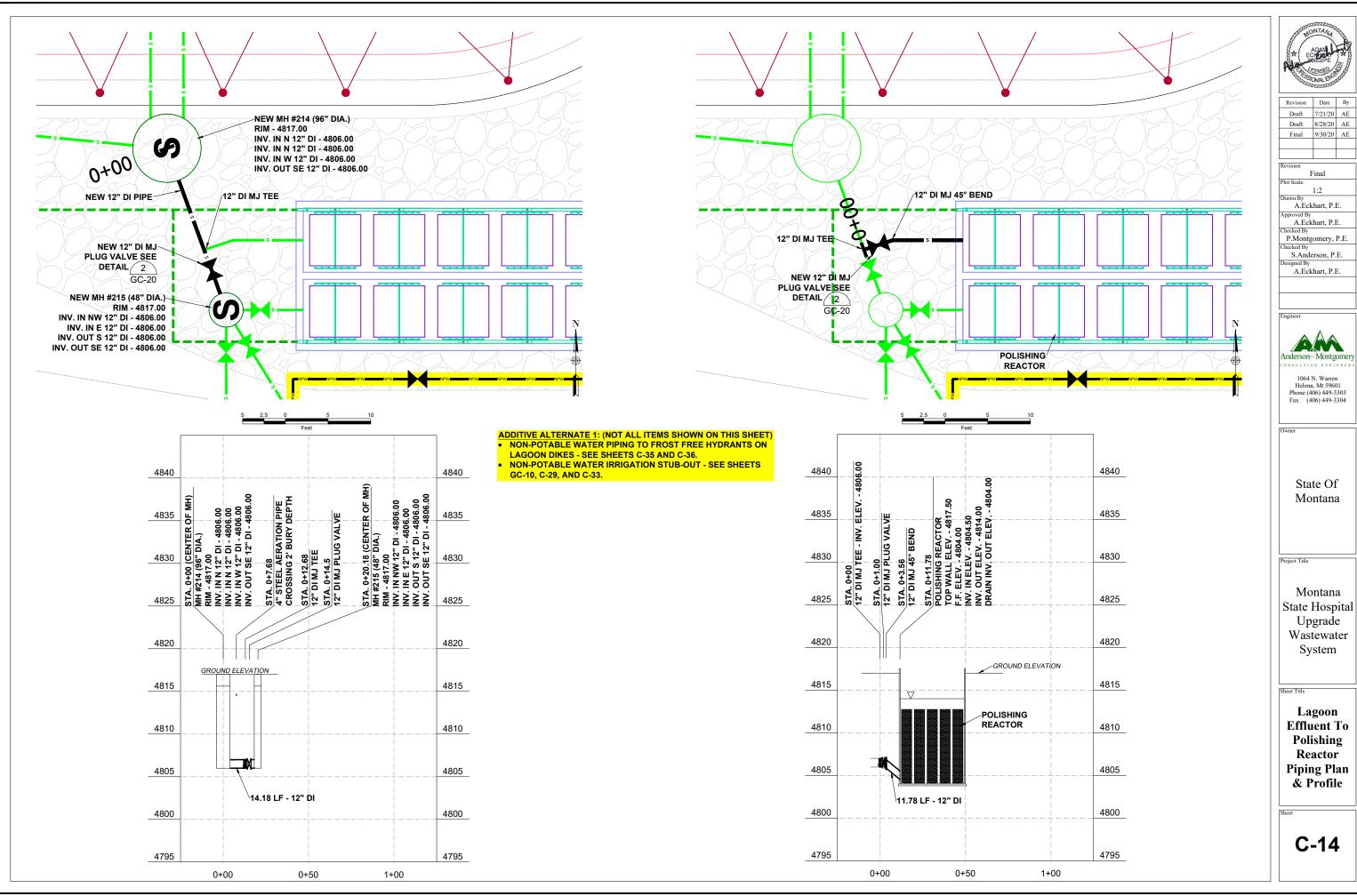
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Engineer			
Anderson-Montgomery consulting engineers Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304			
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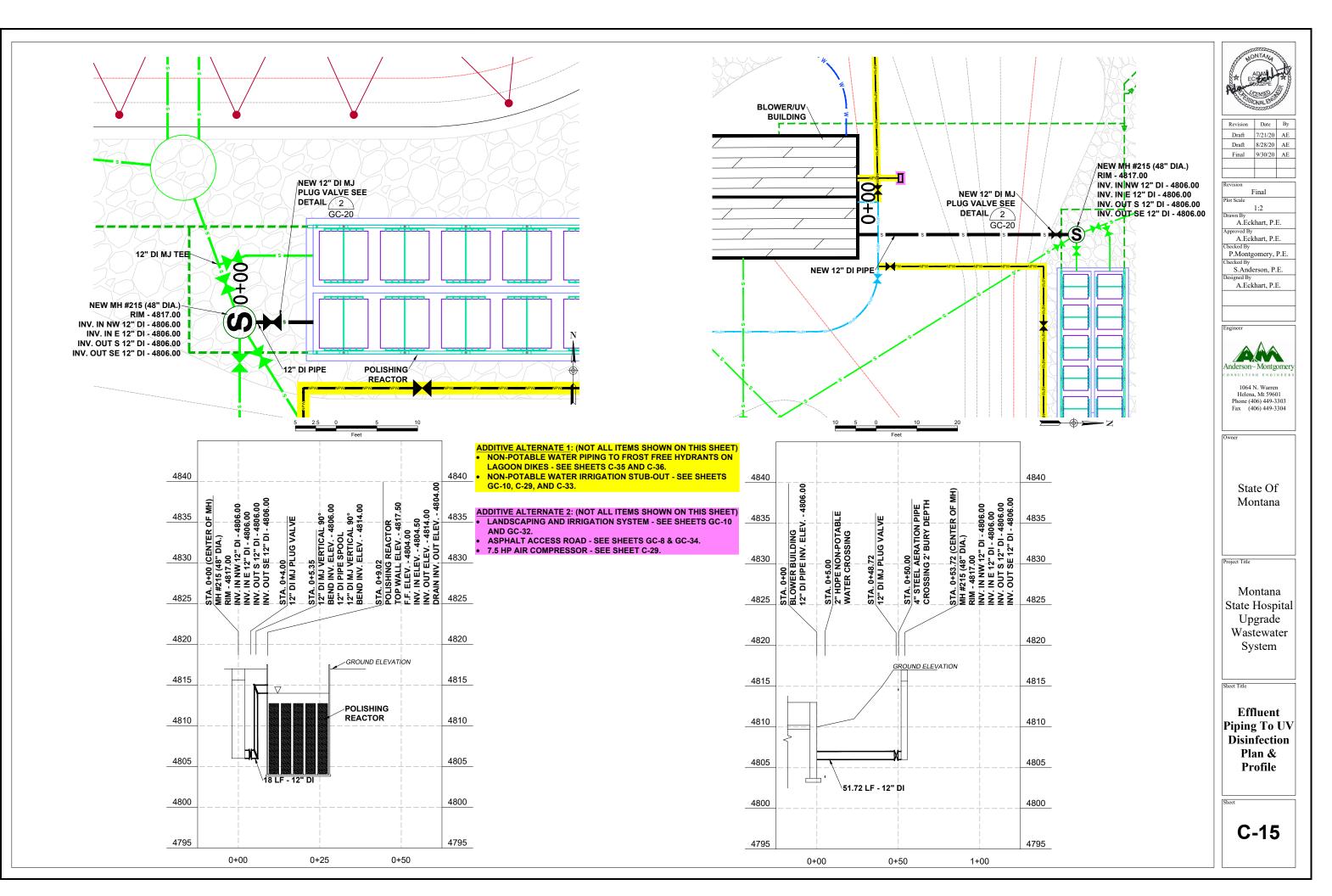


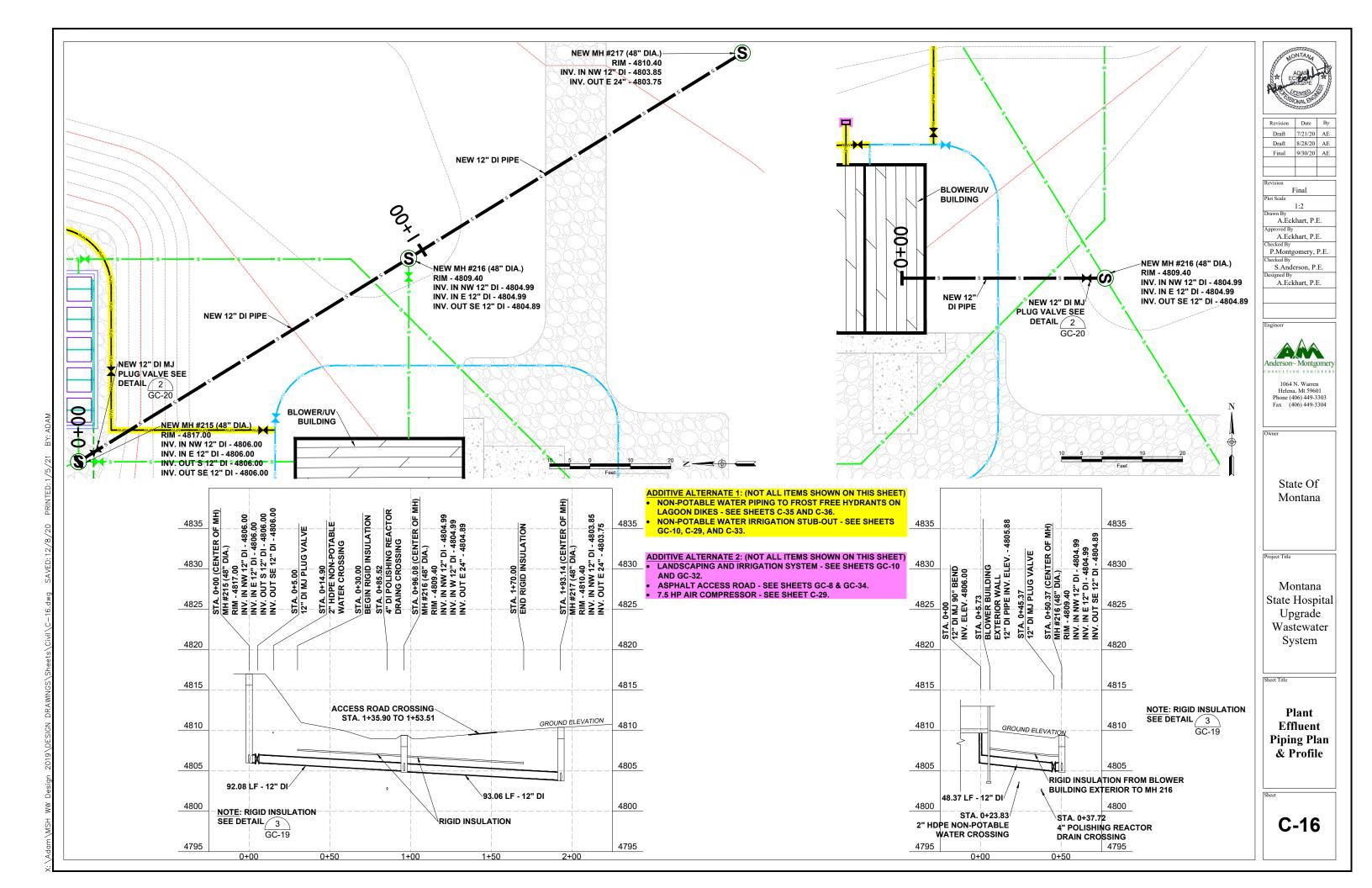


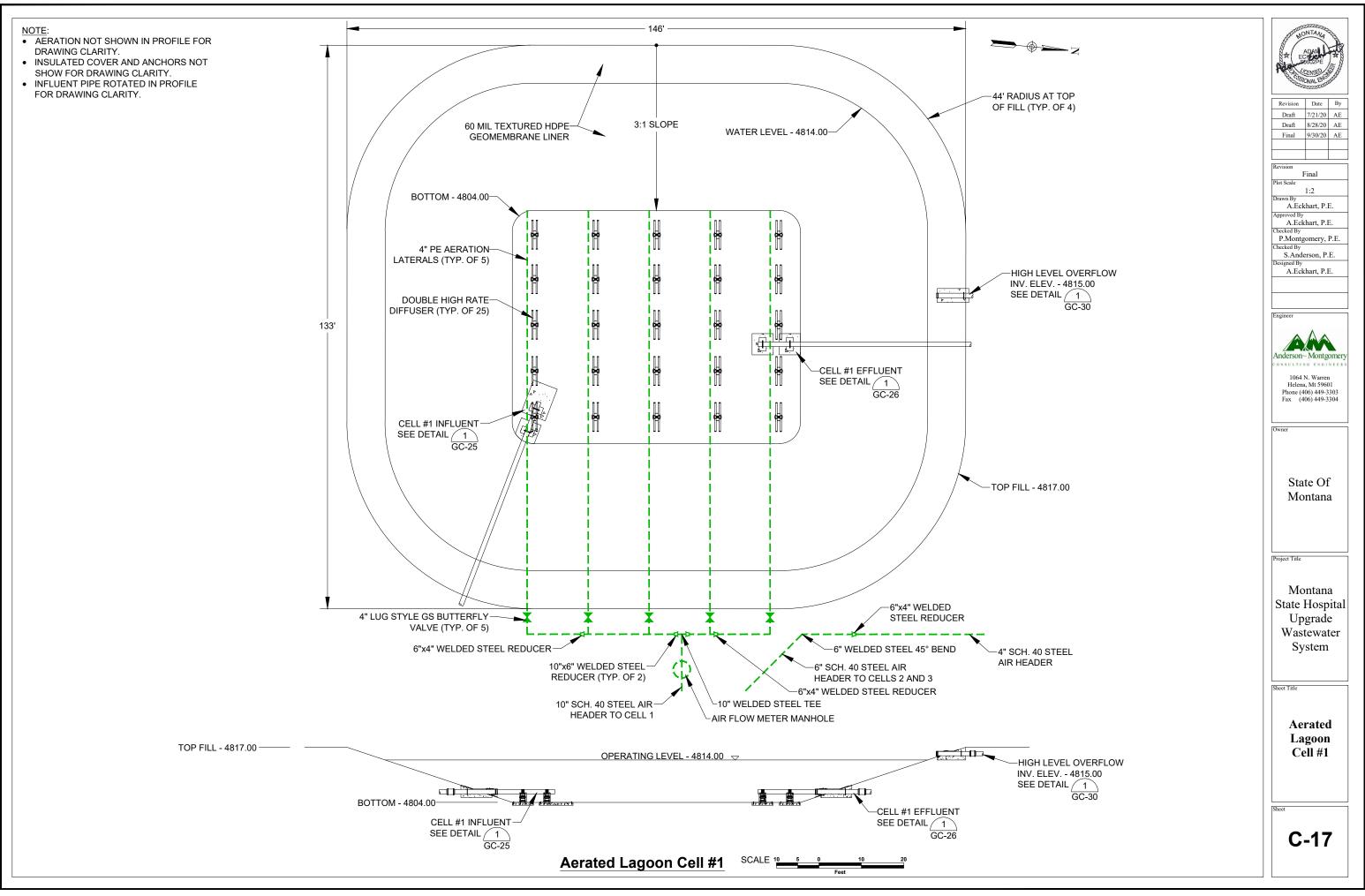
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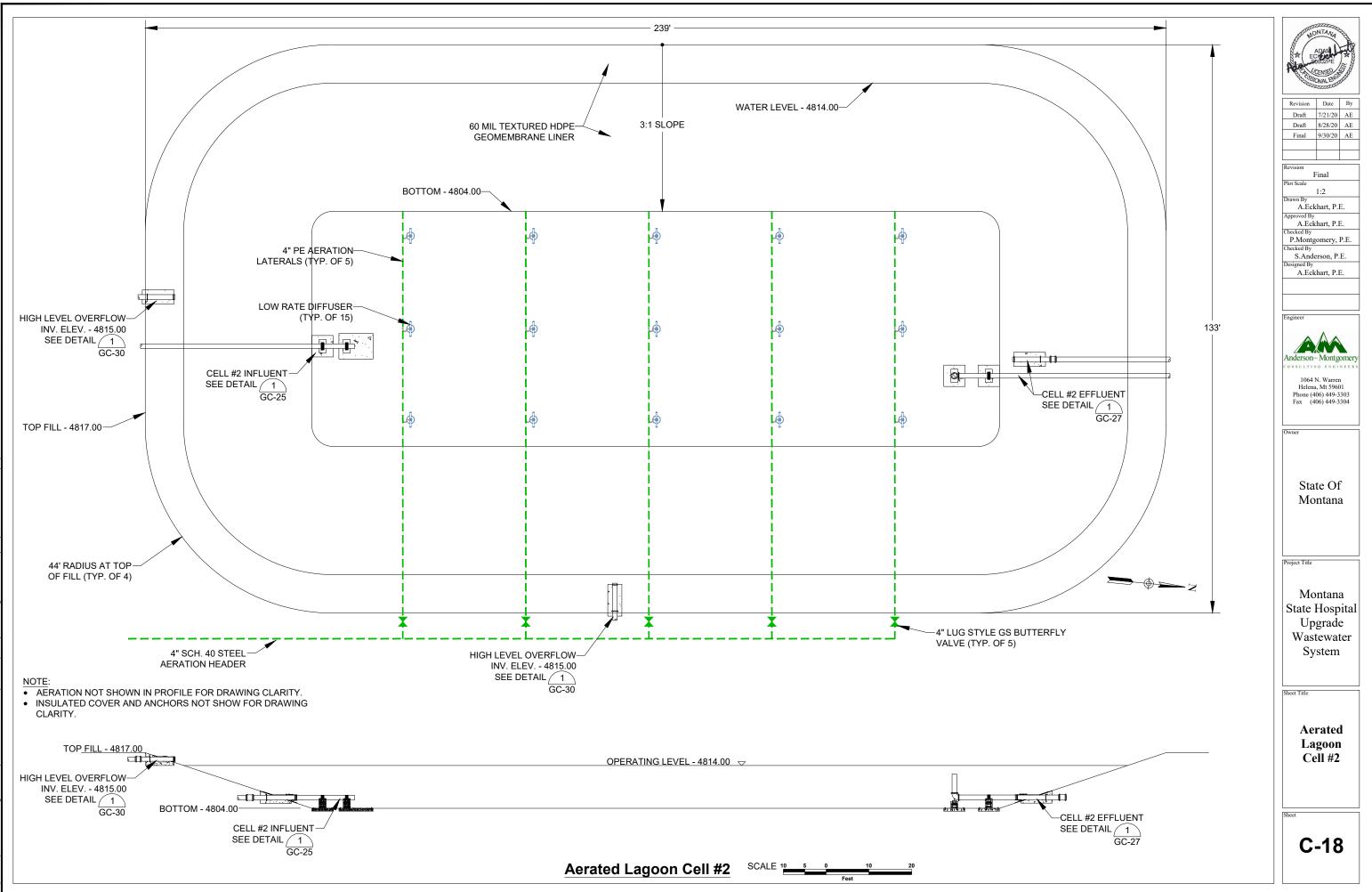


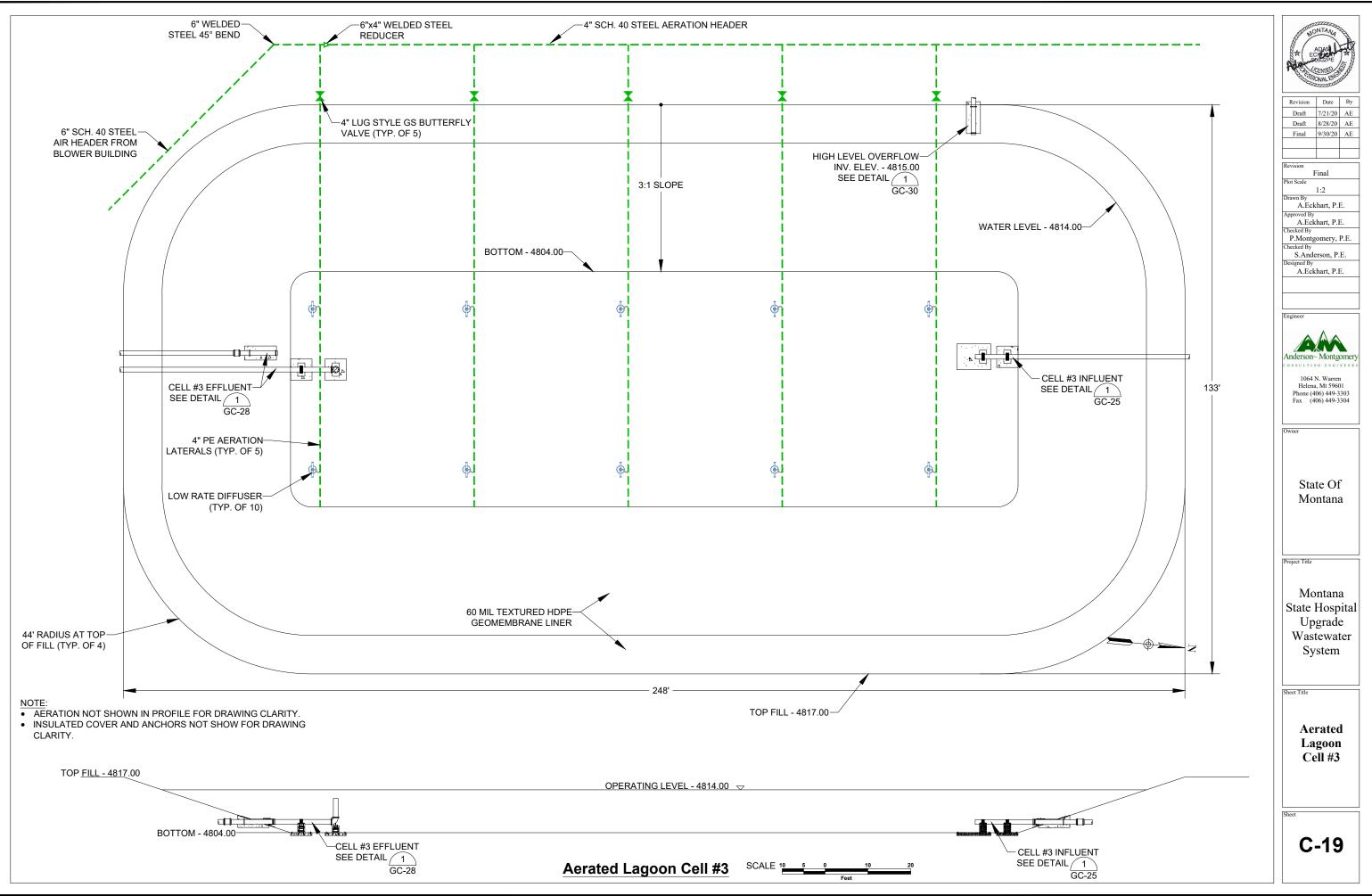


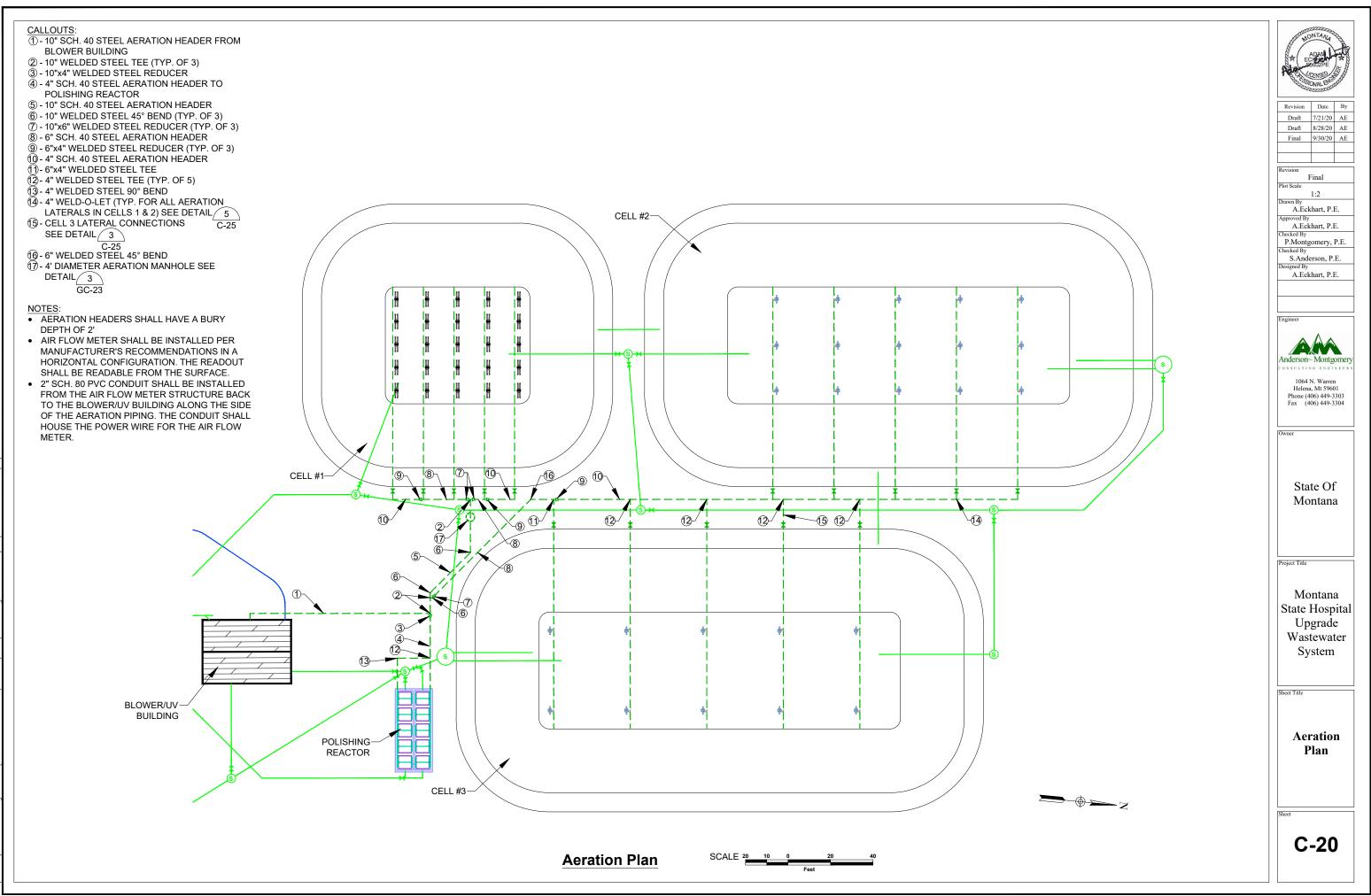


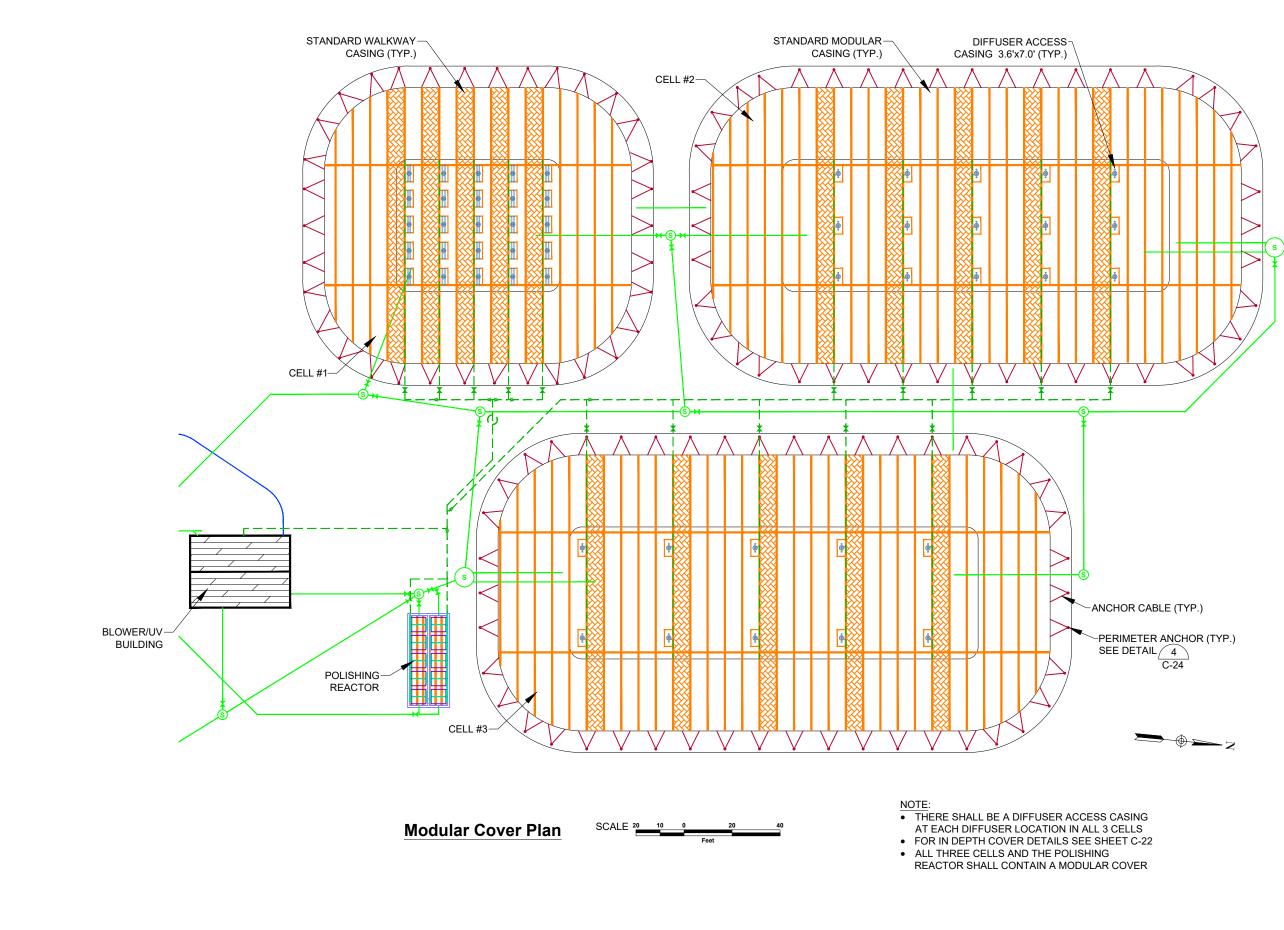




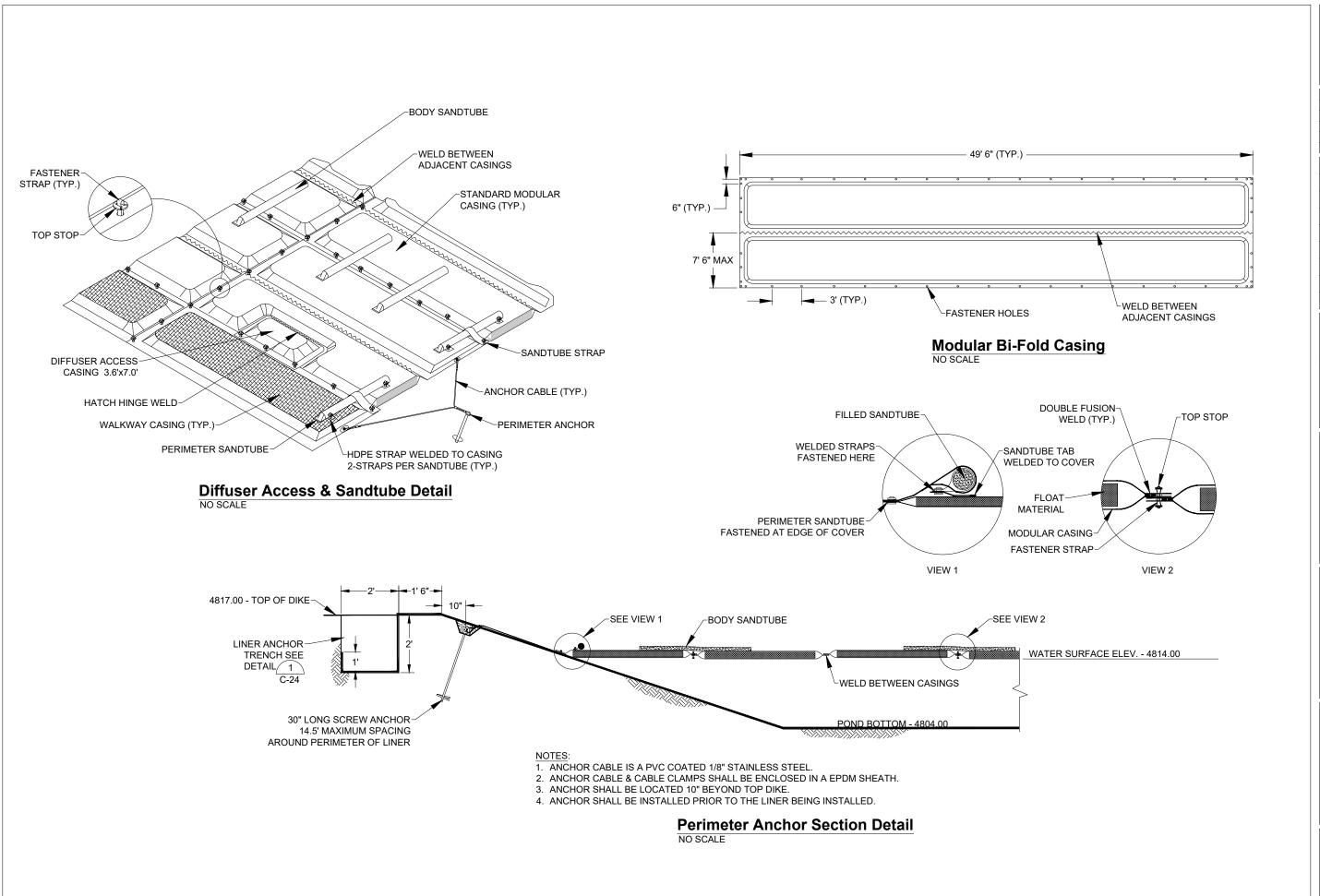




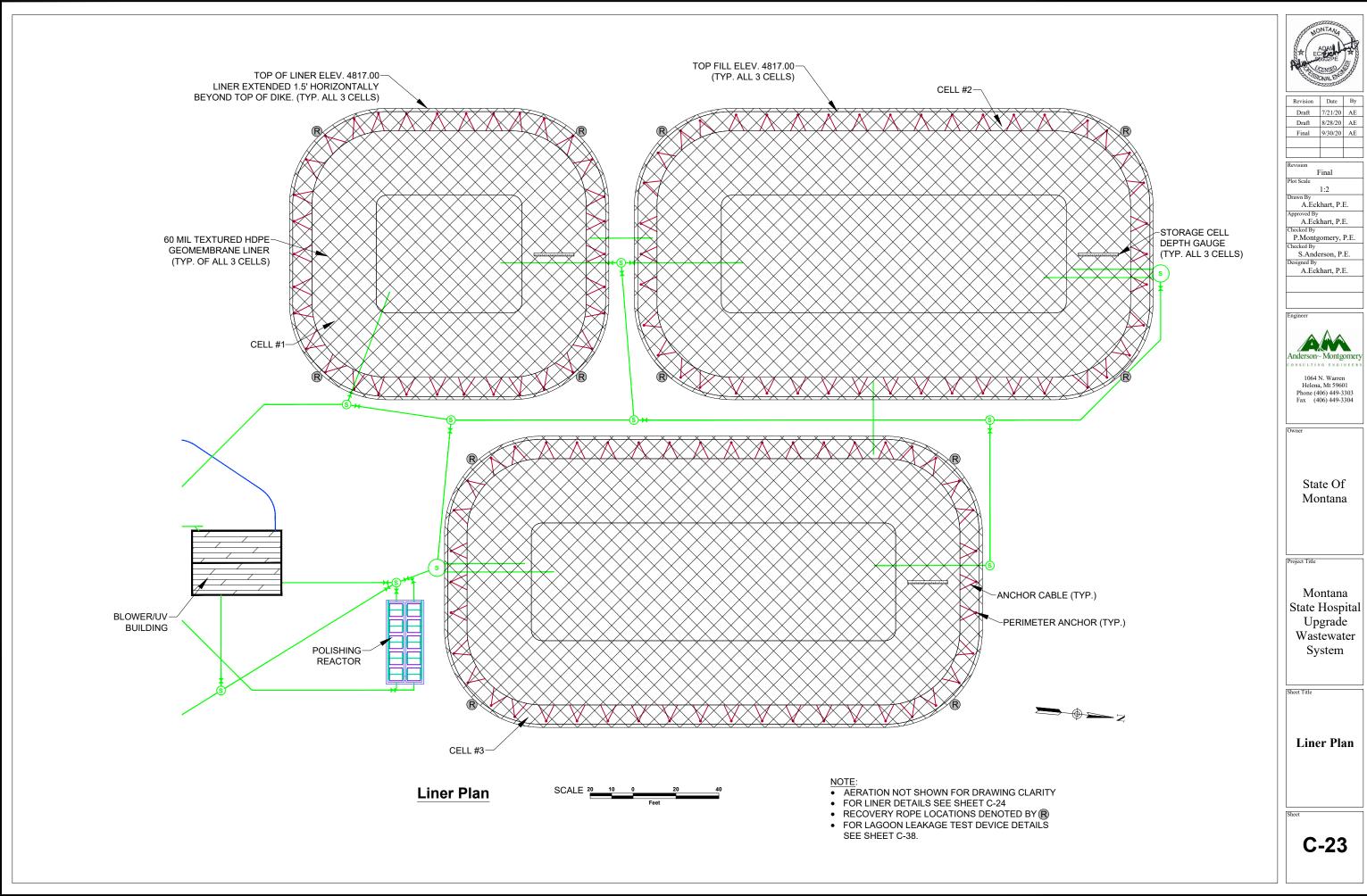


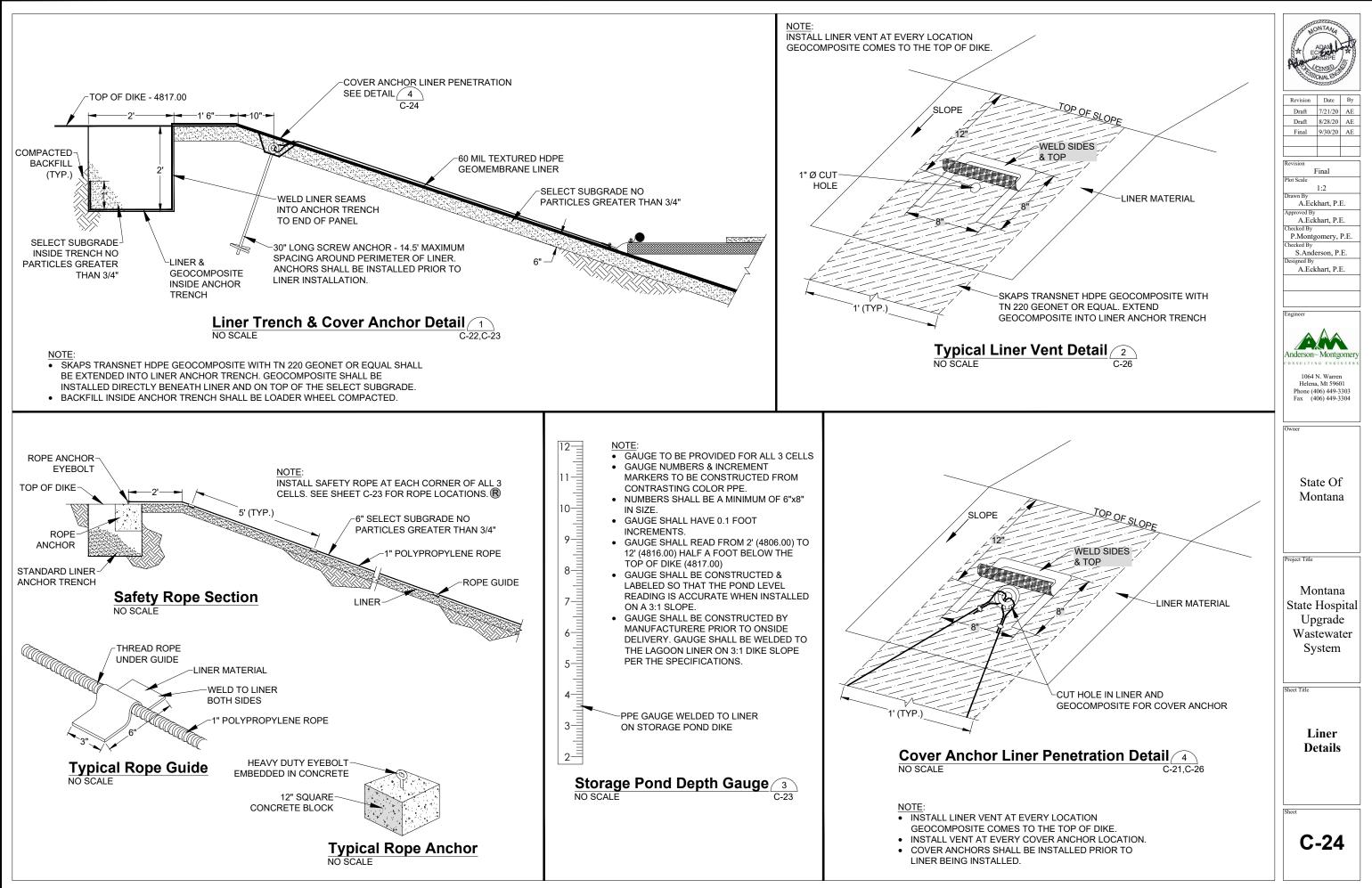


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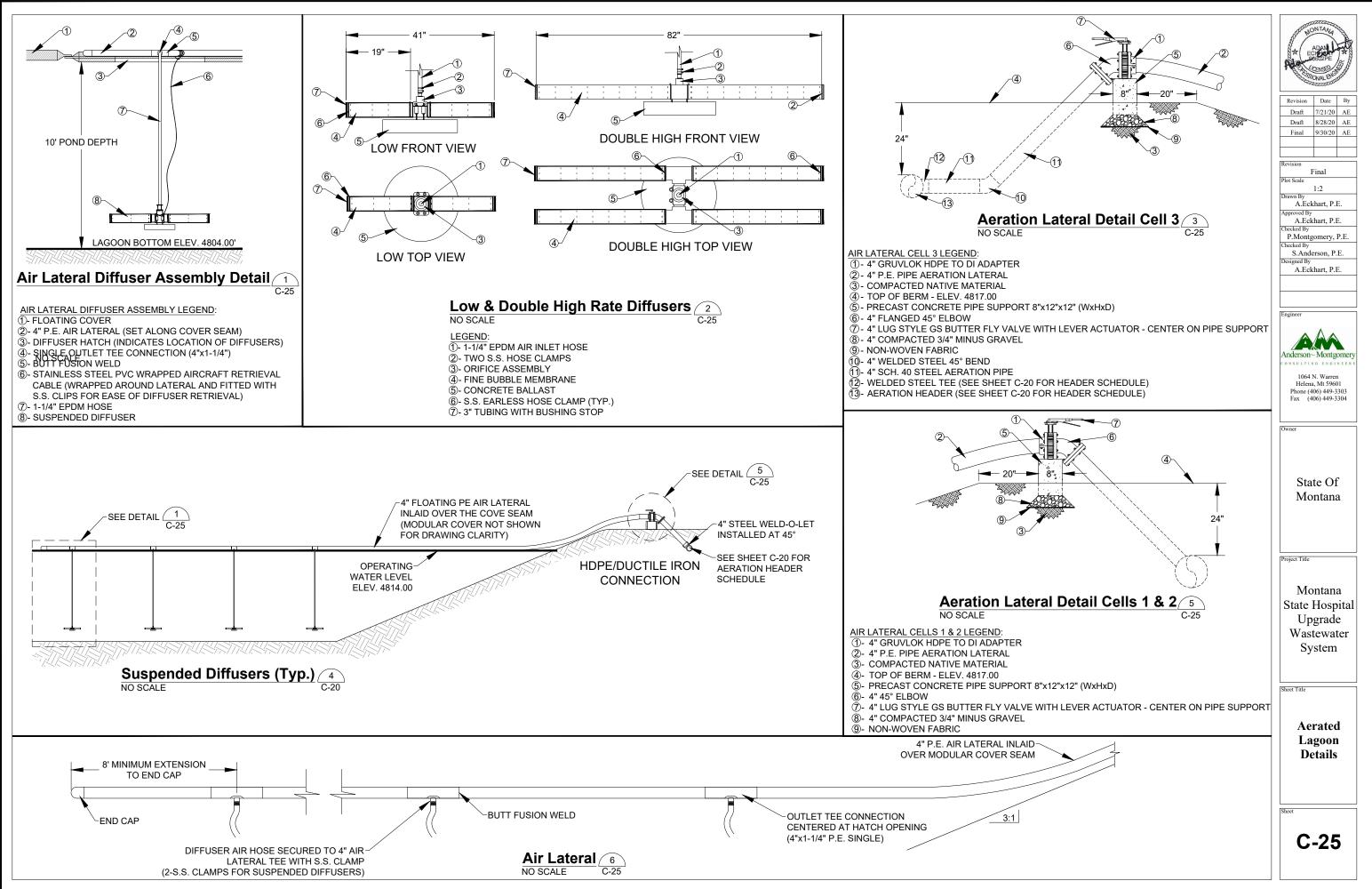


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A.Eckhart, P.E.		
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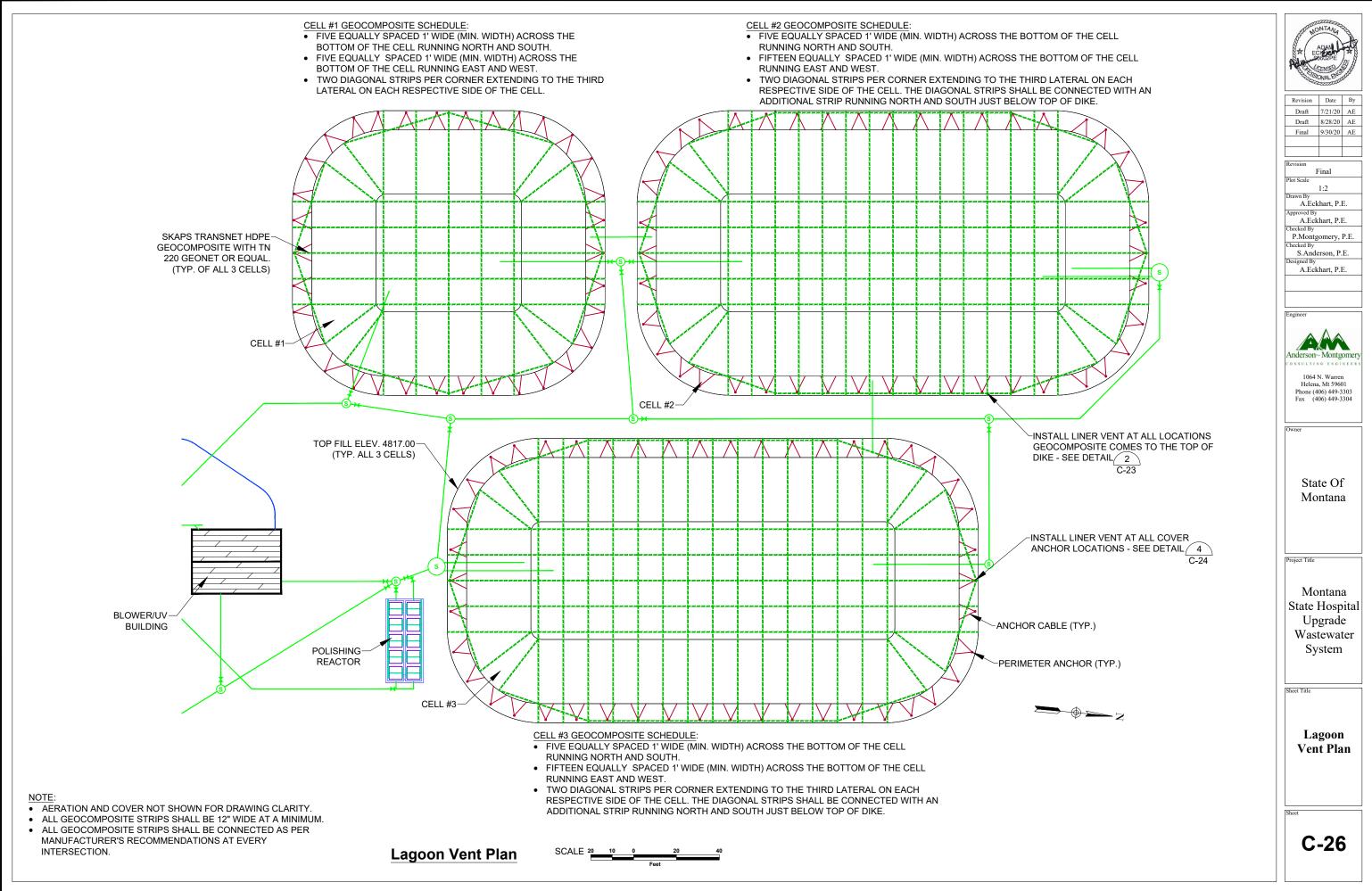


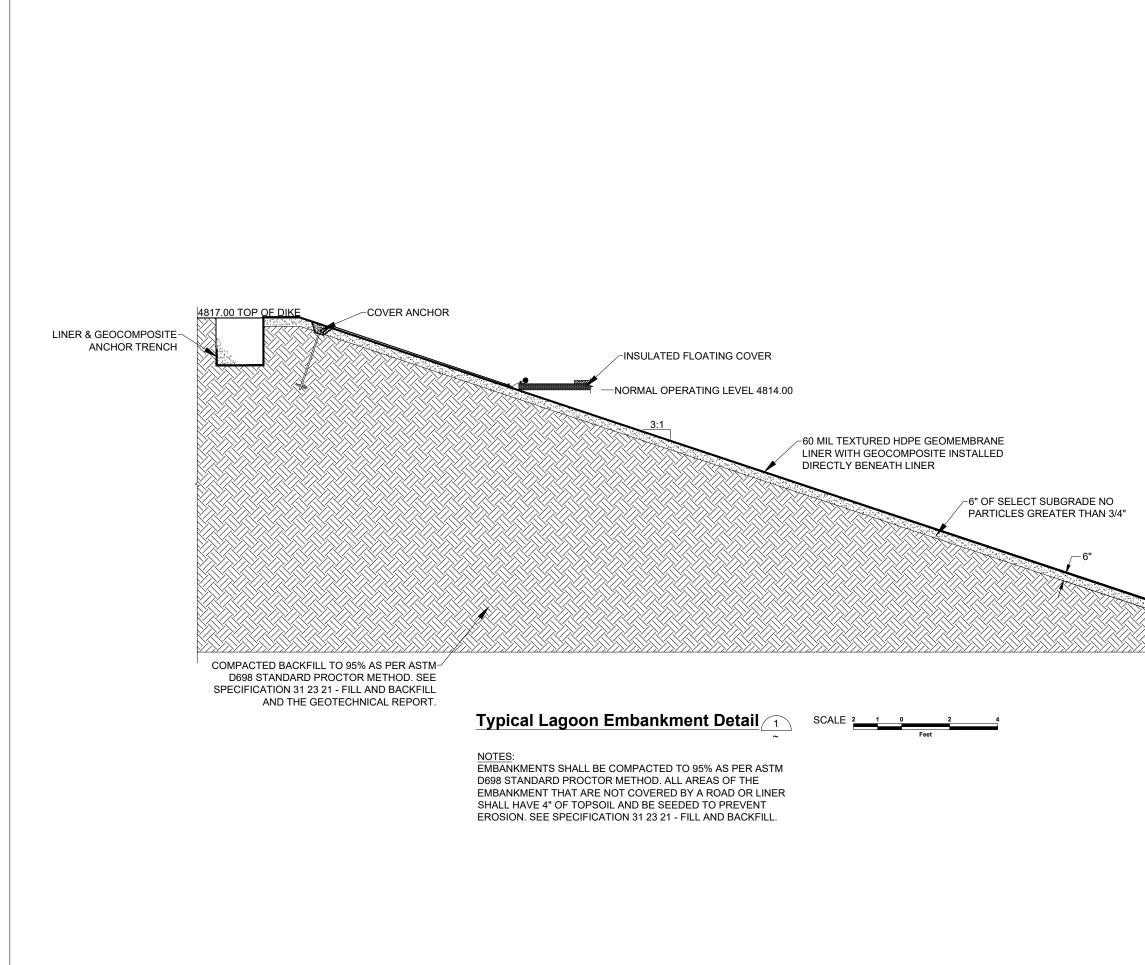


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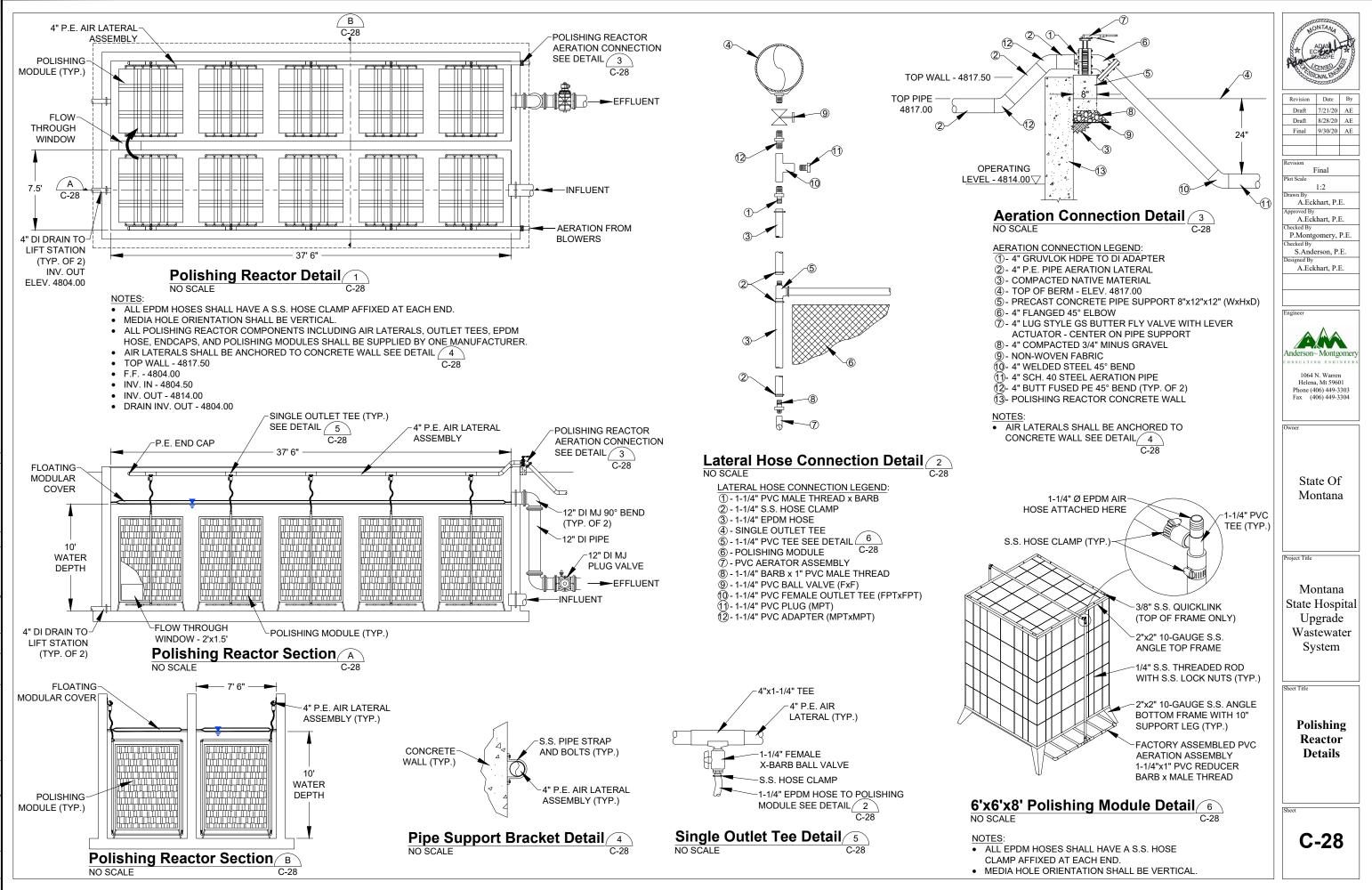


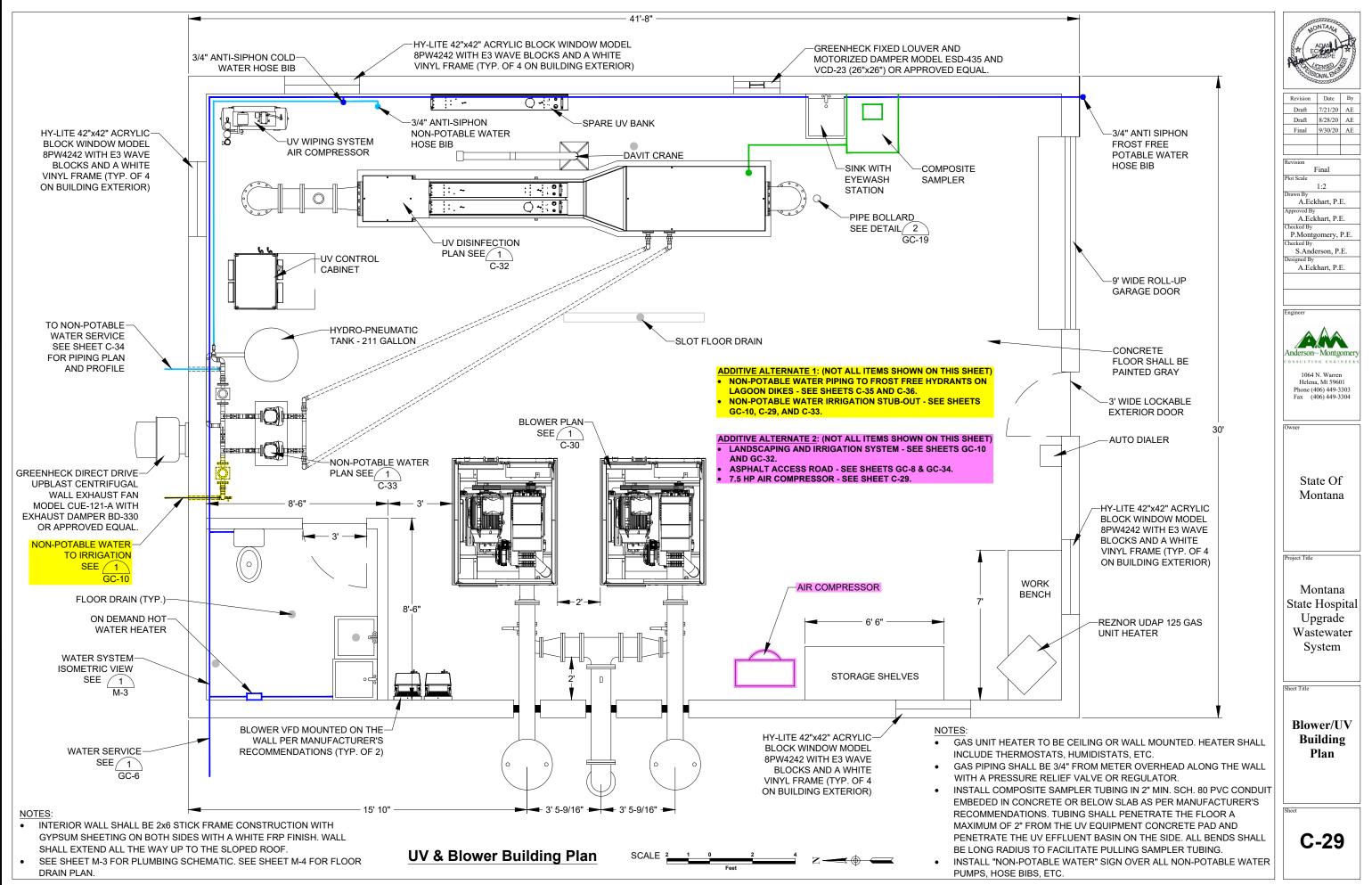
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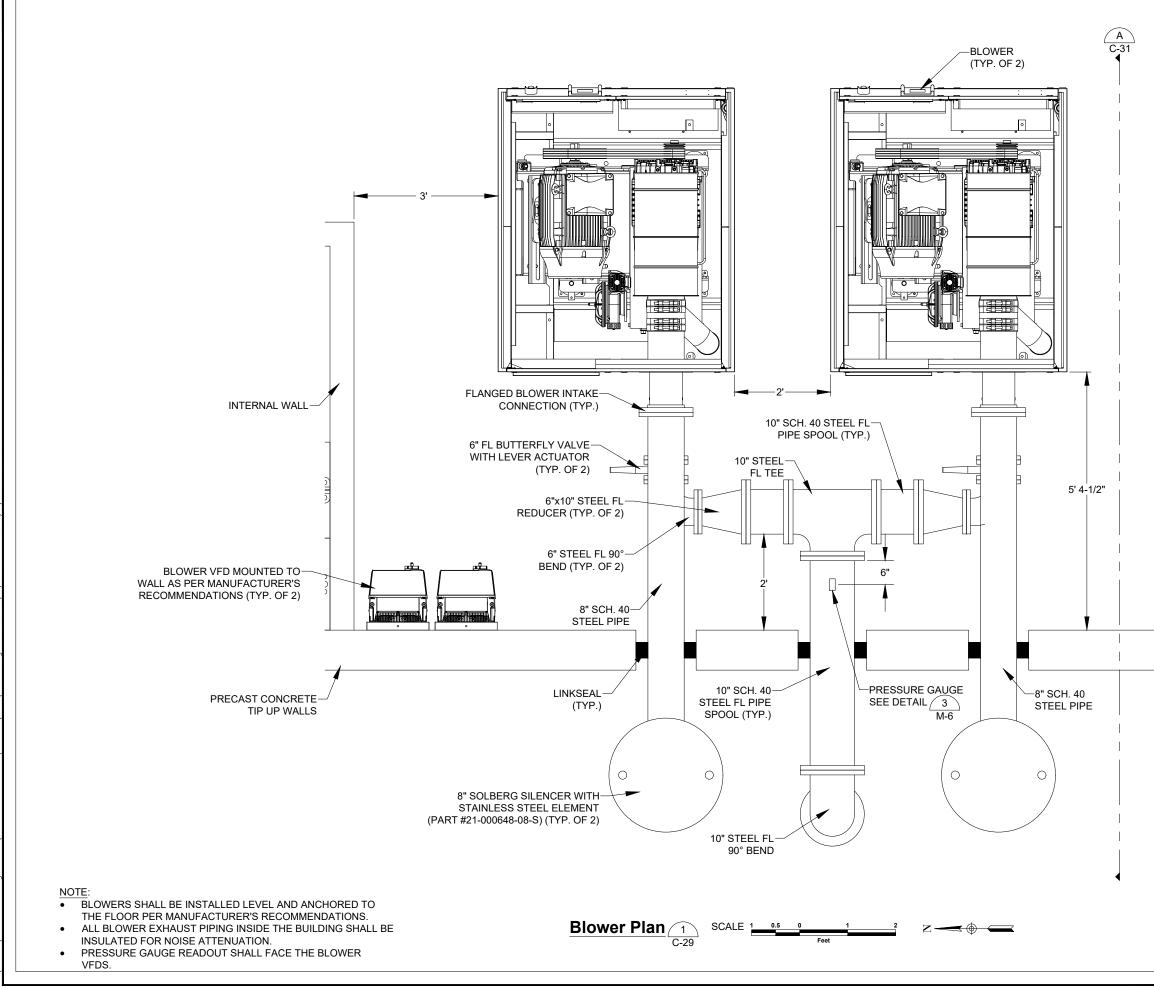




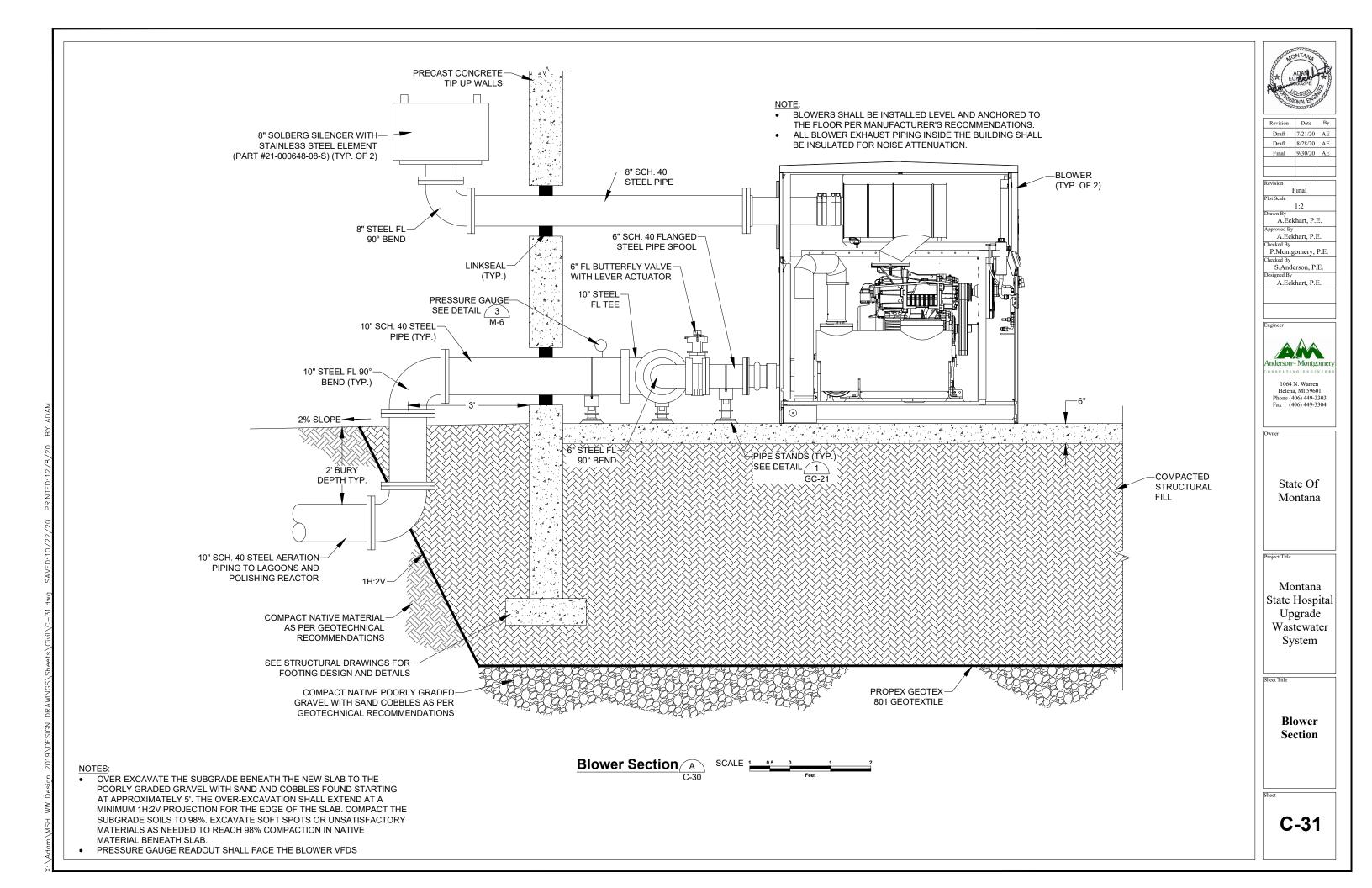
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Engineer Anderson~ Montgomery cossultisg enoisters 1064 N. Warren
Holena, Mr Sofol Helena, Mr Sofol Phone (406) 449-3303 Fax (406) 449-3304 Owner
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Montana State Hospital Upgrade Wastewater System
Sheet Title
Lagoon Embankment Details
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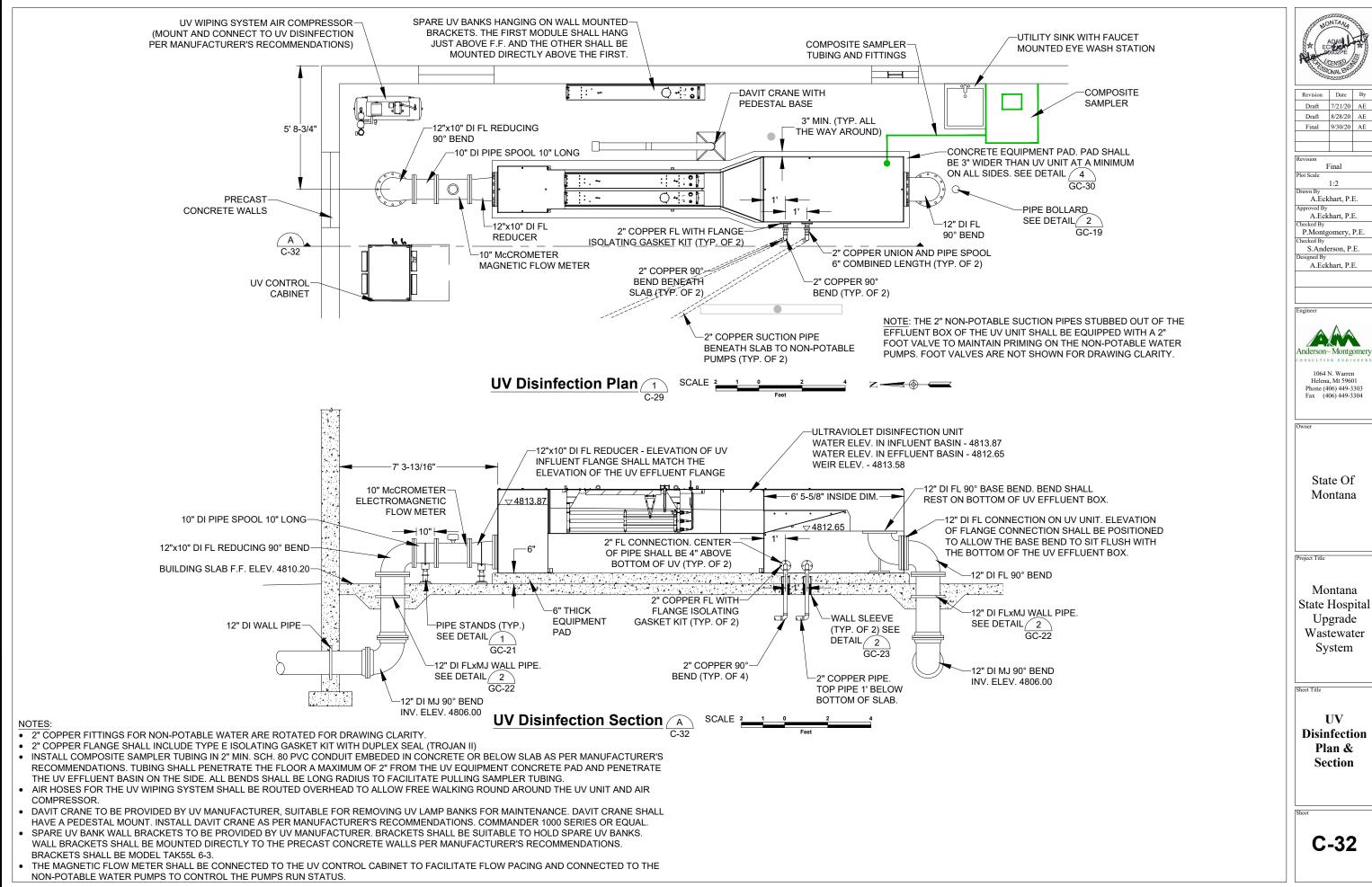


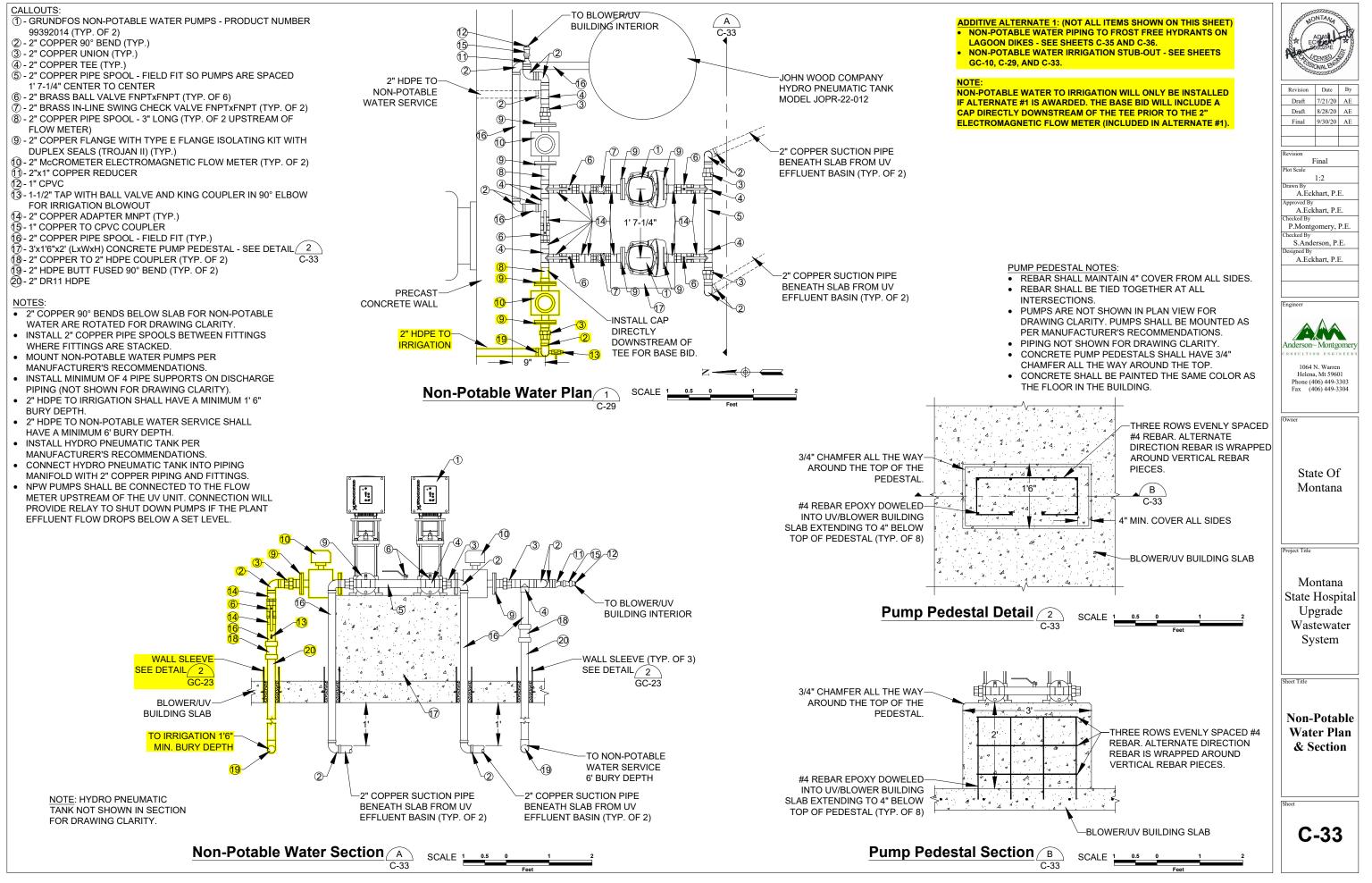


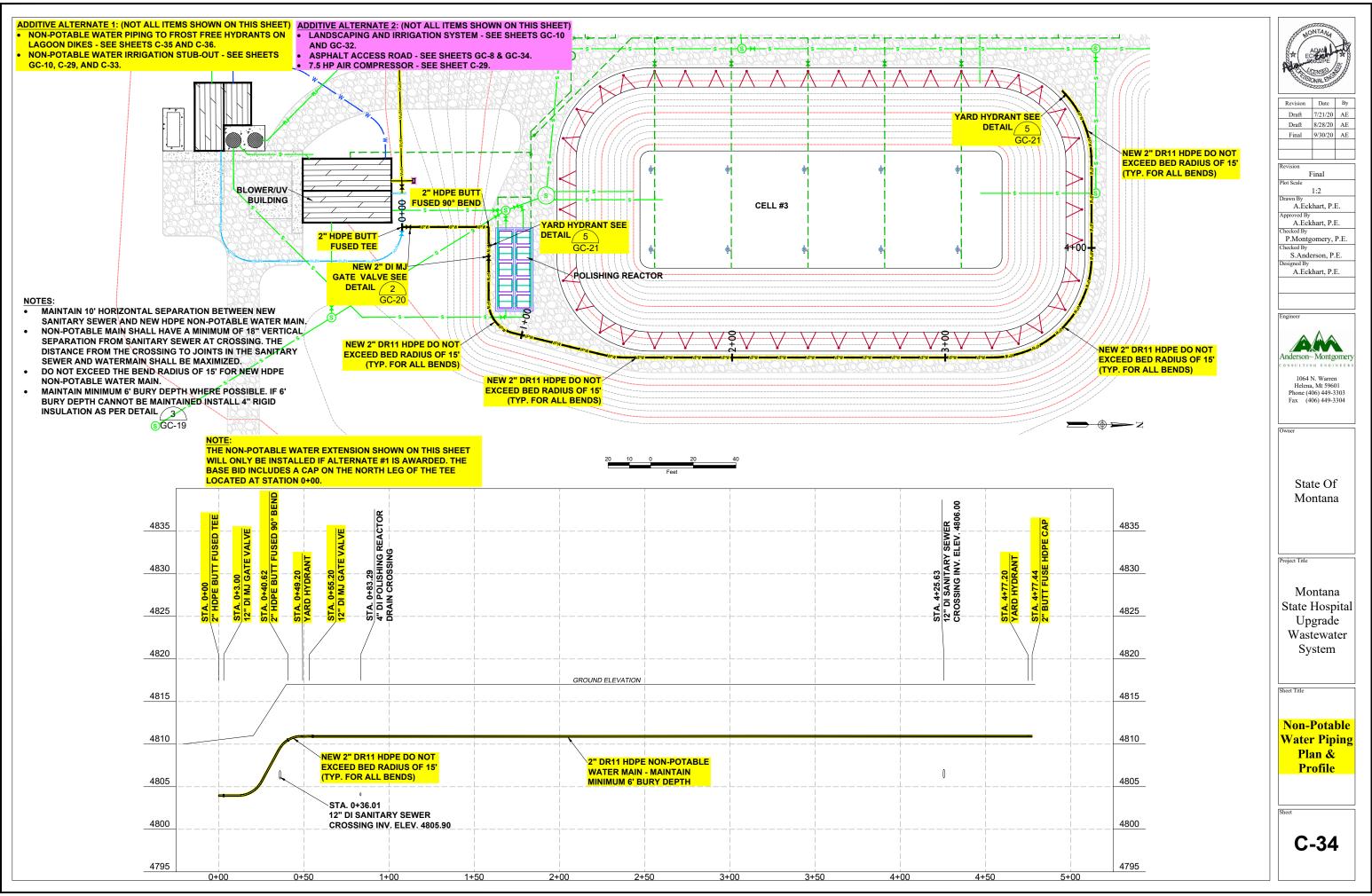


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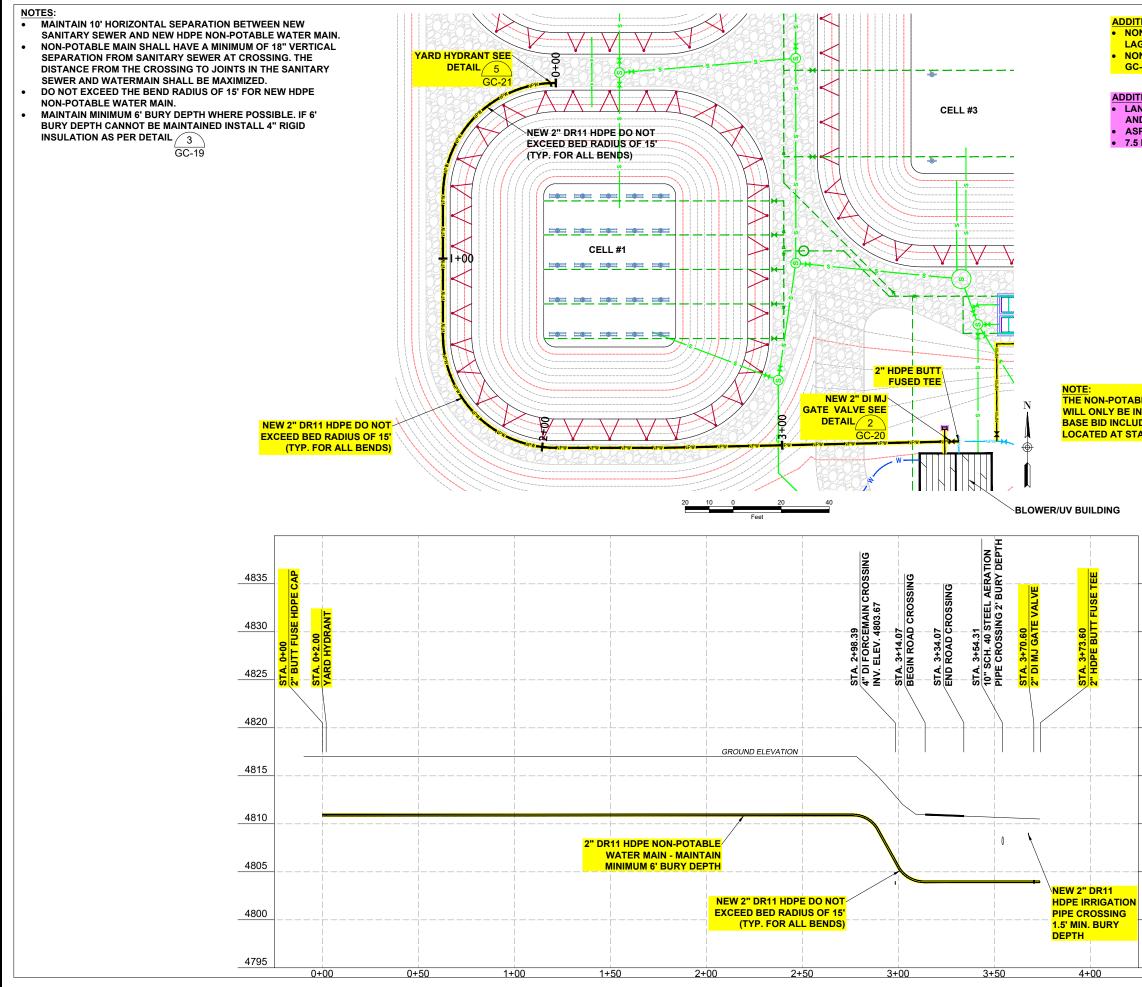




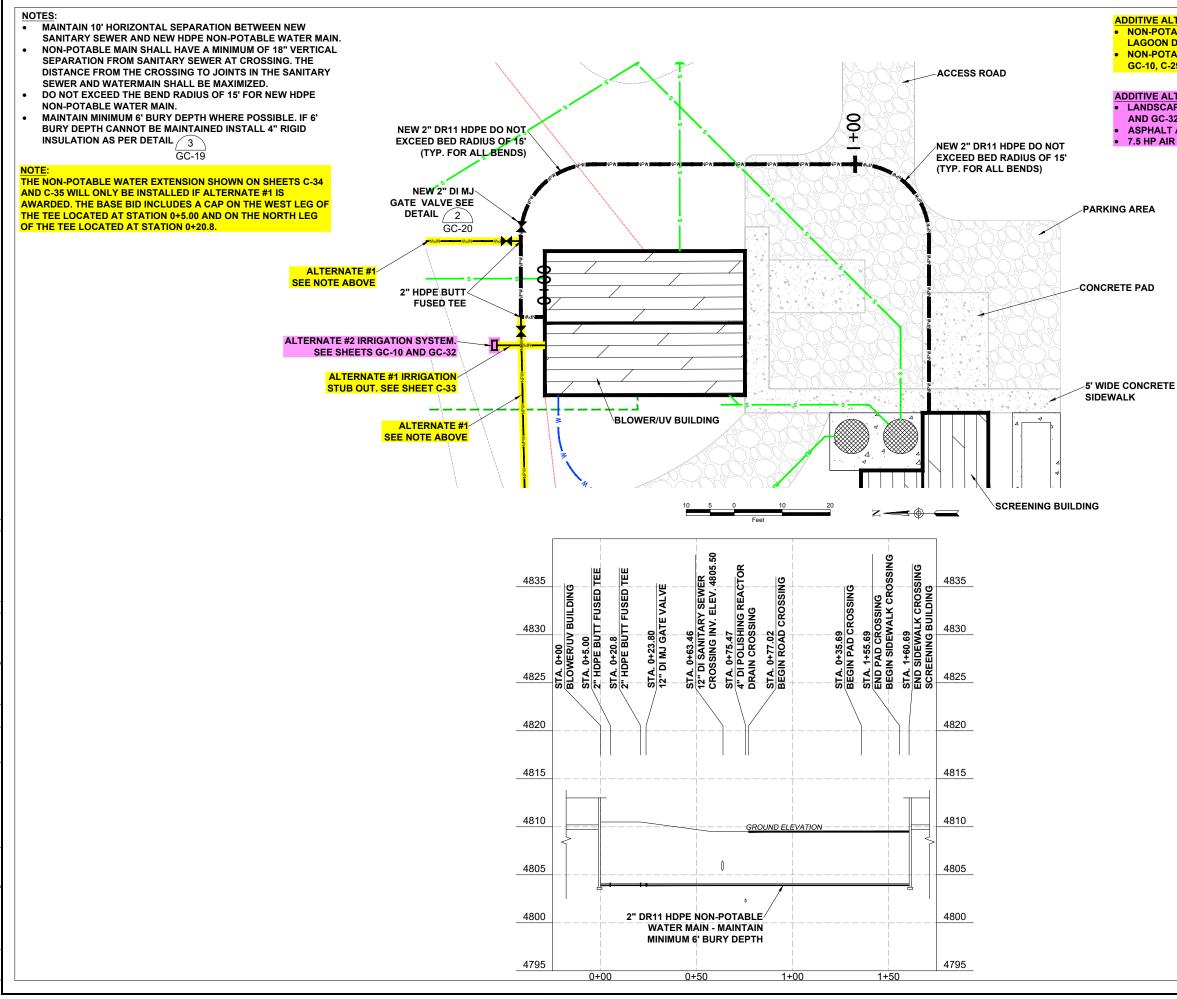




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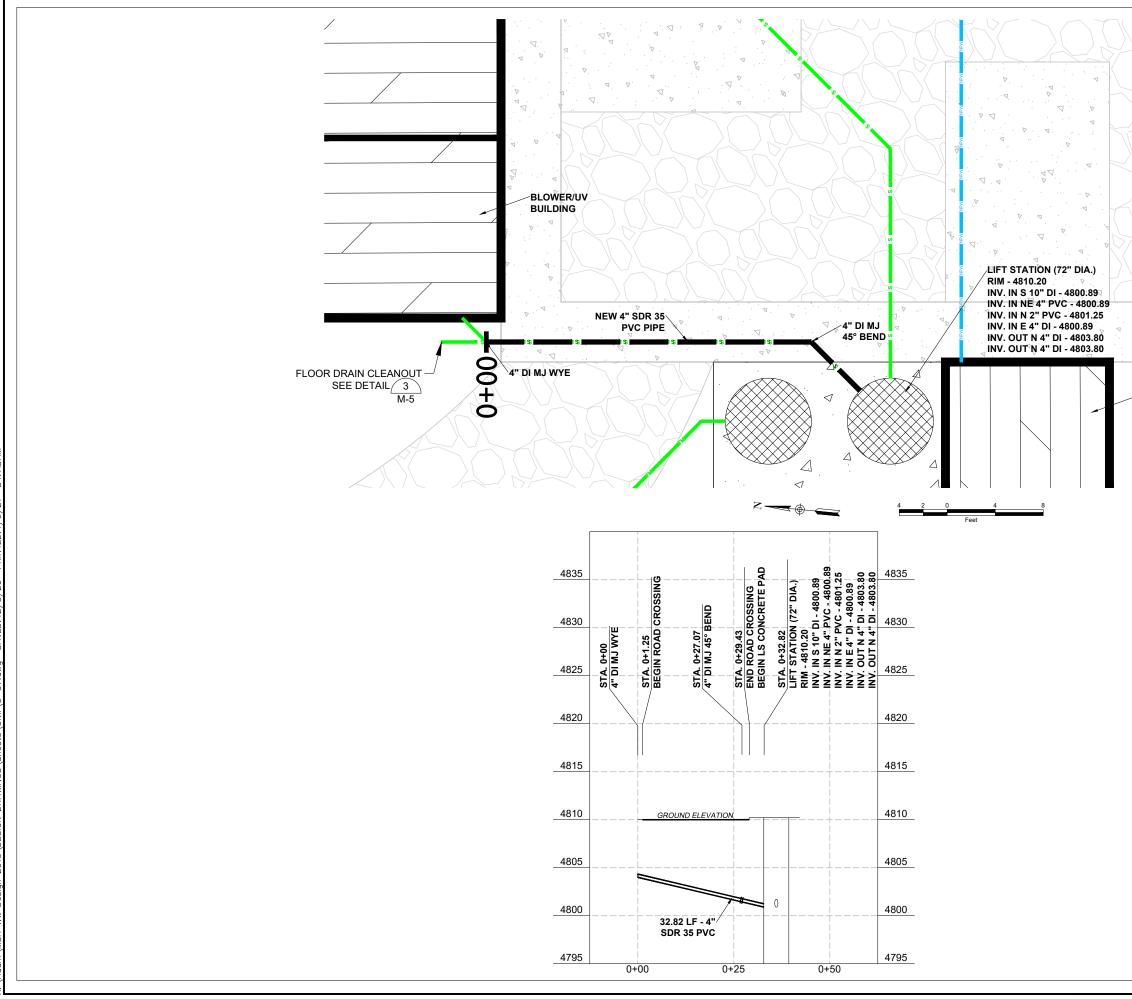
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GOON DIKES - SEE SHEETS C-35 AND C-36.	ADAM ADAM
N-POTABLE WATER IRRIGATION STUB-OUT - SEE SHEETS	COSU2PE AS
-10, C-29, AND C-33.	A LONGE CON
	Baccood A
TIVE ALTERNATE 2: (NOT ALL ITEMS SHOWN ON THIS SHEET)	Revision Date By
NDSCAPING AND IRRIGATION SYSTEM - SEE SHEETS GC-10	Draft 7/21/20 AE
	Draft 8/28/20 AE
PHALT ACCESS ROAD - SEE SHEETS GC-8 & GC-34. HP AIR COMPRESSOR - SEE SHEET C-29.	Final 9/30/20 AE
	Revision
	Final
	Plot Scale
	1:2 Drawn By
	A.Eckhart, P.E. Approved By
	A.Eckhart, P.E.
	Checked By
	P.Montgomery, P.E. Checked By
	S.Anderson, P.E.
	Designed By A.Eckhart, P.E.
	Engineer
	Anderson~ Montgomery
BLE WATER EXTENSION SHOWN ON THIS SHEET	CONSULTING ENGINEERS
NSTALLED IF ALTERNATE #1 IS AWARDED. THE	1064 N. Warren
DES A CAP ON THE WEST LEG OF THE TEE	Helena, Mt 59601 Phone (406) 449-3303
ATION 3+73.6	Fax (406) 449-3304
	Owner
	State Of
	Montana
4835	
	Project Title
4830	
	Montana
4825	State Hospital
	Upgrade
	Wastewater
	System
4820	System
4815	Sheet Title
	Non-Potable
4810	Water Piping
	Plan &
	Profile
4805	
	Sheet
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	C-35
4705	
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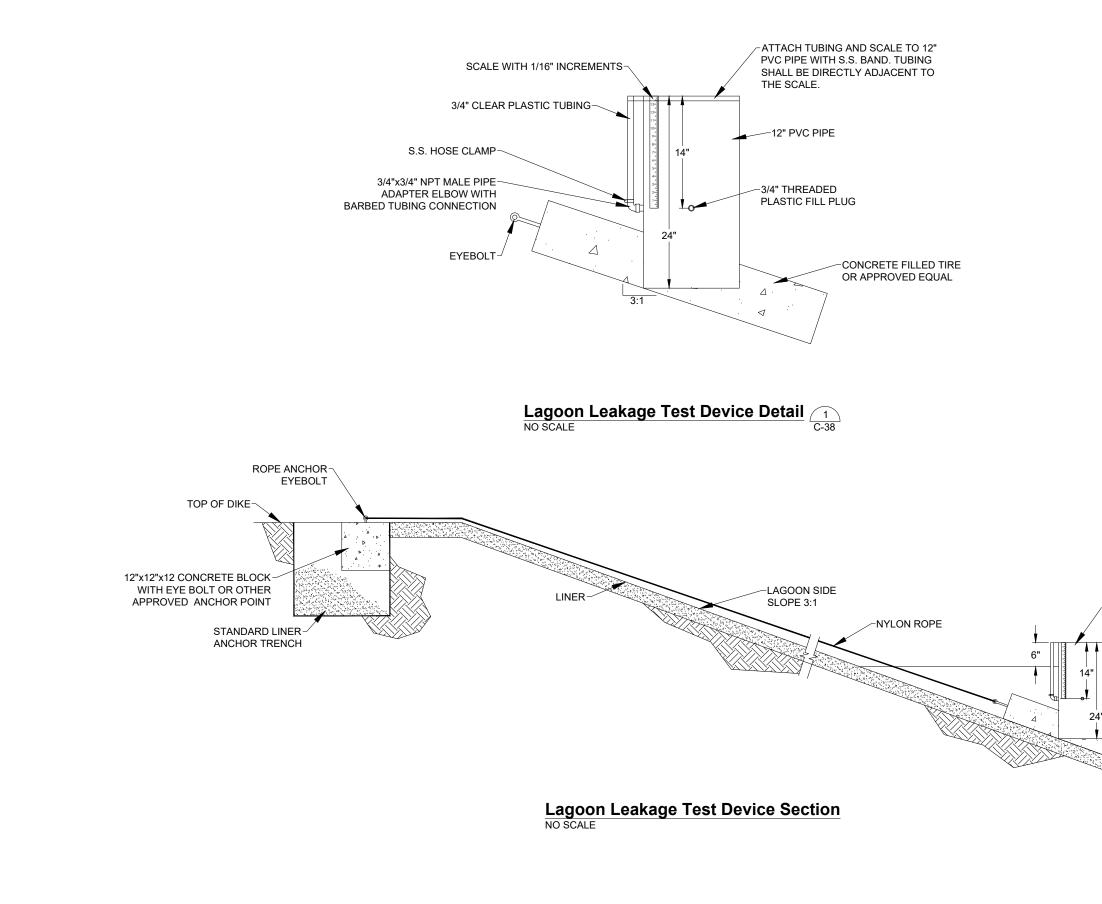
ADDITIVE ALTERNATE 1: (NOT ALL ITEMS SHOWN ON THIS SHEET) NON-POTABLE WATER PIPING TO FROST FREE HYDRANTS ON LAGOON DIKES - SEE SHEETS C-35 AND C-36 NON-POTABLE WATER IRRIGATION STUB-OUT - SEE SHEETS GC-10, C-29, AND C-33. ADDITIVE ALTERNATE 2: (NOT ALL ITEMS SHOWN ON THIS SHEET) LANDSCAPING AND IRRIGATION SYSTEM - SEE SHEETS GC-10 Revision Date Draft 7/21/20 AE AND GC-32 Draft 8/28/20 AE ASPHALT ACCESS ROAD - SEE SHEETS GC-8 & GC-34. • 7.5 HP AIR COMPRESSOR - SEE SHEET C-29. Final 9/30/20 AE Revisio Final Plot Scale 1:2 Drawn By A.Eckhart, P.E. pproved By A.Eckhart, P.E. Thecked By P.Montgomery, P.E. Checked By S.Anderson, P.E. A.Eckhart, P.E. Enginee AAA 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304 State Of Montana Project Title Montana State Hospital Upgrade Wastewater System Sheet Title Non-Potable Water Piping Plan & Profile

C-36

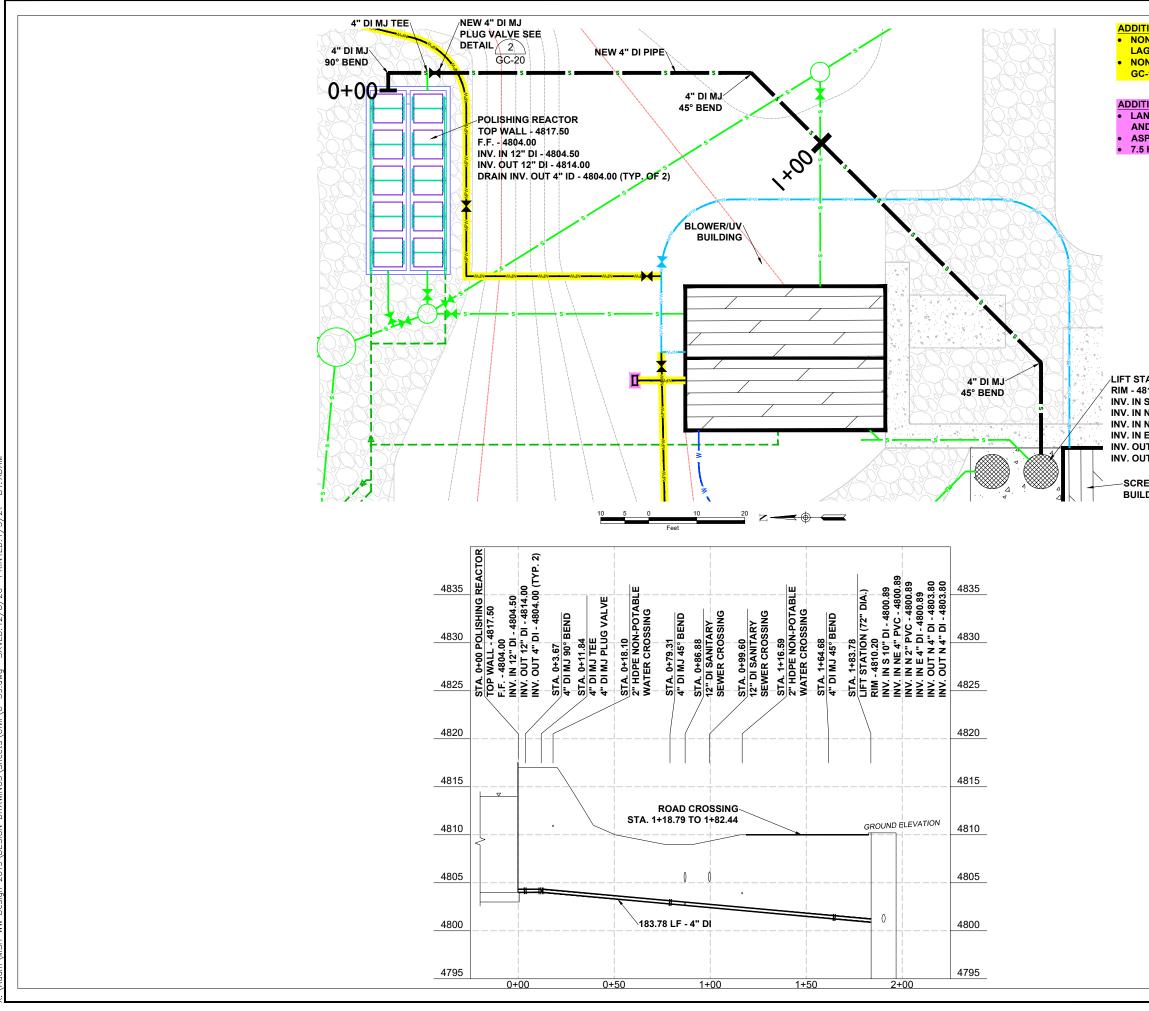
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	Revision Final Plot Scale
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	A.Eckhart, P.E. Approved By A.Eckhart, P.E.
	Checked By P.Montgomery, P.E.
	Checked By S.Anderson, P.E.
	Designed By A.Eckhart, P.E.
، تر.	Engineer
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~SCREENING	Anderson~ Montgomery
BUILDING	consulting engineers 1064 N. Warren
	Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
	Owner
	State Of
	State Of Montana
	Project Title
	Montana State Hospital
	Upgrade
	Wastewater
	System
	Sheet Title
	Blower/UV Building
	Sewer
	Service Plan & Profile
	Sheet
	C-37



	C-38
	Lagoon Leakage Test Device
-12" PVC PIPE WATER SURFACE	Project Title Montana State Hospital Upgrade Wastewater System
	State Of Montana
	Anderson Montgomery consulting engineers 1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
	Revision Final Plot Scale 1:2 Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By P.Montgormery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.
	Revision     Date     By       Draft     7/21/20     AE       Final     9/30/20     AE       Revision     Image: Constraint of the second secon
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ADDITIVE ALTERNATE 1: (NOT ALL ITEMS SHOWN ON THIS SHEET)

NON-POTABLE WATER PIPING TO FROST FREE HYDRANTS ON LAGOON DIKES - SEE SHEETS C-35 AND C-36.
NON-POTABLE WATER IRRIGATION STUB-OUT - SEE SHEETS GC-10, C-29, AND C-33.

ADDITIVE ALTERNATE 2: (NOT ALL ITEMS SHOWN ON THIS SHEET) • LANDSCAPING AND IRRIGATION SYSTEM - SEE SHEETS GC-10 AND GC-32.

ASPHALT ACCESS ROAD - SEE SHEETS GC-8 & GC-34.
 7.5 HP AIR COMPRESSOR - SEE SHEET C-29.

LIFT STATION (72" DIA.) RIM - 4810.20 INV. IN S 10" DI - 4800.89 INV. IN NE 4" PVC - 4800.89 INV. IN N 2" PVC - 4801.25 INV. IN S 3" DI - 4800.89 INV. OUT N 4" DI - 4803.80 INV. OUT N 4" DI - 4803.80

> -SCREENING BUILDING

A CENER A C
Revision         Date         By           Draft         7/21/20         AE           Draft         8/28/20         AE           Final         9/30/20         AE
Revision Final Plot Scale 1:2 Drawn By A.Eckhart, P.E. Approved By A.Eckhart, P.E. Checked By P.Montgomery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E.
Engineer Anderson~ Montgomery
1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
State Of Montana
Project Title Montana State Hospital Upgrade Wastewater System
Sheet Title Polishing Reactor Drain Piping Plan & Profile
Sheet C-39

# DRAWING LEGEND

MARK	DESCRIPTION	MARK	DESCRIPTION
F2.0	FOOTING SYMBOL (REFER TO SPREAD FOOTING SCHEDULE)	I	INDICATES WIDE FLANGE COLUMN
$\langle 1P \rangle$	PILE CAP SYMBOL (REFER TO PILE CAP SCHEDULE)		INDICATES HOLLOW STRUCTURAL SECTION (HSS) COLUMN OR TUBE STEEL (TS) COLUMN
1	TILT-UP/PRECAST CONCRETE WALL CONNECTION SYMBOL (REFER TO CONNECTION DETAIL)	0	INDICATES HOLLOW STRUCTURAL SECTION (HSS) COLUMN OR STEEL PIPE COLUMN
2W4	SHEAR WALL SYMBOL (REFER TO SHEAR WALL SCHEDULE)		INDICATES WOOD POST
$\land$	REVISION TRIANGLE	•	INDICATES BUNDLED STUDS
1	TILT-UP/PRECAST CONCRETE WALL PANEL NUMBER (REFER TO TILT-UP/ PRECAST CONCRETE WALL ELEVATIONS)		INDICATES CONCRETE COLUMN
$\langle 1 \rangle$	CMU WALL REINFORCING SYMBOL (REFER TO CMU WALL REINFORCING SCHEDULE)		INDICATES PRECAST CONCRETE COLUMN
8"	CONTINUITY PLATE LENGTH (REFER TO TYPICAL DETAIL)	<b></b>	INDICATES MOMENT FRAME CONNECTION
DS	INDICATES DOUBLE SHEAR CONNECTION (REFER TO THE DOUBLE SHEAR PLATE CONNECTIONS DETAIL)		INDICATES CANTILEVER CONNECTION
	ROOF/FLOOR DIAPHRAGM NAILING SYMBOL (REFER TO DIAPHRAGM NAILING SCHEDULE)	<del></del>	INDICATES WOOD OR STEEL STUD BEARING WALL LINE PER KEY ON SHEET
C1 XX"xXX"	STEEL/CONCRETE COLUMN SYMBOL (REFER TO STEEL COLUMN SCHEDULE)	₩ OR ₩	INDICATES WOOD OR STEEL STUD SHEAR WALL LINE AND HOLD-DOWN PER KEY ON SHEET
T/FTG = X'-X	ELEVATION SYMBOL (T/ REFERSTO COMPONENT THAT THEELEVATION REFERENCES)	\$777777	INDICATES MASONRY/CMU WALL
3	STUD BUBBLE (INDICATES NUMBER OF STUDS REQUIRED IF EXCEEDS NUMBER SPECIFIED IN PLAN NOTE)	\$ <u>*******</u> \$	INDICATES CONCRETE/TILT-UP CONCRETE WALL
\$	INDICATES STEP IN FOOTING (REFER TO TYPICAL STEP IN FOOTING DETAIL)	\$\$	INDICATES BEARING WALL BELOW
X SX.X	DETAILS OR SECTION CUT (DETAIL NUMBER/SHEET NUMBER)	<b>↓</b>	INDICATES EXISTING WALL
) 00 S0.0	DETAILS OR SECTION CUT IN PLAN VIEW (DETAIL NUMBER/SHEET NUMBER)	<b>þ</b>	POST-TENSION DEAD END (PLAN)
XX/SXX.XX	INDICATES LOCATION OF CONCRETE WALLS, SHEAR WALLS OR BRACED FRAME ELEVATIONS	<b>←+→</b>	POST-TENSION STRESSING END (PLA
	INDICATES DIRECTION OF DECK SPAN		

ABBREVIATIONS					MONTAN4	
					ARCEN	
L	Angle	EXT	Exterior	PJP	Partial Joint Penetration	20 14046PE
AB	Anchor Bolt	FB	Factory-Built	PREFAB	Prefabricated	ONAL ENUM
ADDL ADH	Additional	FD FDN	Floor Drain	PSF PSI	Pounds per Square Foot	""Internation
ALT	Adhesive Alternate	FDN FIN	Foundation Finish	PSL	Pounds Per Square Inch Parallel Strand Lumber	Revision Date By
ARCH	Architectural	FLR	Floor	P-T	Parallel Strand Lumber Post-Tensioned	Draft 7/31
B or BOT	Bottom	FRP	Fiberglass Reinforced Plastic	PT	Pressure Treated	Draft         8/13           Draft         8/25
B/	Bottom Of	FRT	Fire Retardant Treated	R	Radius	Final 9/30
BLDG	Building	FTG	Footing	RD	Roof Drain	
BLKG	Blocking	F/	Face of	REF	Refer/Reference	Revision Final
BMU	Brick Masonry Unit	GA	Gage	REINF	Reinforcing	Plot Scale
BP	Baseplate	GALV	Galvanized	REQD	Required	As Noted Drawn By
BRBF	Buckling Restrained	GEOTECH	Geotechnical	RET	Retaining	. ĎDD
	Braced Frame	GL	Glue Laminated Timber	SB	Site-Built	Approved By MJS
BRG	Bearing	GWB	Gypsum Wall Board	SCBF	Special Concentric	Checked By TPV
BTWN	Between	HDR	Header		Braced Frame	Designed By
C	Camber	HF	Hem-Fir	SCHED	Schedule	TCG
СВ	Castellated Beam	HGR	Hanger	SER	Structural Engineer of	
C'BORE	Counterbore	HD	Hold-down		Record	
CL or CL	Centerline	HORIZ	Horizontal	SFRS	Seismic Force-	
CLT	Cross-Laminated Timber	HP	High Point	-	Resisting System	
CIP	Cast in Place	HSS = TS	(Hollow Structural Section)	SHTHG	Sheathing	Engineer
ĊJ	Construction or	IBC	International Building Code	SIM	Similar	n a c
	Control Joint	ID	Inside Diameter	SLBB	Short Leg Back-to-Back	
CJP	Complete Joint	IE	Invert Elevation	SMF	Special Moment Frame	
	Penetration	IF	Inside Face	SOG	Slab on Grade	ta E. ⊐
CLR	Clear	INT	Interior	SP	Southern Pine	, Mo
CLG	Ceiling	k	Kips	SPEC	Specification	Vesi oula
CMU	Concrete Masonry Unit	KSF	Kips Per Square Foot	SQ	Square	∏
COL	Column	LF	Lineal Foot	SR	Studrail	Owner
CONC	Concrete	LL	Live Load	SF	Square Foot	Owner
CONN	Connection	LLBB	Long Leg Back-to-Back	SST	Stainless Steel	
CONST	Construction	LLH	Long Leg Horizontal	STAGG	Stagger/Staggered	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
CONT	Continuous	LLV	Long Leg Vertical	STD	Standard	State Of
C'SINK	Countersink	LP	Low Point	STIFF	Stiffener	Montana
CTRD	Centered	LONGIT	Longitudinal	STL	Steel	
DIA	Diameter	LSL	Laminated Strand Lumber	STRUCT	Structural	
DB	Drop Beam	LVL	Laminated Veneer Lumber	SWWJ	Solid Web Wood Joist	
DBA	Deformed Bar Anchor	MAS	Masonry	SYM	Symmetrical	Project Title
DBL	Double	MAX	Maximum	Т	Тор	
DEMO	Demolish	MECH	Mechanical	Τ/	Top Of	
DEV	Development	MEZZ	Mezzanine	T&B	Top & Bottom	Montana
DF	Douglas Fir	MFR	Manufacturer	TC AX LD	Top Chord Axial Load	State Hospital
DIAG	Diagonal	MIN	Minimum	TCX	Top Chord Extension	Upgrade
DIST	Distributed	MISC	Miscellaneous	TDS	Tie Down System	Wastewater
DL	Dead Load	NIC	Not In Contract	T&G	Tongue & Groove	System
DN	Down	NLT	Nail-Laminated Timber	THKND	Thickened	
DO	Ditto	NTS	Not To Scale	THRD	Threaded	
DP	Depth/Deep		On Center	THRU	Through	Sheet Title
DWG	Drawing	OCBF	Ordinary Concentric Braced	TRANSV	Transverse	
(E)	Existing		Frame	TYP	Typical	
EA	Each	OD	Outside Diameter	UNO	Unless Noted Otherwise	Legend/Abbr.
EF	Each Face	OF	Outside Face	URM	Unreinforced Masonry	Ligenu/ADDI.
EL	Elevation	OPNG	Opening		Unit	
ELEC	Electrical	OPP	Opposite	VERT	Vertical	
	Elevator	OWSJ	Open Web Steel Joist	W	Wide	
EMBED	Embedment	OWWJ	Open Web Wood Joist	W/	With	Sheet
EQ	Equal	PL	Plate Powder Actuated Eastener	W/O	Without	
EQUIP EW	Equipment	PAF PC	Powder Actuated Fastener	WHS WP	Welded Headed Stud	S-1
EVV EXP	Each Way	PC PERP	Precast		Working Point	
EXP EXP JT	Expansion Expansion Joint	PERP PLWD	Perpendicular Phanood	WWF	Welded Wire Fabric Plus or Minus	
LAF JI	Expansion Joint	FLVVD	Plywood	±	I IUS ULIVIITIUS	

# **STRUCTURAL - GENERAL NOTES**

# **GENERAL REQUIREMENTS**

<u>GOVERNING CODE</u>: The design and construction of this project is governed by the "International Building Code (IBC)", 2018 Edition, hereafter referred to as the IBC, as adopted and modified by the County of Deer Lodge, MT understood to be the Authority Having Jurisdiction (AHJ).

**<u>REFERENCE STANDARDS</u>: Refer to Chapter 35 of 2018 IBC**. Where other Standards are noted in the drawings, use the latest edition of the standard unless a specific date is indicated. Reference to a specific section in a code does not relieve the contractor from compliance with the entire standard.

**DEFINITIONS**: The following definitions cover the meanings of certain terms used in these notes:

"Architect/Engineer" - The Architect of Record and the Structural Engineer of Record.

- "Structural Engineer of Record" (SER) The structural engineer who is licensed to stamp & sign the structural documents for the project. The SER is responsible for the design of the Primary Structural System.
- "Submit for review" Submit to the Architect/SER for review prior to fabrication or construction.
- "Per Plan" Indicates references to the structural plans, elevations and structural general notes.
- "Seismic Force Resisting System (SFRS)" A recognized structural system of components (beams, braces, drags, struts, collectors, diaphragms, columns, walls, etc) of the primary structure that are specially designed and proportioned to resist earthquake-induced ground motions and maintain stability of the structure. Fabrication and installation of components designated as part of the SFRS require the general contractor, subcontractor, or supplier who is responsible for any portion of SFRS fabrication or installation to comply with special requirements (including, but not limited to, material control, compliance certifications, personnel qualifications, documentation, reporting requirements, etc) and to provide the required Quality Control including the required coordination of Special Inspections (Quality Assurance – QA). Special provisions apply to any member designated as part of the SFRS. Refer to plans, elevations, details, Design Criteria and Symbols and Legends for applicable members and connections.
- "Specialty Structural Engineer" (SSE) A professional engineer (PE or SE), licensed in the State
  where the project is located, (typically not the SER), who performs specialty structural engineering
  services for selected specialty-engineered elements identified in the Contract Documents, and who
  has experience and training in the Specialty. Documents stamped and signed by the SSE shall be
  completed by or under the direct supervision of the SSE.
- "Bidder-designed" Components of the structure that require the general contractor, subcontractor, or supplier who is responsible for the design, fabrication and installation of specialty-engineered elements identified in the Contract Documents to retain the services of an SSE. Submittals of "Bidder-designed" elements shall be stamped and signed by the SSE.

**<u>SPECIFICATIONS</u>**: Refer to the project specifications issued as part of the contract documents for information supplemental to these drawings.

**<u>OTHER DRAWINGS</u>**: Refer to the architectural, mechanical, electrical, civil and plumbing drawings for additional information including but not limited to: dimensions, elevations, slopes, door and window openings, non-bearing walls, stairs, finishes, drains, waterproofing, railings, curtain walls, elevators, curbs, depressions, mechanical unit locations, and other nonstructural items.

**STRUCTURAL DETAILS:** The structural drawings are intended to show the general character and extent of the project and are not intended to show all details of the work. Use entire detail sheets and specific details referenced in the plans as "typical" wherever they apply. Similarly, use details on entire sheets with "typical" in the name wherever they apply.

**<u>STRUCTURAL RESPONSIBILITIES</u>**: The structural engineer (SER) is responsible for the strength and stability of the primary structure in its completed form.

**<u>COORDINATION</u>**: The Contractor is responsible for coordinating details and accuracy of the work; for confirming and correlating all quantities and dimensions; for selecting fabrication processes; for techniques of assembly; and for performing work in a safe and secure manner.

**PRE-CONSTRUCTION MEETINGS:** The Contractor is responsible for coordinating pre-construction meetings prior to commencing work. Pre-con meetings, scheduled approximately two weeks prior to the start of the relevant work, are required for the following phases of construction: **Post-tensioned slabs**, **Structural Steel, Cold-Formed Steel, Shotcrete, Concrete, Masonry, Pile Installation, Demolition, Heavy Timber, Cross-Laminated Timber, Wood Framing**. Attendees for pre-construction meeting are to include contractor, relevant subcontractors, fabricators, inspectors, architect/SER, and representative of the Authority Having Jurisdiction where required. Meeting agendas are to include review of the work scope, project schedule relevant to the work, contact information of responsible parties, inspection points, review of materials and any special cases or issues, procedures for clarifications if required, testing and acceptance, etc.

**MEANS, METHODS and SAFETY REQUIREMENTS**: The contractor is responsible for the means and methods of construction and all job-related safety standards such as OSHA and DOSH (Department of Occupational Safety and Health). Contractor is responsible to adhere to OSHA regulations regarding steel erection items specifically addressed in the latest OSHA regulations. Bolting and field welding at all member connections is to be completed prior to the release of the member from the hoisting mechanism unless reviewed and approved by the General Contractor's temporary bracing and shoring design engineer. The construction documents represent the completed structure. The contractor is responsible for means and methods of construction related to the intermediate structural conditions (i.e. movement of the structure due to moisture and thermal effects; construction sequence; temporary bracing, etc).

**BRACING/SHORING DESIGN ENGINEER**: The contractor shall at his discretion employ an SSE, a registered professional engineer for the design of any temporary bracing and shoring.

**TEMPORARY SHORING, BRACING:** The contractor is responsible for the strength and stability of the structure during construction and shall provide temporary shoring, bracing and other elements required to maintain stability until the structure is complete. It is the contractor's responsibility to be familiar with the work required in the construction documents and the requirements for executing it properly.

**<u>CONSTRUCTION LOADS</u>**: Loads on the structure during construction shall not exceed the design loads as noted in DESIGN CRITERIA & LOADS below or the capacity of partially completed construction as determined by the Contractor's SSE for Bracing/Shoring.

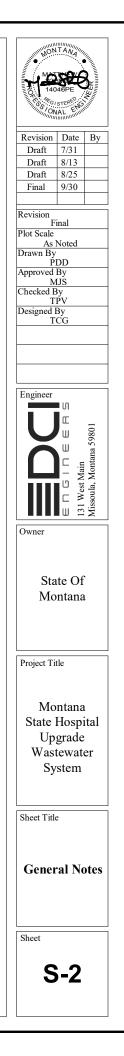
**CHANGES IN LOADING:** The contractor has the responsibility to notify the SER of any architectural, mechanical, electrical, or plumbing load imposed onto the structure that differs from, or that is not documented on the original Contract Documents (architectural / structural / mechanical / electrical or plumbing drawings). Provide documentation of location, load, size and anchorage of all undocumented loads in excess of **400** pounds. Provide marked-up structural plan indicating locations of any new equipment or loads. Submit plans to the Architect/Engineer for review prior to installation.

**NOTE PRIORITIES**: Plan and detail notes and specific loading data provided on individual plans and detail drawings supplements information in the Structural General Notes.

**DISCREPANCIES**: In case of discrepancies between the General Notes, Specifications, Plans/Details or Reference Standards, the Architect/Engineer shall determine which shall govern. Discrepancies shall be brought to the attention of the Architect/Engineer before proceeding with the work. Should any discrepancy be found in the Contract Documents, the Contractor will be deemed to have included in the price the most expensive way of completing the work, unless prior to the submission of the price, the Contractor asks for a decision from the Architect as to which shall govern. Accordingly, any conflict in or between the Contract Documents shall not be a basis for adjustment in the Contract Price.

**<u>SITE VERIFICATION</u>**: The contractor shall verify all dimensions and conditions at the site. Conflicts between the drawings and actual site conditions shall be brought to the attention of the Architect/Engineer before proceeding with the work.

**ADJACENT UTILITIES**: The contractor shall determine the location of all adjacent underground utilities prior to earthwork, foundations, shoring, and excavation. Any utility information shown on the drawings and details is approximate and not necessarily complete.



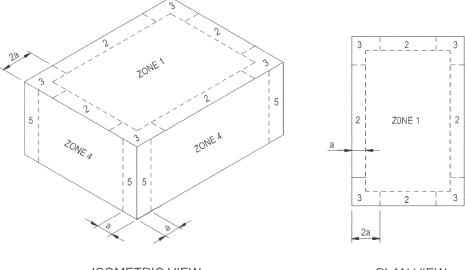
ALTERNATES: Alternate products of similar strength, nature and form for specified items may be submitted with adequate technical documentation (proper test report, etc.) to the Architect/Engineer for review. Alternate materials that are submitted without adequate technical documentation or that significantly deviate from the design intent of materials specified may be returned without review. Alternates that require substantial effort to review will not be reviewed unless authorized by the Owner.

# DESIGN CRITERIA AND LOADS

OCCUPANCY:	Risk Category of Building per 2018 IBC Table 1604.5 =		
------------	-------------------------------------------------------	--	--

WIND DESIGN:	MAIN WIND FORCE RESISTING SYSTEM		
	Ultimate Design Wind Speed, $V_{ULT}$ (MPH)		113
	Exposure Category		В
	Internal Pressure Coefficient	Cpi =	+/- 0.18
	Topographic Factor	Kzt =	1.0
	Wind Analysis procedure used:		Directional

#### WIND DESIGN: **COMPONENTS & CLADDING PRESSURES FOR DESIGN (PSF,** ULTIMATE)



SOME	ETRIC	VIEW

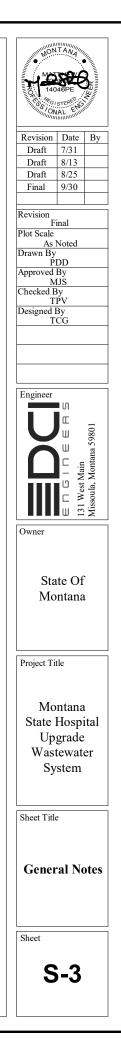
PLAN VIEW

- 1) Components and Cladding Wind Pressures are based on ASCE 7-16 Chapter 30 Part 3: Buildings with h > 60 ft.
- 2) Components and Cladding zone locations are based on ASCE 7-16 Table 30.5-1 for Flat Roofs  $\Theta$  < 10 deg.
- 3) For parapets around the perimeter of the roof equal to or higher than 3 ft, Zone 3 shall be treated as Zone 2.
- 4) All Parapet Components and Cladding Wind Pressures shall be determined through ASCE 7-16 Figure 30.6-2.

Seismic Design Category:	SDC =	С
Basic Structural System		Bearing Wall
Seismic Force Resisting System		Intermediate Pre- cast Concrete Shear Walls
Response Modification Factor:	R =	4 (Intermediate Precast Shear Walls)
System Over Strength Factor	Omega =	2.5
Deflection Amplification Factor	Cd =	4
Site Classification per IBC 1613.3.2 & ASCE 7-16, <b>Site Class =</b>	Ch. 20	D
Seismic Importance Factor per ASCE 7-16 Table 1	.5-2 <b>le =</b>	1.00
Spectral Response Acceleration (Short Period)	S _s =	0.390 g
Spectral Response Acceleration (1-Second Period)	S ₁ =	0.127 g
Spectral Design Response Coefficient (Short Period	d) <b>S</b> _{DS} =	0.387 g
Spectral Design Response Coefficient (1-Second P	eriod) <b>S_{DI} =</b>	0.194 g
Seismic response coefficient(s)	Cs =	0.114
Redundancy Factor (North/South Direction)	N/S rho=	1.0
Redundancy Factor (East / West Direction)	E/W rho=	1.0
Design Base Shear (North/South Direction)	(KIPS)	16.7 (Screening Building) 18 (Blower Build- ing)
Design Base Shear (East / West Direction)	(KIPS)	16.7 (Screening Building) 18 (Blower Build- ing)
Base shear governed by:		Seismic
Seismic Analysis procedure used:		Equivalent Lateral Force (ELF)

SEISMIC

DESIGN:



SNOW LOAD: (1)	Flat Roof Snow Load, (PSF)	р _f =	<b>30</b> ⁽²⁾
	Snow Drift Loading required by Authority Having Jurisdiction?		Yes
	Snow Load Importance Factor	I _s =	<b>0.8</b> ⁽³⁾
	Ground Snow Load, (PSF)	р _g =	32
	Snow Exposure Factor	C $_{\rm e}$ =	1.0
	Thermal Factor	<b>C</b> _t =	1.0
	Snow Drift Loading – Against High Wall (Screening Building) Snow Drifting Loading – Unbalanced (Blower Building)		70 psf 51 psf (within 7' of ridge)

1) Snow Load is un-reducible and includes 5 psf rain-on-snow surcharge where ground snow load is greater than zero and 20 psf or less per ASCE 7-16 Section 7.10.

Snow Load based on Montana Ground Snow Load Finder. 2)

3) Snow Load Importance Factor per ASCE 7-16 Table 1.5-2.

DESIGN LIVE LOADS	AREA	LIVE LOADS (PSF) UNO	REMARKS & FOOT- NOTES (6)
	Handrails & Pedestrian Guardrails	50 PLF or 200 LB	(1)
	Stairs & Exits	100 PSF or 300 LB	Stair treads per note (2)
	Vehicle Barrier	6000 lbs	Applied horizontally at both 18" and 27" above the level (3)
	Platforms	125	1000 lb conc. load
	Mechanical Rooms	150	

(1) Top rail shall be designed to resist 50 PLF line load or 200 lb point load applied in any direction at any point. Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 LB on an area not to exceed 1 ft square. These three loads are to be considered separately with worst case used for design.

(2) Place 300 lb concentrated load over 2"x2" area at any point to produce maximum stress. Area load and concentrated load are to be considered separately with worst case used for design.

(3)Need not apply concurrently with other handrail and guardrail loads; applied over not more than 1 square foot.

DESIGN DEAD LOADS	BIDDER DESIGN	DEAD LOADS (PSF) UNO	REMARKS & FOOTNOTES
	Roof	<u>5 PSF</u>	Additional

# SUBMITTALS

**SUBMIT FOR REVIEW:** SUBMITTALS of shop drawings, product data are required for items noted in the individual materials sections and for bidder designed elements.

SUBMITTAL REVIEW PERIOD: Submittals shall be made in time to provide a minimum of TWO WEEKS or 10 WORKING DAYS for review by the Architect/Engineer prior to the onset of fabrication.

GENERAL CONTRACTOR'S PRIOR REVIEW: Prior to submission to the Architect/Engineer, the Contractor shall review the submittal for completeness. Dimensions and quantities are not reviewed by the SER, and therefore, must be verified by the General Contractor. Contractor shall provide any necessary dimensional details requested by the Detailer and provide the Contractor's review stamp and signature before forwarding to the Architect/Engineer.

SHOP DRAWING REVIEW: Once the contractor has completed his review, the SER will review the submittal for general conformance with the design concept and the contract documents of the building and will stamp the submittal accordingly. Markings or comments shall not be construed as relieving the contractor from compliance with the project plans and specifications, nor departures there from. The SER will return submittals in the form they are submitted in (either hard copy or electronic). For hard copy submittals, the contractor is responsible for submitting the required number of copies to the SER for review.

SHOP DRAWING DEVIATIONS: When shop drawings (component design drawings) differ from or add to the requirements of the structural drawings they shall be designed and stamped by the responsible SSE.

# **DEFERRED SUBMITTALS**

# **BIDDER-DESIGNED ELEMENTS**

Submit "Bidder-Designed" deferred submittals to the Architect and SER for review. The deferred submittals shall also be submitted to the city for approval, if required by the city.

Design of prefabricated, "bidder designed", manufactured, pre-engineered, or other fabricated products shall comply with the following requirements:

- 1) Design considers tributary dead, live, wind and earthquake loads in combinations required by IBC.
- Design within the Deflection Limits noted herein and as specified or referenced in the IBC.
- 3) Design shall conform to the specifications and reference standards of the governing code.
- Submittal shall include:
  - a. Calculations prepared, stamped and signed by the SSE demonstrating code conformance
  - b. Engineered component design drawings are prepared, stamped and signed by the SSE.
  - approvals as applicable.
  - d. SSE may submit to the Architect/Engineer, a request to utilize relevant alternate design criteria of similar nature and generally equivalency which is recognized by the Code and acceptable to the Authority Having Jurisdiction. Submit adequate documentation of design.

DEFLECTION	VERTICAL	LIMIT
LIMITS FOR SSE / BIDDER	Roof Members, Dead + Live or Snow or Wind, Total Load (TL) Deflection	L / 240, where (L is span length,inches)
DESIGNED	Roof, Live or Snow or Wind Load (RLL)	L / 360
ELEMENTS:	Floor Members, Total Load (TL) uno	L / 240
	Floor Live Load (LL) uno	L / 360
	HORIZONTAL	LIMIT and FOOTNOTE
	Members Supporting Brittle Finishes	L/240 (1)
	Members Supporting Flexible Finishes	L/180 (1)

(1) Wind Load is reducible to 0.42 times the Component and Cladding Loads per Table 1604.3 footnote f.

GENERAL CONTRACTOR'S PRIOR REVIEW: Once the contractor has completed his review of the SSE component drawings, the SER will review the submittal for general conformance with the design of the building and will stamp the submittal accordingly. Review of the Specialty Structural Engineer's (SSE) shop drawings (component design drawings) is for compliance with design criteria and compatibility with the design of the primary structure and does not relieve the SSE of responsibility for that design. All necessary bracing, ties, anchorage, proprietary products shall be furnished and installed per manufacturer's instructions or the SSE's design drawings and calculations. These elements include but are not limited to:

c. Product data, technical information and manufacturer's written requirements and Agency

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- Exterior Cladding Systems: Curtain Wall Systems, Pre-engineered Panels
- **Temporary Shoring Systems** .
- Precast Structural Elements

# INSPECTIONS. QUALITY ASSURANCE VERIFICATIONS AND TEST REQUIREMENTS

INSPECTIONS: Foundations, footings, under slab systems and framing are subject to inspection by the Building Official in accordance with IBC 110.3. Contractor shall coordinate all required inspections with the Building Official.

SPECIAL INSPECTIONS, VERIFICATIONS and TESTS: Special Inspections, Verifications and Testing shall be done in accordance with IBC Chapter 17, the STATEMENT AND SCHEDULES OF SPECIAL IN-SPECTIONS listed in these drawings.

### STRUCTURAL OBSERVATION: per IBC Section 1704.6

Structural Observation is the visual observation of the structural system by a registered design professional for general conformance to the approved construction documents. It is not always required on a project, does not include or waive the responsibility for the special inspections and tests required by a Special Inspector per IBC Chapter 17, is not continuous, and does not certify conformance with the approved construction documents.

Structural Observation for this project is required per IBC Section 1704.6. Contractor shall notify the SER in a timely manner to allow required Structural Observations to occur. Reports will be distributed to the Architect, the Contractor, Special Inspector and the Authority Having Jurisdiction.

The frequency and extent of observations is at the discretion of the structural observer. Only significant stages of construction identified by the Structural Observer require observation. For repetitive or similar structural elements identified as significant, only the first element of a stage requires observation unless noted otherwise. The following significant stages of construction require observation: prior to foundation concrete placement, prior to shear wall concrete placement, shear wall construction, during the first elevated floor framing, during roof framing, and after roof diaphragm is complete prior to roofing.

CONTRACTOR RESPONSIBILITY: Prior to issuance of the building permit, the Contractor is required to provide the Authority Having Jurisdiction a signed, written acknowledgement of the Contractor's responsibilities associated with the above Statement of Special Inspections addressing the requirements listed in IBC Section 1704.4. Contractor is referred to IBC Sections 1705.12.5 and 1705.12.6 for architectural and MEP building systems that may be subject to additional inspections (based on the building's designated Seismic Design Category listed in the CRITERIA), including anchorage of HVAC ductwork containing hazardous materials, piping systems and mechanical units containing flammable, combustible or highly toxic materials, electrical equipment used for emergency or standby power, exterior wall panels and suspended ceiling systems.

# SOILS AND FOUNDATIONS

REFERENCE STANDARDS: Conform to IBC Chapter 18 "Soils and Foundations."

GEOTECHNICAL REPORT: Recommendations contained inMontana State Hospital Treatment Plant Geotechnical Report by Pioneer Technical Services, Inc. dated September 2019 were used for design.

CONTRACTOR'S RESPONSIBILITIES: Contractor shall be responsible to review the Geotechnical Report and shall follow the recommendations specified therein including, but not limited to, subgrade preparations, pile installation procedures, ground water management and steep slope Best Management Practices."

GEOTECHNICAL SUBGRADE INSPECTION: The Geotechnical Engineer shall inspect all sub-grades and prepared soil bearing surfaces, prior to placement of foundation reinforcing steel and concrete. Geotechnical Engineers shall provide a letter to the owner stating that soils are adequate to support the "Allowable Foundation Bearing Pressure(s)" shown below. Assumed values shall be field verified by the Building Official or the Geotechnical Engineer prior to placing concrete.

### **DESIGN SOIL VALUES:**

Safety Factor per Soils Report	1.5
Allowable Foundation Bearing Pressure	3000 F
Passive Lateral Pressure	222 P
Active Lateral Pressure (unrestrained)	37 PS
At-Rest Lateral Pressure (restrained)	53 PS
Seismic Lateral Pressure	
Coefficient of Sliding Friction	0.4

FOUNDATIONS and FOOTINGS: Foundations shall bear either on competent native soil or compacted structural fill as per the geotechnical report. Exterior perimeter footings shall bear not less than 36 inches below finish grade, unless otherwise specified by the geotechnical engineer and/or the building official.

FOOTING DEPTH: Tops of footings shall be as shown on plans with vertical changes as indicated with steps in the footings; locations of steps shown as approximate and shall be coordinated with the civil grading plans.

SLABS-ON-GRADE: All slabs-on-grade shall bear on compacted structural fill or competent native soil per the geotechnical report. All moisture sensitive slabs-on-grade or those subject to receive moisture sensitive coatings/ covering shall be provided with an appropriate capillary break and vapor barrier/retardant over the subgrade prepared and installed as noted in the geotechnical report, barrier manufacturer's written recommendations and coordinated with the finishes specified by the Architect.

# **CAST-IN-PLACE CONCRETE**

**REFERENCE STANDARDS: Conform to:** 

- (1) ACI 301-16 "Specifications for Structural Concrete"
- (2) IBC Chapter 19 "Concrete"
- (3) ACI 318-14 "Building Code Requirements for Structural Concrete" (4) ACI 117-10 "Specifications for Tolerances for Concrete Construction and Materials"

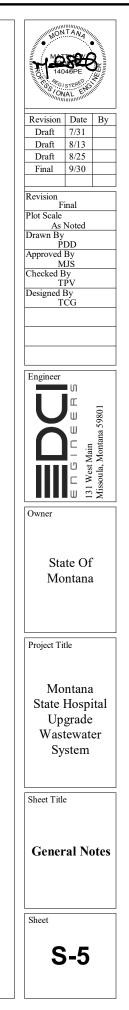
FIELD REFERENCE: The contractor shall keep a copy of ACI Field Reference manual, SP-15, "Standard Specifications for Structural Concrete (ACI 301) with Selected ACI and ASTM References.'

CONCRETE MIXTURES: Conform to ACI 301 Section 4 "Concrete Mixtures" and IBC Section 1904.1.

MATERIALS: Conform to ACI 301 Section 4.2.1 "Materials" for requirements for cementitious materials, aggregates, mixing water and admixtures.

SUBMITTALS: Provide all submittals required by ACI 301 Section 4.1.2. Submit mix designs for each mix in the table below. Substantiating strength results from past tests shall not be older than 24 months per ACI 318 Section 26.4.3.1 (b).

PSF PSF/FT SF/FT SF/FT SF/FT



# TABLE OF MIX DESIGN REQUIREMENTS

Member Type/Location	Strength f'c (psi)	Test Age (days)	Nominal Maximum Aggregate	Exposure Class	Max W/C Ratio	Air Con- tent	Notes (1 to 9 Typical UNO)
Interior Spread Footings/ Slabs on Grade	4500	28	1"	-	0.45	-	10
Exterior Slabs on Grade	4500	28	1"	F2	0.45	5%	
Slabs on Metal Deck	4500	28	1"	-	-	-	-
Interior Precast Concrete Shear Walls	5000	-	-				
Exterior Precast Concrete Shear Walls	5000	-	-	F2	0.45	5%	-
Foundation Walls/Strip Footings	4500	28	1"	F2	0.45	6%	-

Table of Mix Design Requirements Notes:

- (1) W/C Ratio: Water-cementitious material ratios shall be based on the total weight of cementitious materials. Maximum ratios are controlled by strength noted in the Table of Mix Design Requirements and durability requirements given in ACI 318 Section 19.3.
- (2) Cementitious Materials:
  - The use of fly ash, other pozzolans, silica fume, or slag shall conform to ACI 318 Sections 19.3.2 and a. 26.4.2.2. Maximum amount of fly ash shall be 25% of total cementitious content unless reviewed and approved otherwise by SER.
  - b. For concrete used in elevated floors, minimum cementitious-materials content shall conform to ACI 301 Table 4.1.2.9. Acceptance of lower cement content is contingent on providing supporting data to the SER for review and acceptance.
  - Cementitious materials shall conform to the relevant ASTM standards listed in ACI 318 Section C. 26.4.1.1.1(a).
- (3) Air Content: Conform to ACI 318 Section 19.3.3.1. Minimum standards for exposure class are noted in the table. If freezing and thawing class is not noted, air content given is that required by the SER. Tolerance is  $\pm 1-\frac{1}{2}$ %. Air content shall be measured at point of placement.
- (4) Aggregates shall conform to ASTM C33.
- (5) Slump: Conform to ACI 301 Section 4.2.2.2. Slump shall be determined at point of placement.
- (6) Chloride Content: Conform to ACI 318 Table 19.3.2.1.
- (7) Non- chloride accelerator: Non-chloride accelerating admixture may be used in concrete placed at ambient temperatures below 50°F at the contractor's option.
- (8) ACI 318, Section 19.3.1.1 exposure classes shall be assumed to be F2 unless different exposure classes are listed in the Table of Mix Design Requirements that modify these base requirements.

FORMWORK & RESHORING: Conform to ACI 301 Section 2 "Formwork and Form Accessories." Removal of Forms shall conform to Section 2.3.2 except strength indicated in Section 2.3.2.5 shall be 0.75 f' c.

MEASURING, MIXING, AND DELIVERY: Conform to ACI 301 Section 4.3.

HANDLING, PLACING, CONSTRUCTING AND CURING: Conform to ACI 301 Section 5. In addition, hot weather concreting shall conform to ACI 305R-10 and cold weather concreting shall conform to ACI 306R-10.

CONSTRUCTION JOINTS: Conform to ACI 301 Sections. 2.2.2.5 and 5.3.2.6. Construction joints shall be located and detailed as on the construction drawings. Submit alternate locations per ACI 301 Section 5.1.2.4 (a) for review and approval by the SER two weeks minimum prior to forming. Use of an acceptable adhesive, surface retardant, portland cement grout or roughening the surface is not required unless specifically noted on the drawings.

EMBEDDED ITEMS: Position and secure in place expansion joint material, anchors and other structural and non-structural embedded items before placing concrete. Contractor shall refer to mechanical, electrical, plumbing and architectural drawings and coordinate other embedded items.

GROUT: Use 7000 psi non-shrink grout under column base plates and under tilt-up panels.

GROUTED REBAR: See Post-Installed Anchors to Concrete.

POST-INSTALLED ANCHORS to CONCRETE: Anchor location, type, diameter and embedment shall be as indicated on drawings. Reference the POST INSTALLED ANCHORS section for applicable Post-Installed Anchor Adhesives. Anchors shall be installed and inspected in strict accordance with the applicable ICC-Evaluation Service Report (ESR). Special inspection shall be per the TESTS and INSPECTIONS section.

SHRINKAGE: Conventional and post-tensioned concrete slabs will continue to shrink after initial placement and stressing of concrete. Contractor and subcontractor shall coordinate jointing and interior material finishes to provide adequate tolerance for expected structural frame shrinkage and shall include, but not be limited to: curtain wall, dryvit, storefront, skylight, floor finish, and ceiling suppliers. Contact Engineer for expected range of shrinkage.

### STRENGTH TESTING AND ACCEPTANCE:

Testing: Obtain samples and conduct tests in accordance with ACI 301 Section 1.6.3.2. Additional samples may be required to obtain concrete strengths at alternate intervals than shown below.

- Cure 4 cylinders for 28-day test age [Cure 6 cylinders for 28-day test age post-tensioned concrete. Test 2 cylinders at 2 or 3 days for post-tensioned concrete only, ] test 1 cylinder at 7 days, test 2 cylinders at 28 days, and hold 1 cylinder in reserve for use as the Engineer directs. After 56 days, unless notified by the Engineer to the contrary, the reserve cylinder may be discarded without being tested for specimens meeting 28-day strength requirements.
- The number of cylinders indicated above reference 6 by 12 in cylinders. If 4 by 8 in cylinders are to be used, additional cylinders must be cured for testing of 3 cylinders at test age per the table of mix design requirements.

Acceptance. Strength is satisfactory when:

- (1) The averages of all sets of 3 consecutive tests equal or exceed the specified strength.
- (2) No individual test falls below the specified strength by more than 500 psi.

A "test" for acceptance is the average strength of two 6 by 12 in. cylinders or three 4 by 8 in. cylinders tested at the specified test age.

CONCRETE PLACEMENT TOLERANCE: Conform to ACI 117-10 for concrete placement tolerance.



CONCRETE COVER: Conform to the following cover requirements unless noted otherwise in the drawings.

Concrete cast against earth	. 3"
Concrete exposed to earth or weather	
Ties in columns and beams	
Bars in slabs	. 3⁄4"
Bars in walls	. 3⁄4"
Exterior bars in Tilt-up Panels	. 1"

SPLICES: Conform to ACI 301, Section 3.3.2.7, "Splices". Refer to "Typical Lap Splice and Development Length Schedule" for typical reinforcement splices. Splices indicated on individual sheets shall control over the schedule. Mechanical connections may be used when approved by the SER. FIELD BENDING: Conform to ACI 301 Section 3.3.2.8. "Field Bending or Straightening." Bar sizes #3 through #5 may be field bent cold the first time. Subsequent bends and other bar sizes require preheating. Do not twist bars. Bars shall not be bent past 45 degrees.

WATERSTOPS: Provide waterstops where indicated on drawings. Waterstops shall be Sika Greenstreak PVC, profile 703 or approved equal. Install waterstops in strict accordance with manufacturer's written instructions.

# **CONCRETE REINFORCEMENT**

**REFERENCE STANDARDS: Conform to:** 

- (1) ACI 301-16 "Standard Specifications for Structural Concrete", Section 3 "Reinforcement and Reinforcement Supports."
- (2) ACI SP-66(04) "ACI Detailing Manual"
- (3) CRSI MSP-09, 28th Edition, "Manual of Standard Practice."
- (4) ANSI/AWS D1.4: 2005, "Structural Welding Code Reinforcing Steel."

(5) IBC Chapter 19-Concrete.

- (6) ACI 318-14 "Building Code Requirements for Structural Concrete."
- (7) ACI 117-10 "Specifications for Tolerances for Concrete Construction and Materials"

SUBMITTALS: Conform to ACI 301 Section 3.1.2 "Submittals." Submit placing drawings showing fabrication dimensions and placement locations of reinforcement and reinforcement supports.

LIFTING REQUIREMENTS for Tilt-Up Panels or Precast Plank: The contractor is responsible for temporarily bracing the panels against wind or other forces that may occur during construction and until connections to the permanent structural system are completed.

# MATERIALS:

Reinforcing Bars	. ASTM A615, Grade 60, deformed bars.
-	ASTM A706, Grade 60, deformed bars.
Smooth Welded Wire Fabric	. ASTM A1064
Deformed Welded Wire Fabric	. ASTM A1064
	. CRSI MSP-09, Chapter 3 "Bar Supports."
Tie Wire	. 16 gage or heavier, black annealed.
Stud Rails	. ASTM A1044
Headed Deformed Bars	. ASTM A970

FABRICATION: Conform to ACI 301, Section 3.2.2. "Fabrication", and ACI SP-66 "ACI Detailing Manual."

WELDING: Bars shall not be welded unless authorized. When authorized, conform to ACI 301, Section 3.2.2.2. "Welding", AWS D1.4, and provide ASTM A706, grade 60 reinforcement.

PLACING: Conform to ACI 301, Section 3.3.2 "Placing." Placing tolerances shall conform to ACI 117.

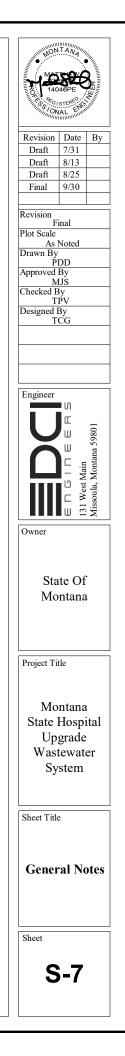
# POST-INSTALLED ANCHORS (INTO CONCRETE AND MASONRY)

**REFERENCE STANDARDS:** Conform to:

- 1) IBC Chapter 19 "Concrete"
- 2) ACI 318-14 "Building Code Requirements for Structural Concrete"
- 3) IBC Chapter 21 "Masonry"
- 4) TMS402-16 "Building Code Requirements for Masonry Structures"

POST-INSTALLED ANCHORS: Install only where specifically shown in the details or allowed by SER. All post-Installed anchors types and locations shall be approved by the SER and shall have a current ICC-Evaluation Service Report that provides relevant design values necessary to validate the available strength exceeds the required strength. Submit current manufacturer's data and ICC ESR report to SER for approval regardless of whether or not it is a pre-approved anchor. Anchors shall be installed in strict accordance to ICC-ESR and the manufacturer's printed installation instructions (MPII) in conjunction with edge distance, spacing and embedment depth as indicated on the drawings. The contractor shall arrange for a manufacturer's field representative to provide installation training for all products to be used, prior to the commencement of work. Only trained installer shall perform post installed anchor installation. A record of training shall be kept on site and be made available to the SER as requested. Adhesive anchors installed in horizontally or upwardly inclined orientation shall be performed by a certified adhesive anchor installer (AAI) as certified through ACI/CRSI or approved equivalent. Proof of current certification shall be submitted to the engineer for approval prior to commencement of installation. No reinforcing bars shall be damaged during installation of post-installed anchors. Special inspection shall be per the TESTS and INSPECTIONS section. Anchor type, diameter and embedment shall be as indicated on drawings.

- 1. ADHESIVE ANCHORS: The following Adhesive-type anchoring systems have been used in the design and shall be used for anchorage to CONCRETE, as applicable and in accordance with corresponding current ICC ESR report. Reference the corresponding ICC ESR report for required minimum age of concrete, concrete temperature range, moisture condition, light weight concrete, and hole drilling and preparation requirements. Drilled-in anchor embedment lengths shall be as shown on drawings, or not less than 7 times the anchor nominal diameter (7D). Adhesive anchors are to be installed in concrete aged a minimum of 21 days, unless otherwise specified in the ICC ESR report.
  - a. [HILTI "HIT-HY 200" ICC ESR-3187 for anchorage to CONCRETE with embedment depth less than or equal to 20 bar diameters]
  - b. [SIMPSON "SET-XP" ICC ESR 2508 for anchorage to CONCRETE], [IAPMO 265 for anchorage to MASONRY
- 2. [SCREW ANCHORS: The following Screw type anchor is pre-approved for anchorage to CONCRETE or MASONRY in accordance with corresponding current ICC ESR report:



# STRUCTURAL STEEL

# **REFERENCE STANDARDS:** Conform to:

- 1) IBC Chapter 22 "Steel"
- ANSI/AISC 303-16 "Code of Standard Practice for Steel Buildings & Bridges" 2)
- AISC "Manual of Steel Construction", Fifteenth Edition (2016) 3)
- ANSI/AISC 360-16 "Specification for Structural Steel Buildings" 4)
- AWS D1.1:2015 "Structural Welding Code Steel" 5)
- 6) 2014 RCSC "Specification for Structural Joints using High-Strength Bolts"

SUBMITTALS: Submit the following documents to the SER for review:

- (1) SHOP DRAWINGS complying with AISC 360 Sections M1and N3 and AISC 303 Section 4.
- (2) ERECTION DRAWINGS complying AISC 360 Sections M1and N3 and AISC 303 Section 4.

Make copies of the following documents "Available upon Request" to the SER or Owner's Inspection Agency in electronic or printed form prior to fabrication per AISC 360 Section N3.2 requirements:

- (1) Fabricator's written Quality Control Manual that includes, as a minimum:
  - a. Material Control Procedures
  - b. Inspection Procedures
  - c. Non-conformance Procedures
- (2) Steel & Anchor Rod suppliers' Material Test Reports (MTR's) indicating the compliance with specifications.
- (3) Fastener manufacturer's Certification documenting conformance with the specification.
- (4) <u>Filler metal manufacturer's product data</u> for SMAW, FCAW and GMAW indicating:
  - a. Product specification compliance
  - Recommended welding parameters b.
  - Recommended storage and exposure requirements including baking C.
  - d. Limitations of use
- (5) Welded Headed (Shear) Stud Anchors Manufacturer's certification indicating the meet specifications
- Weld Procedure Specifications (WPS's) for shop and field welding. (6)
- Manufacturer's Certificates of Conformance for electrodes, fluxes and gases (welding consumables).
- (8) Procedure Qualification Records (PQR's) for WPS's that are not pregualified in accordance with AWS.
- (9) Welding personnel Performance Qualification Records (WPQR) and continuity records conforming to AWS standards.

#### MATERIALS:

Structural steel materials shall conform to materials and requirements listed in AISC 360 section A3 including, but not limited to:

<b>U</b> '	
	Wide Flange (W), Tee (WT) ShapesASTM A992 Fy = 50 ksi
	Structural (S), (M) & (HP) ShapesASTM A36, Fy = 36 ksi
	Channel (C) & Angle (L) ShapesASTM A36, Fy = 36 ksi
	Structural Plate (PL)ASTM A36, Fy = 36 ksi
	High Strength Plate (Gr 50 PL)ASTM A572, Fy = 50 ksi
	Hollow Structural Section – Square/Rect (HSS)ASTM A500, Grade C Fy = 50 ksi
	Structural Pipe, (PIPE) 12" dia. and lessASTM A53, Grade B Fy = 35 ksi
	High Strength, Heavy Hex Structural BoltsASTM F3125 Gr. A325/F1852, Type 1 or 3, Plain
	Heavy Hex NutsASTM A563, Grade and Finish per RCSC Table 2.1
	Washers (Hardened Flat or Beveled)ASTM F436, Grade and Finish per RCSC Table 2.1
	Anchor Rods (Anchor Bolts, typical)ASTM F1554, Gr. 36
	Anchor Rods (High Strength)ASTM F1554, Gr. 55 (weldable) per Supplement S1
	Welded Headed (shear) Stud AnchorsASTM A108 – Nelson/TRW S3L
	Welded Headed Stud (WHS) AnchorsASTM A108 – Nelson/TRW H4L
	Dowel Bar Anchors (DBA)ASTM A496 – Nelson/TRW D2L, Fy = 70 ksi

### STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS:

- 1) ASTM F3125 Gr. A325-N bolts- "threads NOT excluded in the shear plane".
- 2) High-strength bolted joints have been designed as "BEARING" connections.
- 3) Provide ASTM Bolt Grade and Type as specified in the Materials section above.

- 4) Provide Washers over outer ply of slotted holes and oversize holes per RCSC Table 6.1.
- Provide Nut and Washer grades, types and finishes conforming to RCSC specification Table 2.1. 5)
- Provide *fastener assemblies* from a single supplier. 6)
- Joint Types shall be ST "Snug Tight", for typical beam end "shear" connections, unless noted other-7) wise
- Install bolts in joints in accordance with the RCSC Specification Section 8 and Table 4.1. 8)
- 9) Inspection is per RCSC Section 9.

### ANCHORAGE to CONCRETE:

- 1) SHEAR STUDS on STEEL BEAMS for COMPOSITE CONSTRUCTION: Headed Shear Studs welded to tops of Wide Flance Beams, shall be 3/4" diameter WHS with nominal stud lengths as indicated. Unless noted otherwise, provide minimum shear stud height equal to the (metal deck depth + 1  $\frac{1}{2}$  and a maximum shear stud height that allows for  $\frac{1}{2}$  of concrete cover over the stud.
- EMBEDDED STEEL PLATES for Anchorage to Concrete: Plates (PL) embedded in concrete with 2) studs (WHS) or dowel bar anchors (DBA) shall be of the sizes and lengths as indicated on the plans with minimum 1/2" dia. WHS x 6" long but provide not less than  $\frac{3}{4}$ " interior cover or 1  $\frac{1}{2}$ " exterior cover to the opposite face of concrete, unless noted otherwise.
- 3) COLUMN ANCHOR RODS and BASE PLATES: All columns (vertical member assemblies weighing over 300 pounds) shall be provided with a minimum of four 3/4" diameter anchor rods. Column base plates shall be at least 3/4" thick, unless noted otherwise. Cast-in-place anchor rods shall be provided unless otherwise approved by the Engineer. Unless noted otherwise, embedment of castin-place anchor rods shall be 12 times the anchor diameter (12D).

# FABRICATION:

- 1) Conform to AISC 360 Section M2 "Fabrication" and AISC 303 Section 6 "Shop Fabrication".
- 2) Quality Control (QC) shall conform to:
  - a. AISC 360 Chapter N "Quality Control and Quality Assurance" and
  - b. AISC 303 Section 8 "Quality Control".
  - c. Fabricator and Erector shall establish and maintain written Quality Control (QC) procedures per AISC 360 section N3.
  - Fabricator shall perform self-inspections per AISC 360 section N5 to ensure that their work is performed in accordance with Code of Standard Practice, the AISC Specification, Contract Documents and the Applicable Building Code.
  - QC inspections may be coordinated with Quality Assurance inspections per Section N5.3 e. where fabricators QA procedures provide the necessary basis for material control, inspection, and control of the workmanship expected by the Special Inspector.

# WELDING:

- 1) Welding shall conform to AWS D1.1 with Pregualified Welding Processes except as modified by AISC 360 section J2. Welders shall be qualified in accordance with AWS D1.1 requirements.
- 2) Use 70ksi strength, low-hydrogen type electrodes (E7018) or E71T as appropriate for the process selected.
- Welding of high strength anchor rods is prohibited unless approved by Engineer. 3)
- Welding of headed stud anchors shall be in accordance with AWS D1.1 Chapter 7 "Stud Welding". 4)

### **ERECTION:**

2)

- Conform to AISC 360 Section M4 "Erection" and AISC 303 Section 7 "Erection".
  - Conform to AISC 360 Chapter N "Quality Control and Quality Assurance" and AISC 303 Section 8. a. The Erector shall maintain detailed erection quality control procedures that ensure that the
- 3) Steel work shall be carried up true and plumb within the limits defined in AISC 303 Section 7.13.
- High strength bolting shall comply with the RCSC requirements including RCSC Section 7.2
- "Required Testing", as applicable and AISC 360 Chapter J, Section M2.5 and Section N5.6.
  - Welding of HEADED STUD ANCHORS shall be in accordance with AWS D1.1 Chapter 7 "Stud 5) Welding.
  - Provide Headed (Shear) Stud Anchors welded through the metal deck to tops of beams denoted in 6) plans.
  - The contractor shall provide temporary bracing and safety protection required by AISC 360 Section 7) M4.2 and AISC 303 Section 7.10 and 7.11.

work is performed in accordance with these requirements and the Contract Documents.

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### PROTECTIVE COATING REQUIREMENTS:

- 1) SHOP PAINTING: Conform to AISC 360 Section M3 and AISC 303 Section 6.5 unless otherwise specified by the project specifications.
- 2) INTERIOR STEEL:
  - a. Unless noted otherwise, do not paint any of the steel surfaces meeting the following conditions:
    - Concealed by the interior building finishes,
    - Fireproofed,
    - Embedded in concrete,
    - Specially prepared as a "faving surface" for Type-SC "slip-critical" connections including bolted connections that form a part of the Seismic Force Resisting System governed by AISC 341 unless the coating conforms to requirements of the RCSC Bolt Specification and is approved by the Engineer.
    - Welded; if area requires painting, do not paint until after weld inspections and nondestructive testing requirement, if any, are satisfied.
  - b. Interior steel, exposed to view, shall be painted with one coat of shop primer unless otherwise indicated in the project specifications. Field touch-ups to match the finish coat or as otherwise indicated in the project specifications.
- 3) EXTERIOR STEEL: Exposed exterior steel shall be protected by either:
  - Paint with an exterior multi-coat system as per the project specifications. Field touch-up painting a. shall be per the project specifications.

# PRESTRESSED/PRECAST CONCRETE

Structural prestressed/precast supplier shall be a PCI certified plant. Copy of certification shall be 1. provided.

- 2. Structural prestressed (precast) concrete shall be made with stone aggregate and shall develop 5000 psi compressive strength (higher strengths may be required).
- All fabrication and erection tolerances, cleaning and general product quality including materials and mix-3. es shall be in accordance with the latest editons of ACI 318, PCI MNL-120 and PCI MNL-116.
- Pretensioned steel shall not be released until the concrete has reached 3500 psi (minimum). 4.
- Details of all precast members and connections shall be submitted to the engineer for review and mem-5. bers shall not be fabricated prior to review. Alternate designs or details may be substituted but used only after engineer's written review. Along with shop drawings, design calculations of all precast members and connections bearing the stamp of a registered professional engineer shall be submitted. Individual piece drawings are not required unless specifically requested.
- 6. Precast concrete shall be handled and erected in a manner that will not impair the strength of the members and adequate temporary bracing shall be provided until all related field connections have been fully completed. Provide lifting devices that will support twice the weight of the precast members and are not to be left exposed. All connections requiring dry packing to be completed prior to applying any superimposed load including anchor bolt pockets and column base plates. Grout for all joints and embedments shall be non-shrink, non-metallic grout with a minimum 28 day compressive strength of 5000 psi.
- 7. The welding of connections for all precast elements shall be in accordance with AWS D1.1 or AWS D1.4. All welders shall have evidence of passing the AWS standard gualifications test. Steel leveling plates shall be provided at 1'-6" minimum from each end of all wall panels unless otherwise shown on plans. Leveling plates stacked in excess of 1" must be welded together and approved by the engineer. Plates in adjacent slabs shall be welded together to eliminate differential camber. Precast concrete connections shall be of readily weldable steel. Alternate connections may be substituted only after review by the engineer.
- Precaster shall design precast walls at all exterior stairs to transfer earth, wind or seismic loads. Walls 8. may be designed to span horizontally at these locations. Precaster shall provide a minimum of two wall/ wall connections at each vertical wall joint, unless approved otherwise.

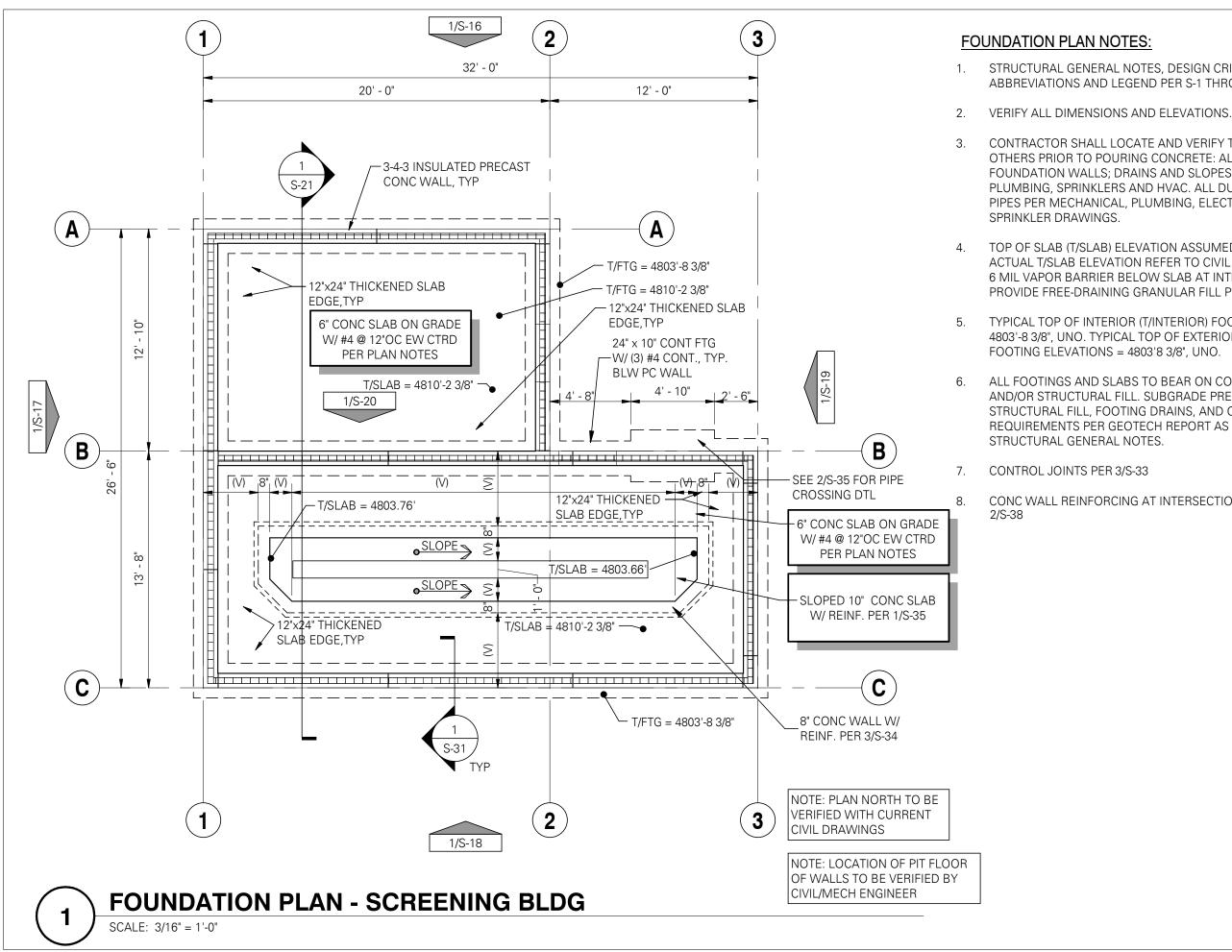
Do not weld floor or roof slabs connections unless slabs have been cast at least two weeks prior to 9. erection.

10. Wire strand used in pre-stressing shall have 270 ksi ultimate strength and conform to "Specifications for Uncoated Seven-Wire Low Relaxation Strand for Prestressed Concrete", ASTM 1416 or ASTM A421. Stress relieved strand may be substituted as an option only after structural engineer review.

# NOTE:

Items discussed on sheets S-2 through S-9 shall conform to the specifications on the drawings or the Technical Specifications in the Contract Documents. The more stringent specification shall aovern.

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STRUCTURAL GENERAL NOTES, DESIGN CRITERIA, ABBREVIATIONS AND LEGEND PER S-1 THROUGH S-9.

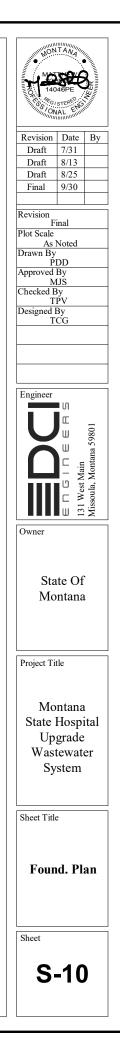
CONTRACTOR SHALL LOCATE AND VERIFY THE FOLLOWING WITH OTHERS PRIOR TO POURING CONCRETE: ALL DOOR OPENINGS IN FOUNDATION WALLS; DRAINS AND SLOPES; BLOCKOUTS FOR PLUMBING, SPRINKLERS AND HVAC. ALL DUCTS, CHASES AND PIPES PER MECHANICAL, PLUMBING, ELECTRICAL AND

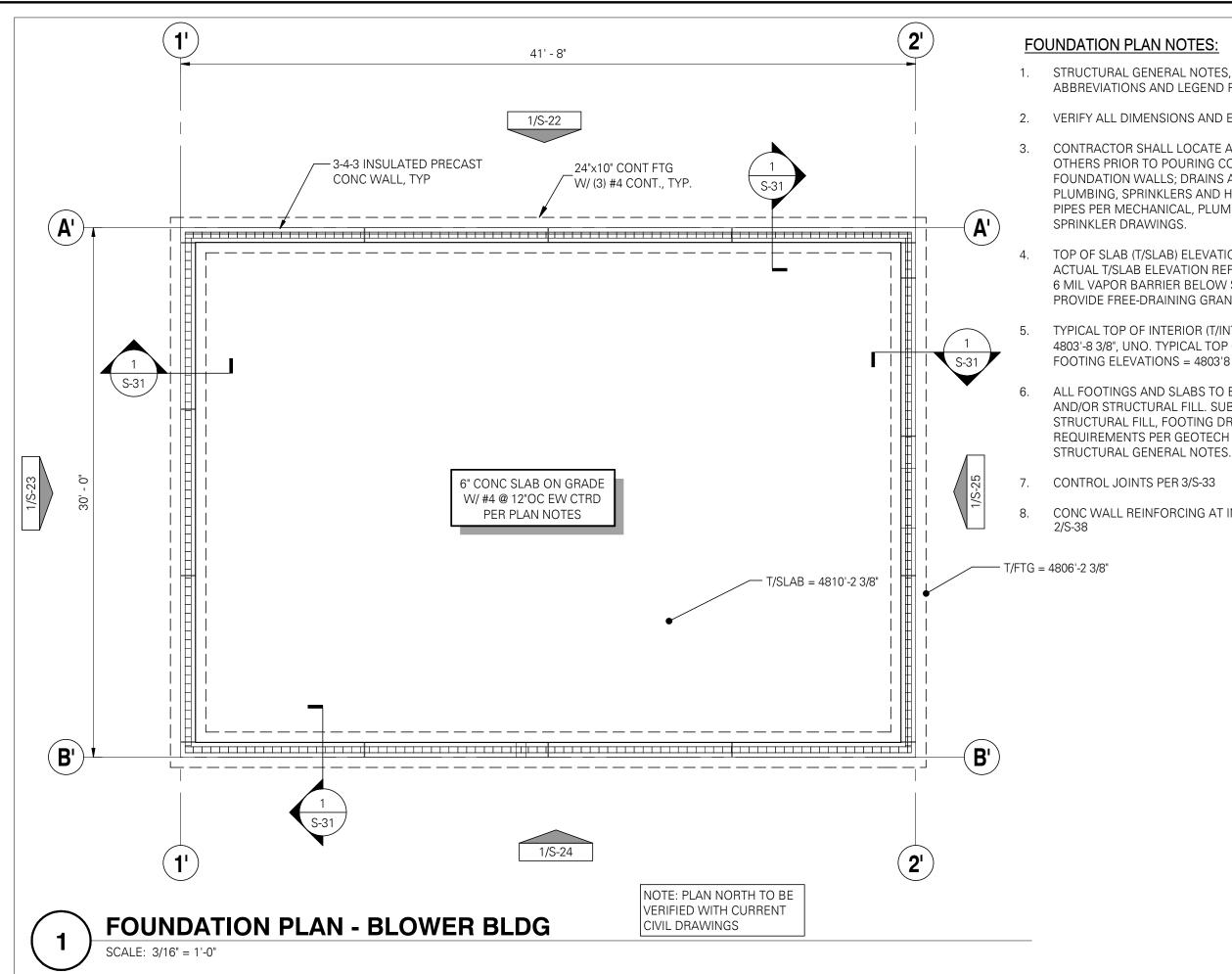
TOP OF SLAB (T/SLAB) ELEVATION ASSUMED 4810'-2 3/8". FOR ACTUAL T/SLAB ELEVATION REFER TO CIVIL DRAWINGS. PROVIDE 6 MIL VAPOR BARRIER BELOW SLAB AT INTERIOR SPACES. PROVIDE FREE-DRAINING GRANULAR FILL PER GEOTECH REPORT.

TYPICAL TOP OF INTERIOR (T/INTERIOR) FOOTING ELEVATION = 4803'-8 3/8", UNO. TYPICAL TOP OF EXTERIOR (T/EXTERIOR)

ALL FOOTINGS AND SLABS TO BEAR ON COMPETENT NATIVE SOIL AND/OR STRUCTURAL FILL. SUBGRADE PREPARATION, STRUCTURAL FILL, FOOTING DRAINS, AND OTHER REQUIREMENTS PER GEOTECH REPORT AS NOTED IN THE

CONC WALL REINFORCING AT INTERSECTIONS/CORNERS PER





STRUCTURAL GENERAL NOTES, DESIGN CRITERIA, ABBREVIATIONS AND LEGEND PER S-1 THROUGH S-9.

VERIFY ALL DIMENSIONS AND ELEVATIONS.

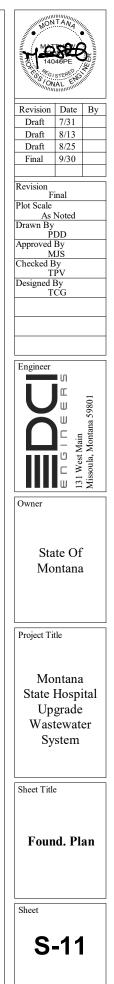
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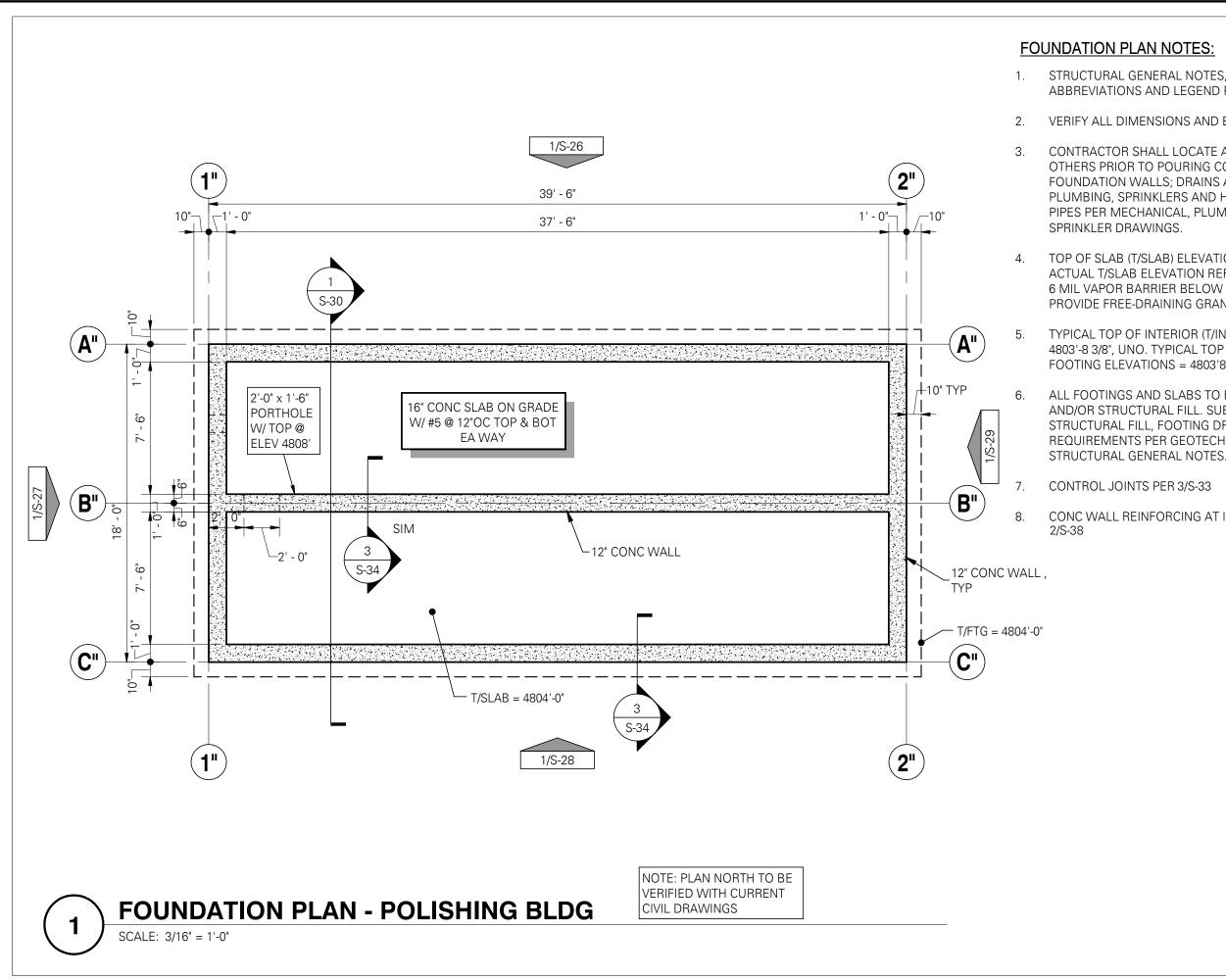
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CONC WALL REINFORCING AT INTERSECTIONS/CORNERS PER





STRUCTURAL GENERAL NOTES, DESIGN CRITERIA, ABBREVIATIONS AND LEGEND PER S-1 THROUGH S-9.

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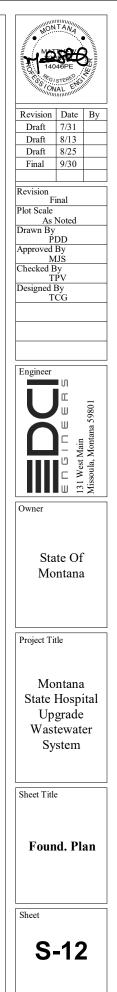
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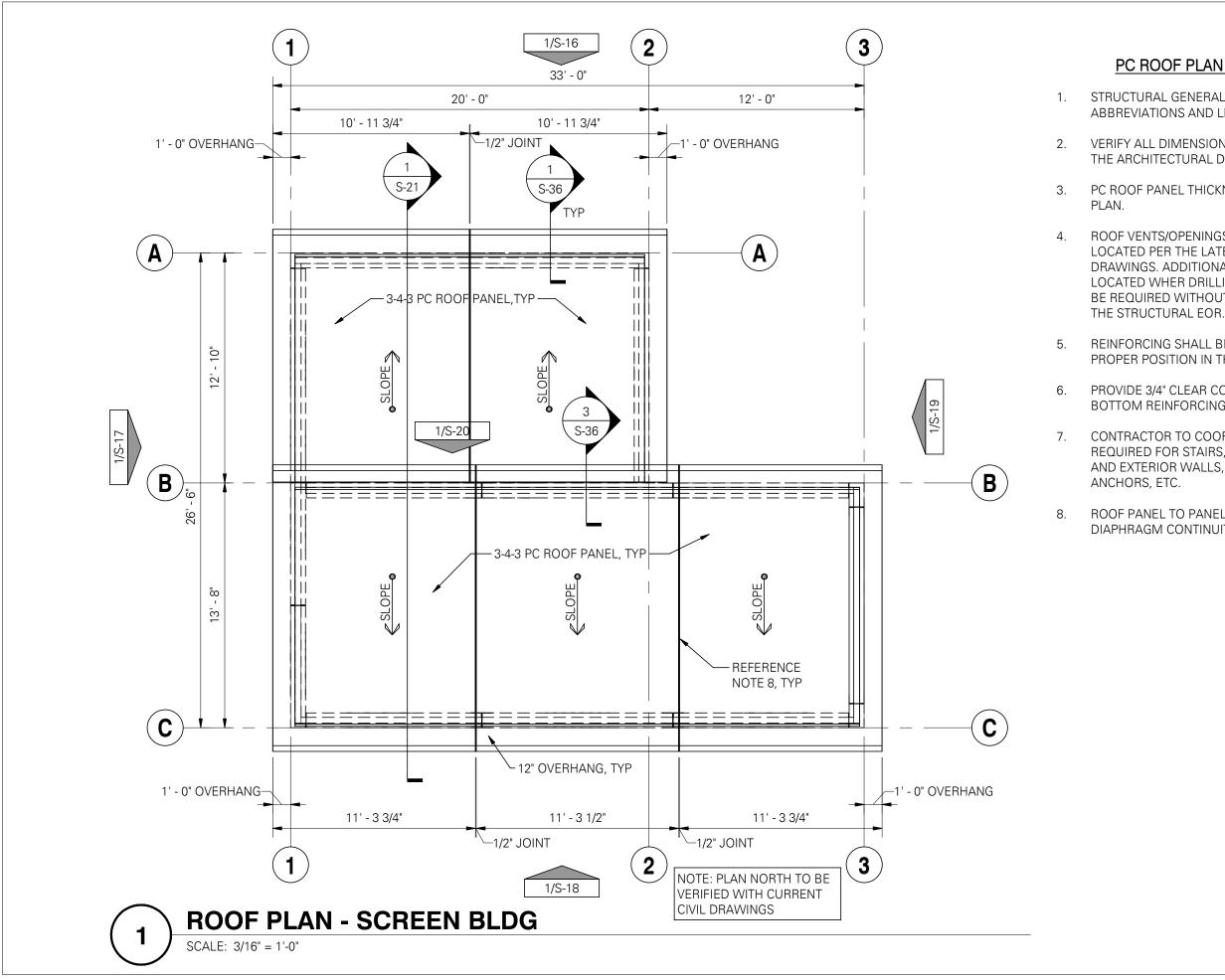
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CONC WALL REINFORCING AT INTERSECTIONS/CORNERS PER





# PC ROOF PLAN NOTES:

1. STRUCTURAL GENERAL NOTES, DESIGN CRITERIA, ABBREVIATIONS AND LEGEND PER S-1 - S-9.

VERIFY ALL DIMENSIONS AND ELEVATIONS WITH THE ARCHITECTURAL DRAWINGS.

PC ROOF PANEL THICKNESS ARE AS SHOWN ON

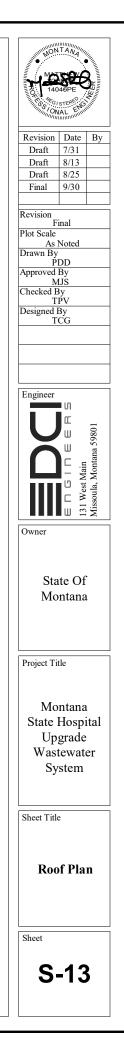
ROOF VENTS/OPENINGS/PENETRATIONS TO BE LOCATED PER THE LATEST CIVIL/MECHANIC DRAWINGS. ADDITIONALLY THEY SHALL NOT BE LOCATED WHER DRILLING OF THE STRAND WOULD BE REQUIRED WITHOUT WRITTEN CONSENT FROM

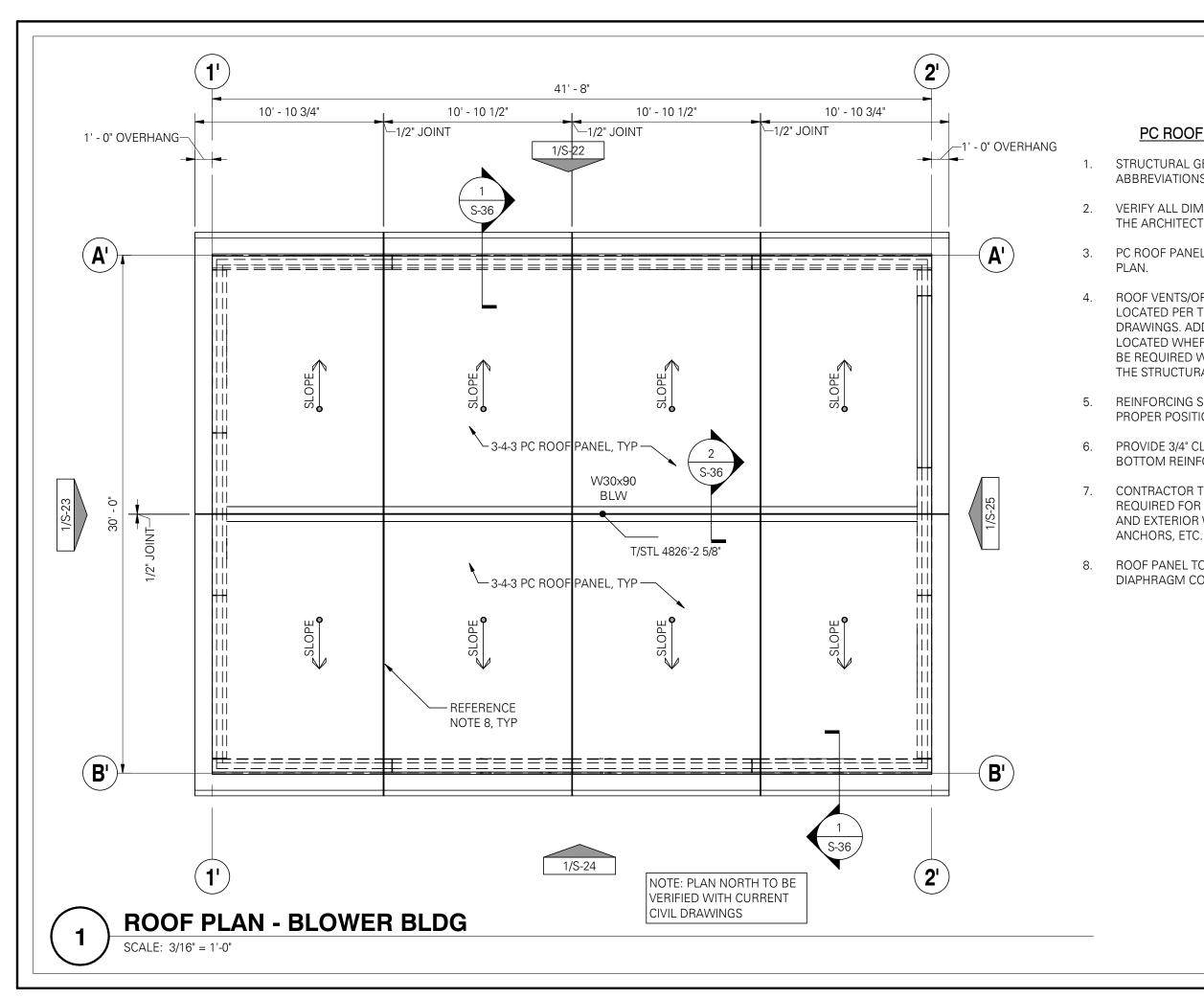
REINFORCING SHALL BE SUPPORTED TO MAINTAIN PROPER POSITION IN THE WALL PANELS.

PROVIDE 3/4" CLEAR COVER FOR ALL TOP AND BOTTOM REINFORCING, UNO.

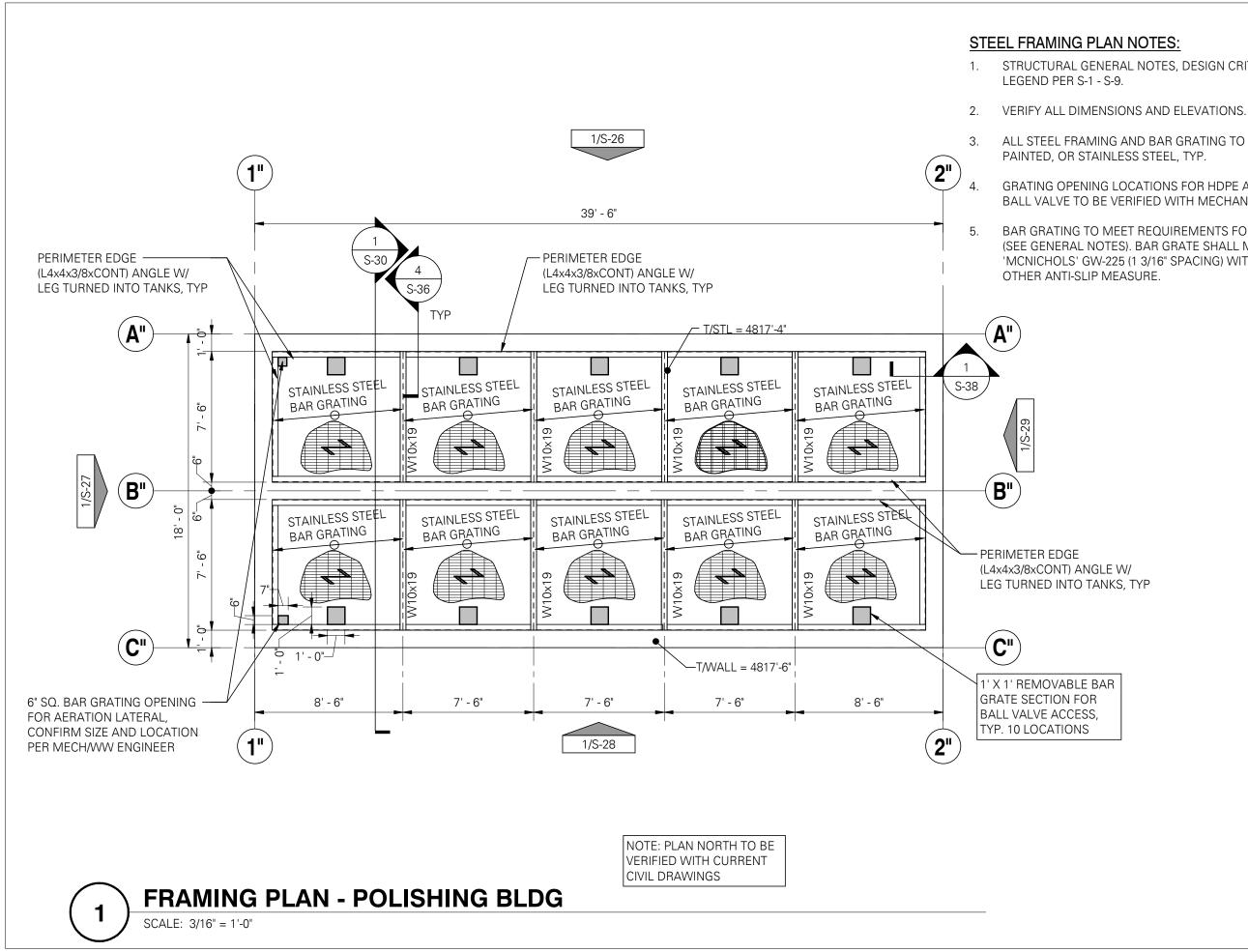
CONTRACTOR TO COORDINATE EMBED PLATES REQUIRED FOR STAIRS, GUARDRAILS, INTERIOR AND EXTERIOR WALLS, WINDOW WASHING

ROOF PANEL TO PANEL CONNECTIONS TO ENSURE DIAPHRAGM CONTINUITY PER PRECAST ENGINEER.





# ONTA PC ROOF PLAN NOTES: Revision Date By Draft 7/31 Draft 8/13 STRUCTURAL GENERAL NOTES, DESIGN CRITERIA, Draft 8/25 ABBREVIATIONS AND LEGEND PER S-1 - S-9. Final 9/30 VERIFY ALL DIMENSIONS AND ELEVATIONS WITH Revision Final THE ARCHITECTURAL DRAWINGS. Plot Scale Drawn By PDD PC ROOF PANEL THICKNESS ARE AS SHOWN ON Approved By MJŚ Checked By TPV Designed By ROOF VENTS/OPENINGS/PENETRATIONS TO BE TĆG LOCATED PER THE LATEST CIVIL/MECHANIC DRAWINGS. ADDITIONALLY THEY SHALL NOT BE LOCATED WHER DRILLING OF THE STRAND WOULD BE REQUIRED WITHOUT WRITTEN CONSENT FROM THE STRUCTURAL EOR. Engineer REINFORCING SHALL BE SUPPORTED TO MAINTAIN PROPER POSITION IN THE WALL PANELS. PROVIDE 3/4" CLEAR COVER FOR ALL TOP AND BOTTOM REINFORCING, UNO. West soula, 7. CONTRACTOR TO COORDINATE EMBED PLATES REQUIRED FOR STAIRS, GUARDRAILS, INTERIOR Owner AND EXTERIOR WALLS, WINDOW WASHING State Of ROOF PANEL TO PANEL CONNECTIONS TO ENSURE Montana DIAPHRAGM CONTINUITY PER PRECAST ENGINEER. Project Title Montana State Hospital Upgrade Wastewater System Sheet Title **Roof Plan** Sheet S-14



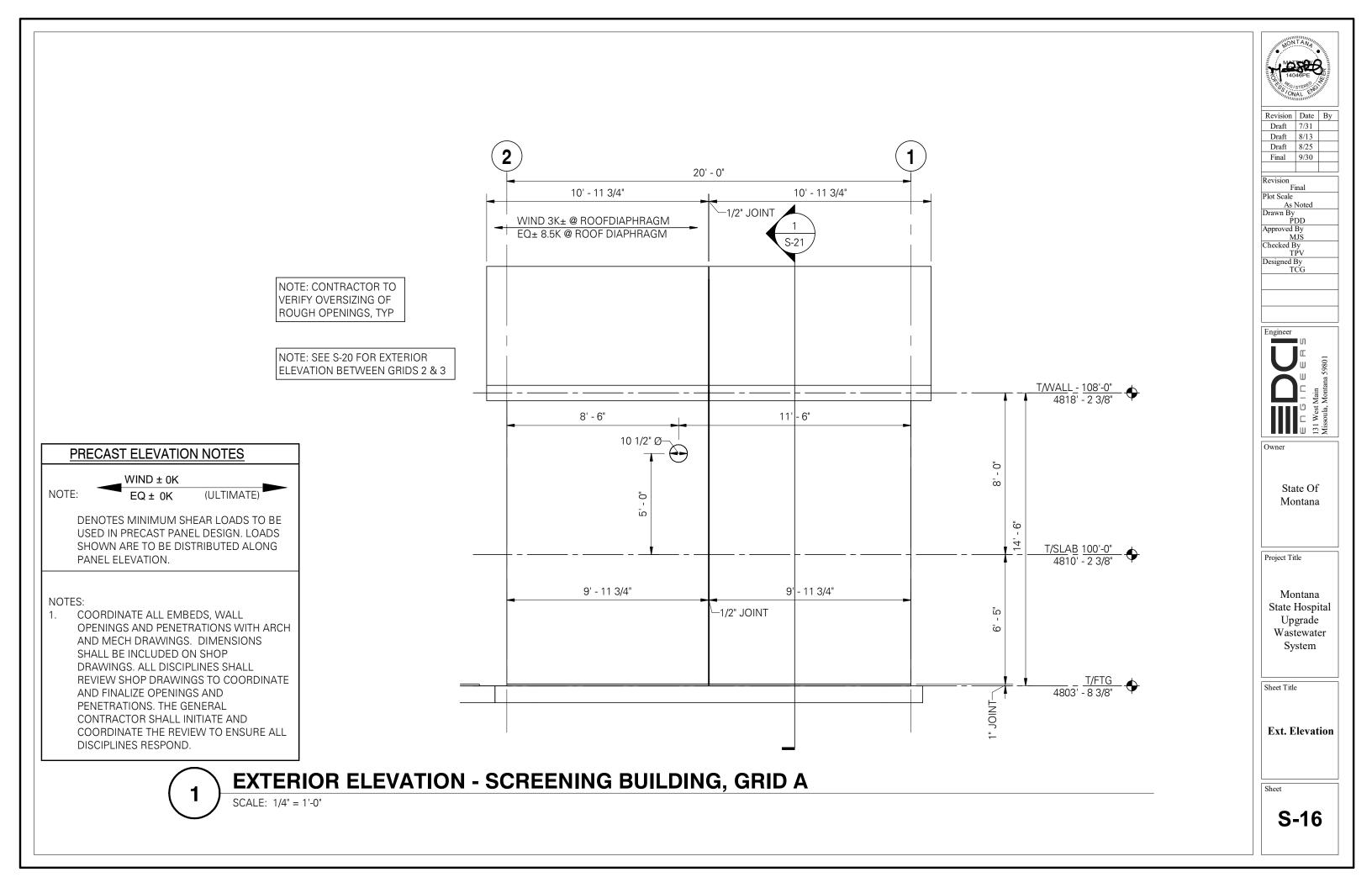
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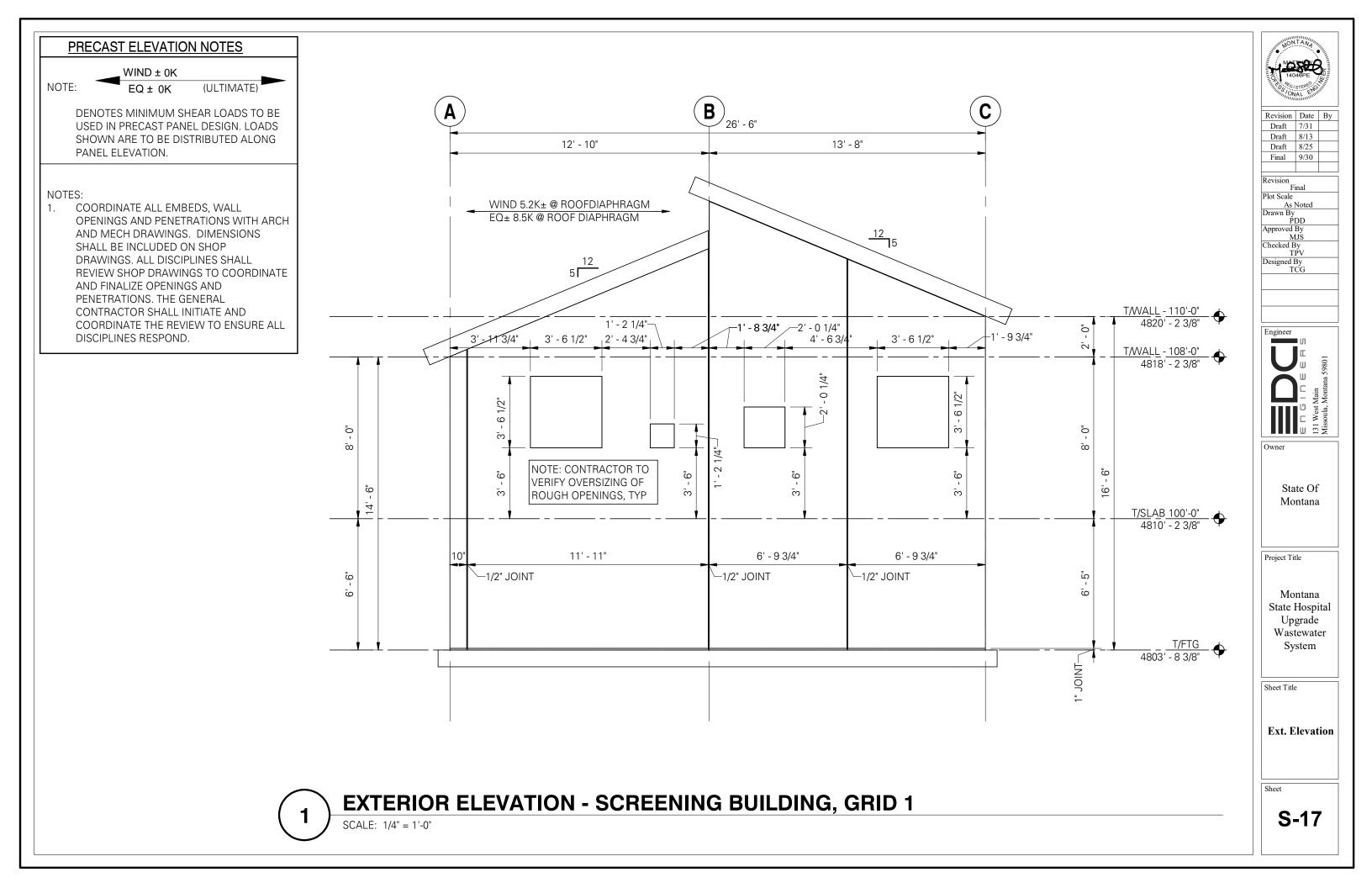
ALL STEEL FRAMING AND BAR GRATING TO BE GALVANIZED, EPOXY

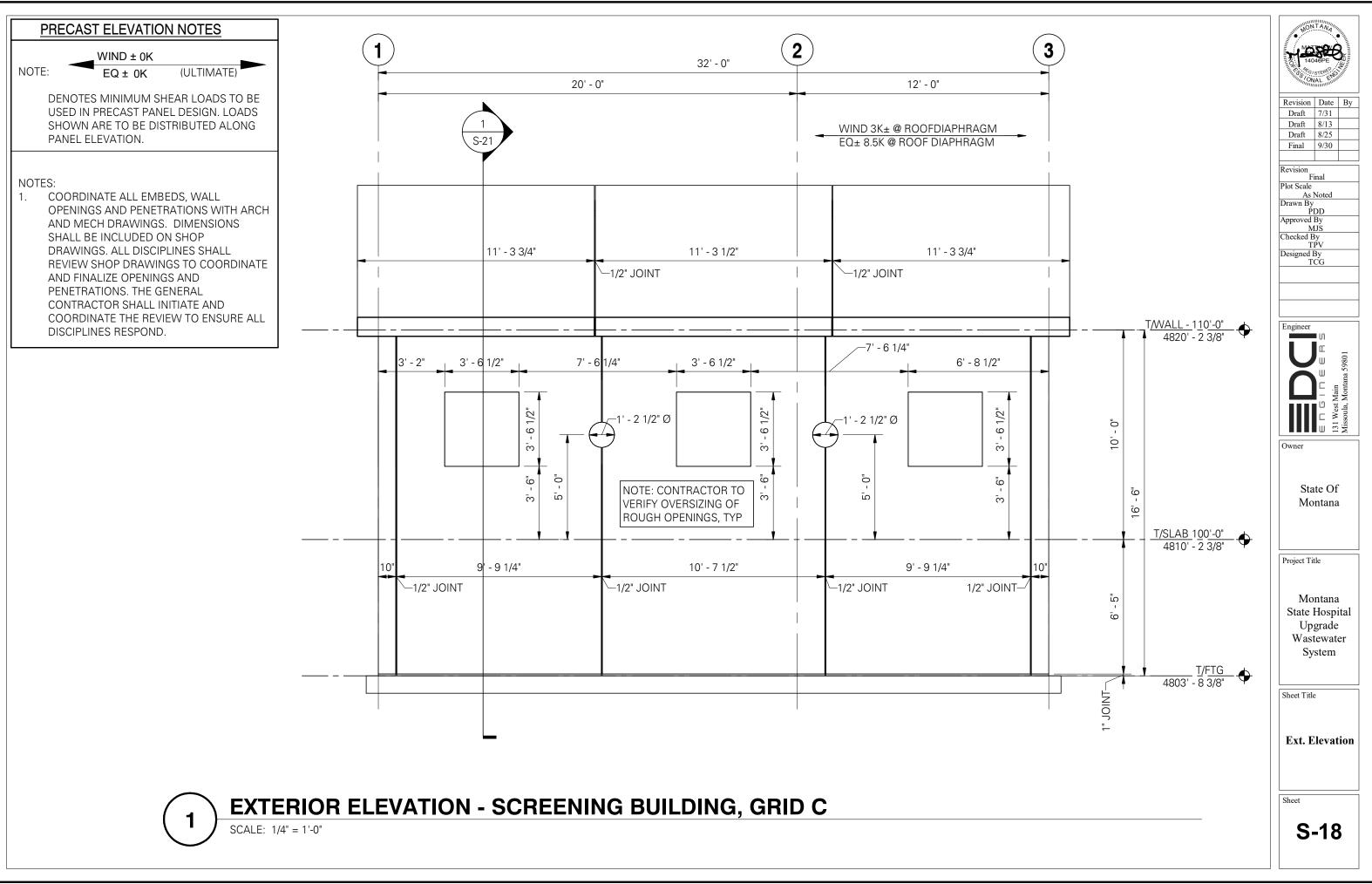
GRATING OPENING LOCATIONS FOR HDPE AERATION LATERAL AND BALL VALVE TO BE VERIFIED WITH MECHANICAL/WW ENGINEER.

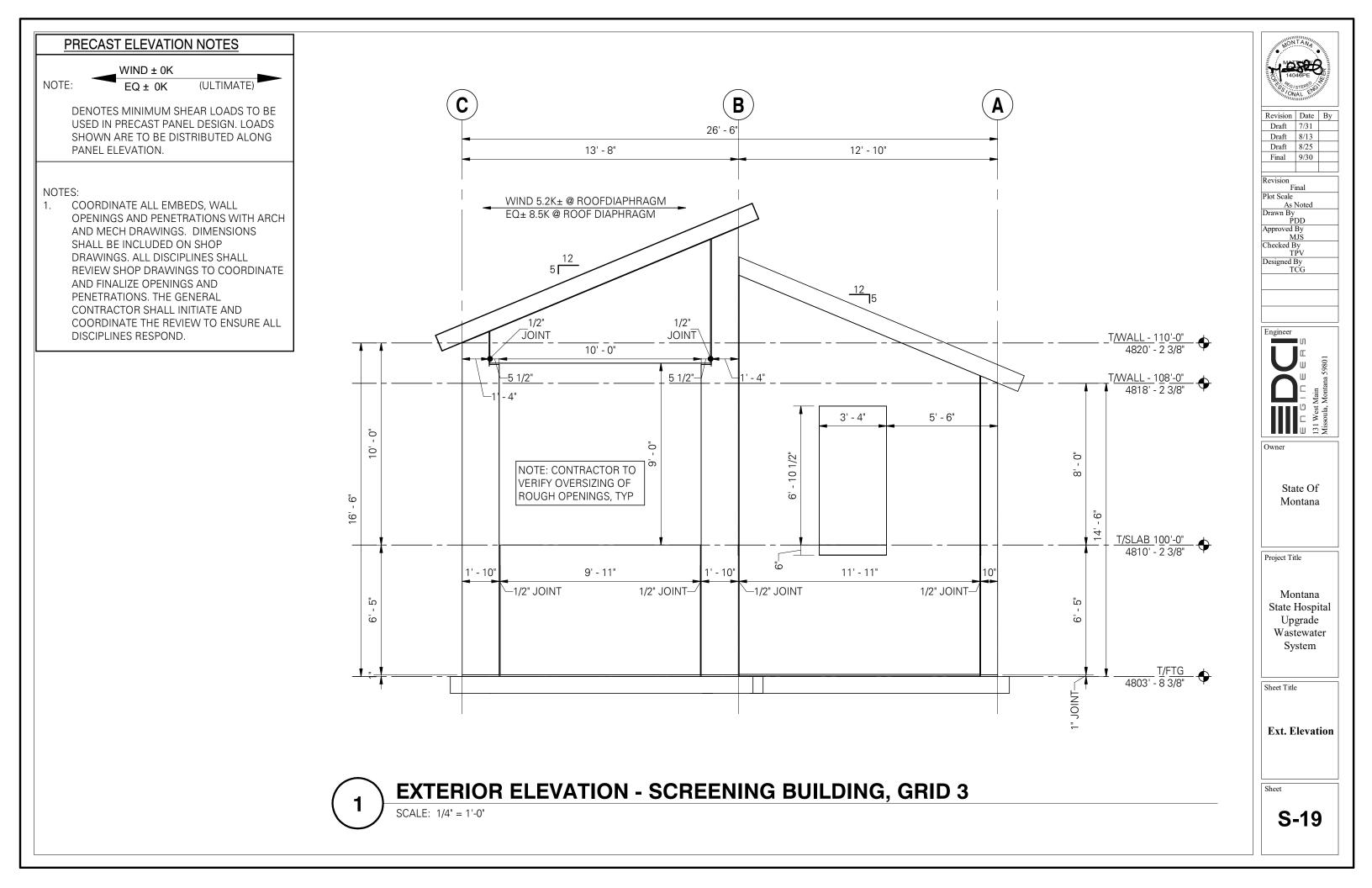
BAR GRATING TO MEET REQUIREMENTS FOR PLATFORM LIVE LOADS (SEE GENERAL NOTES). BAR GRATE SHALL MEET OR EXCEED 'MCNICHOLS' GW-225 (1 3/16" SPACING) WITH SERRATED SURFACE OR

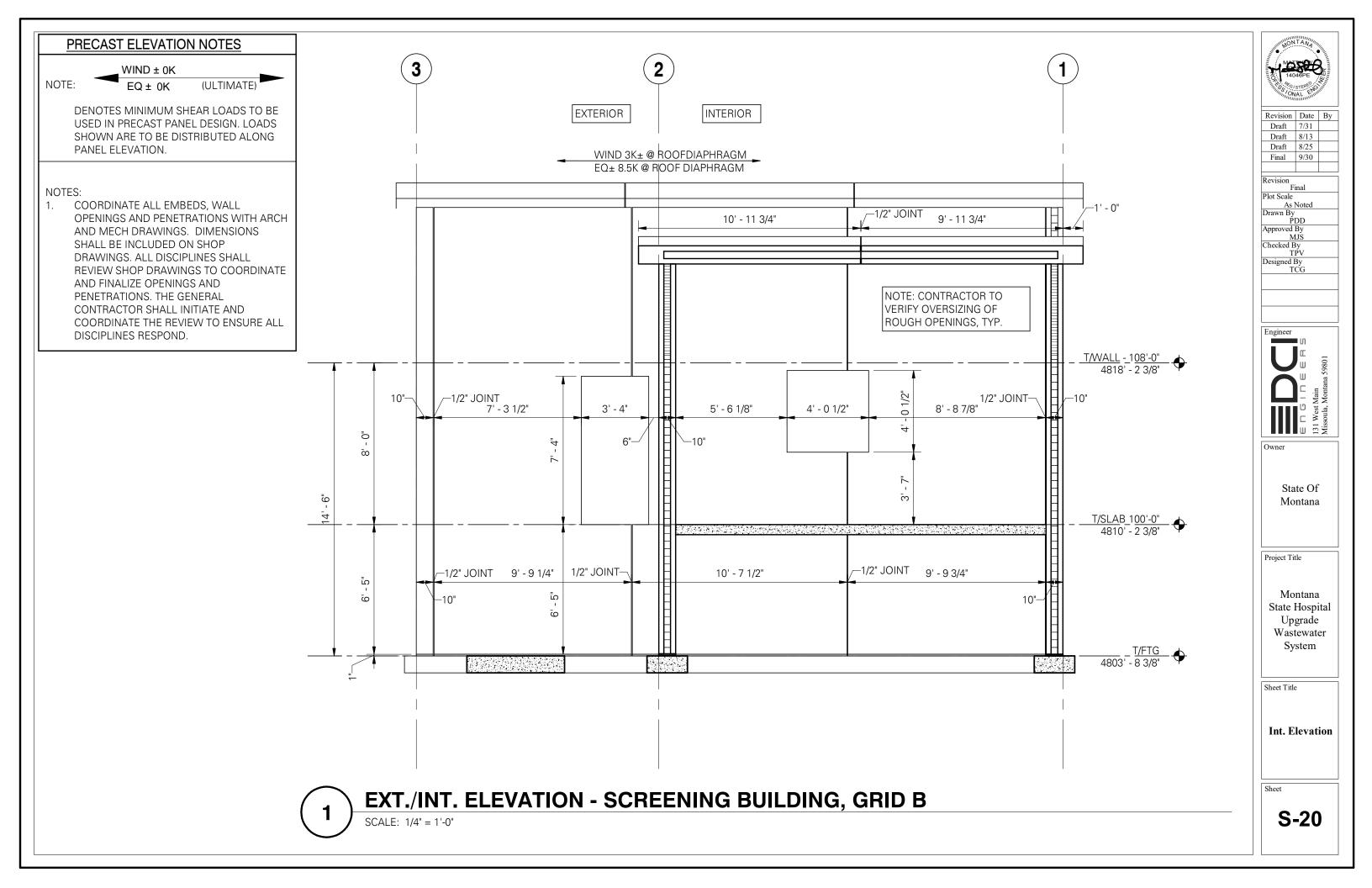
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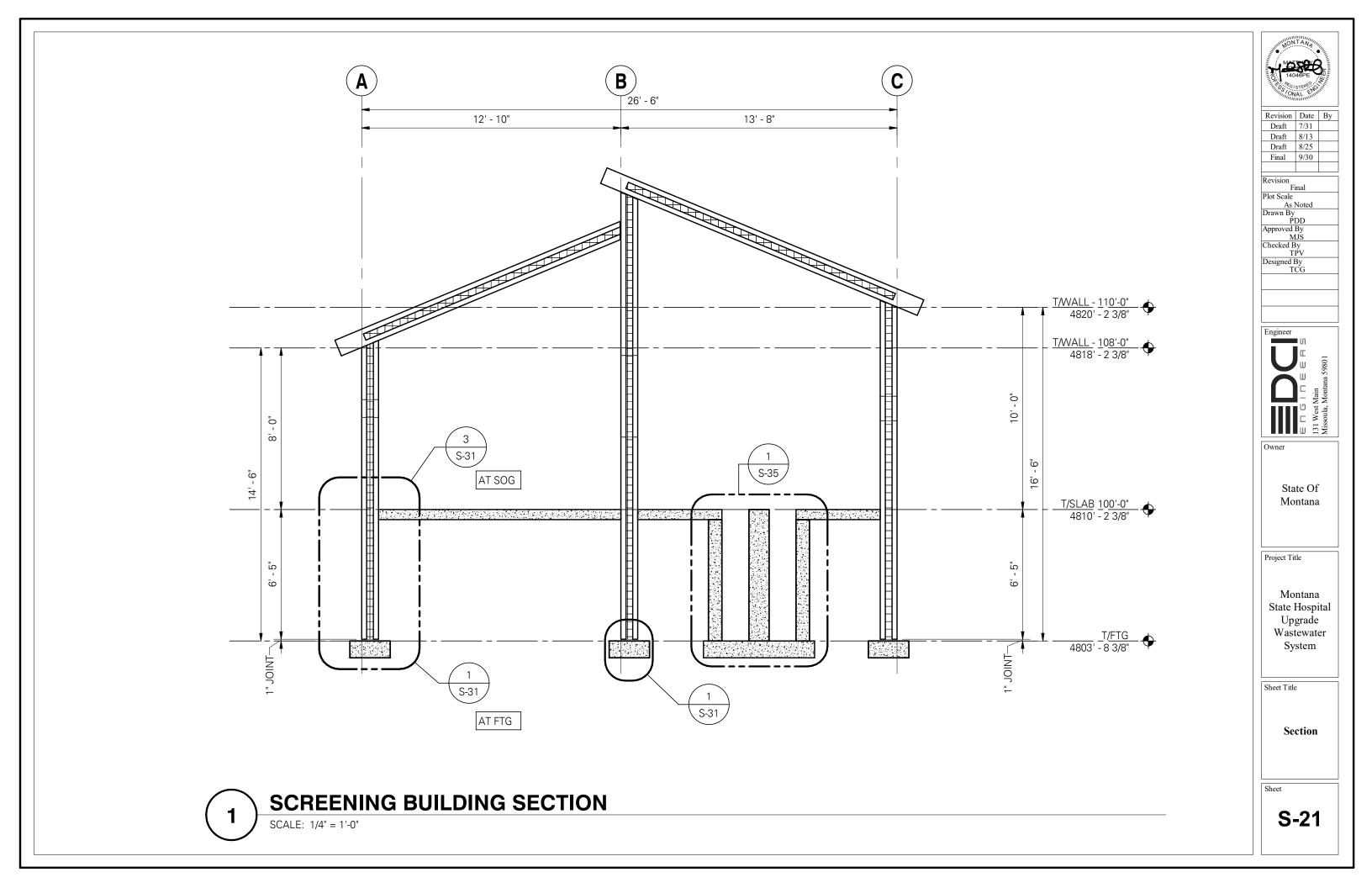


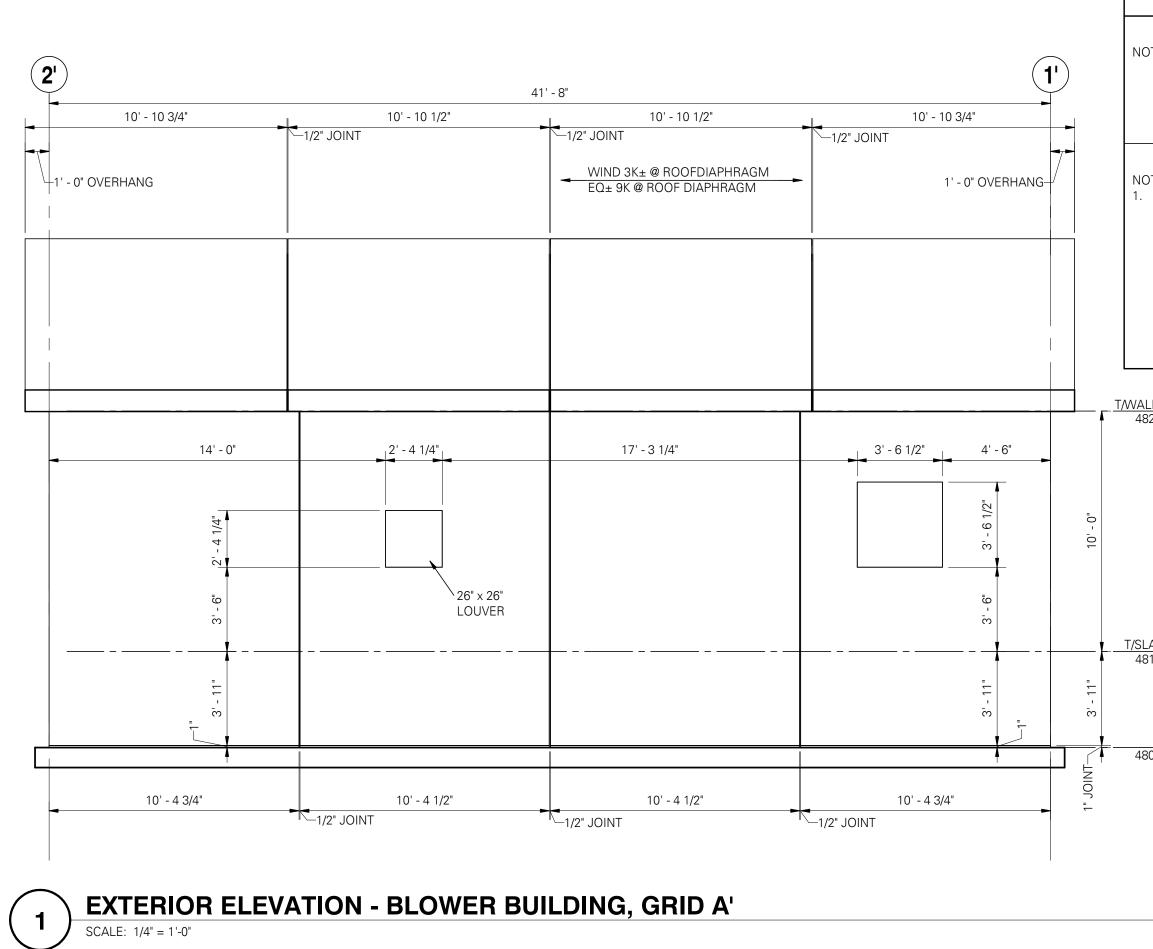




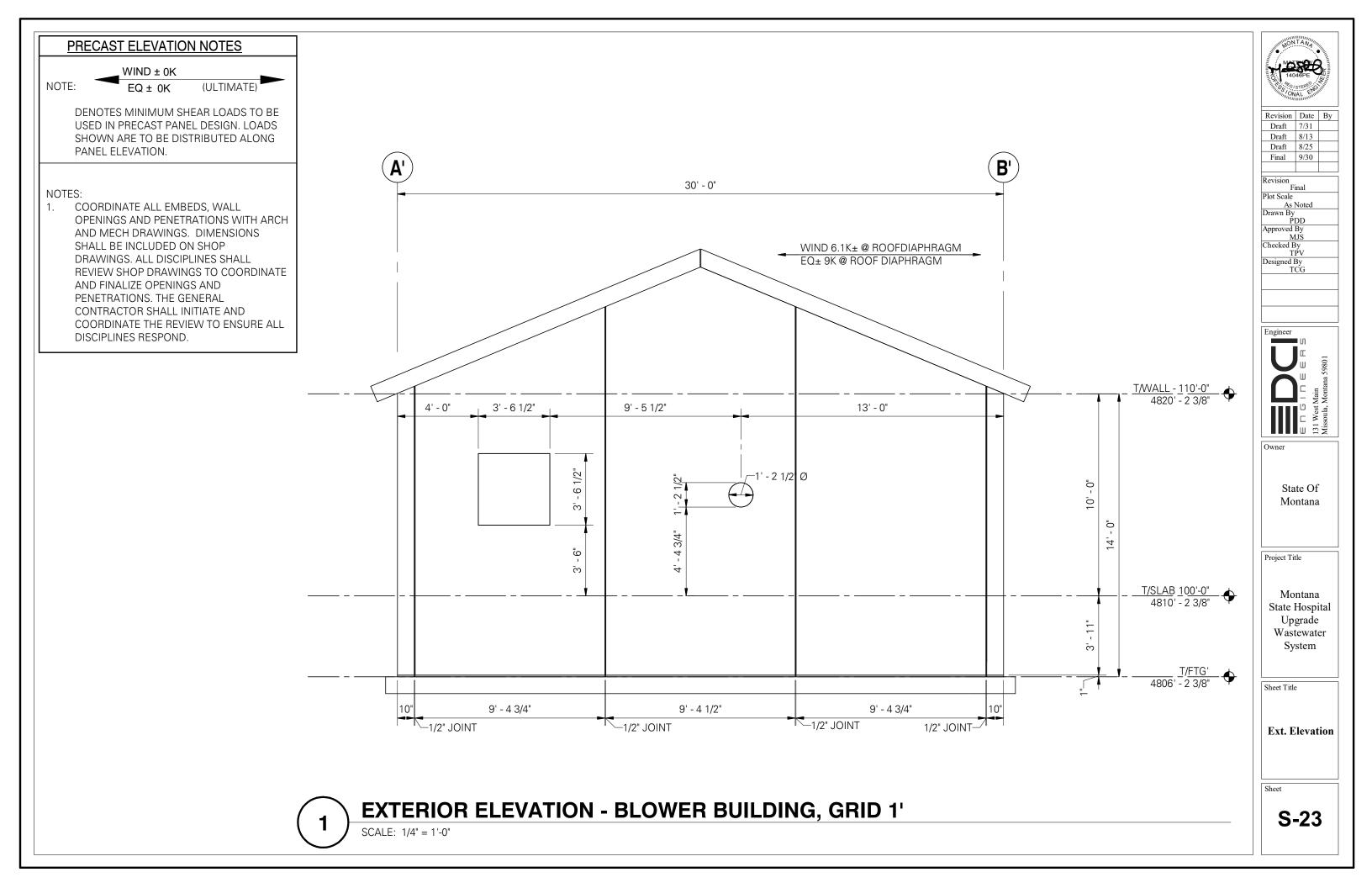


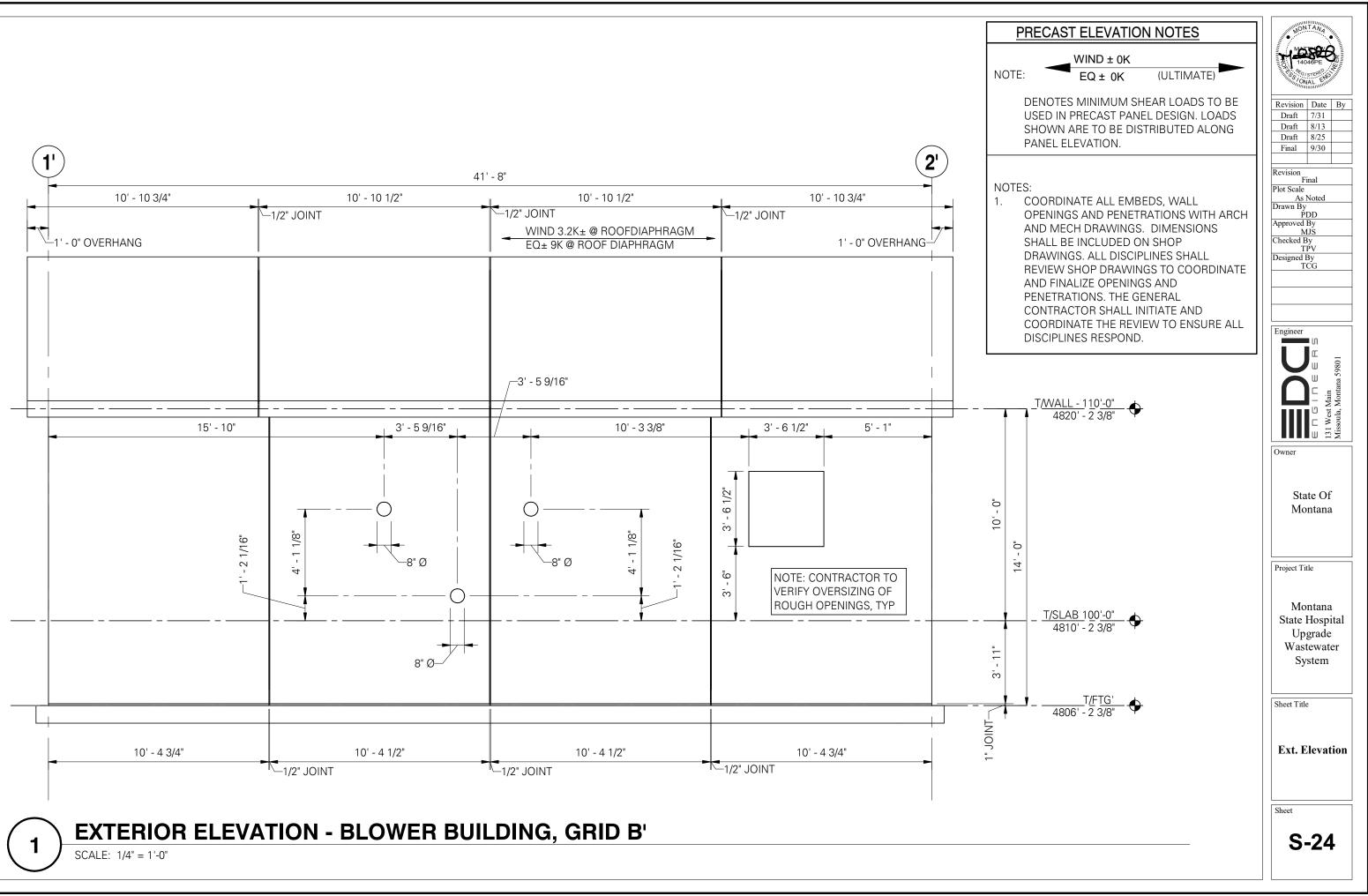


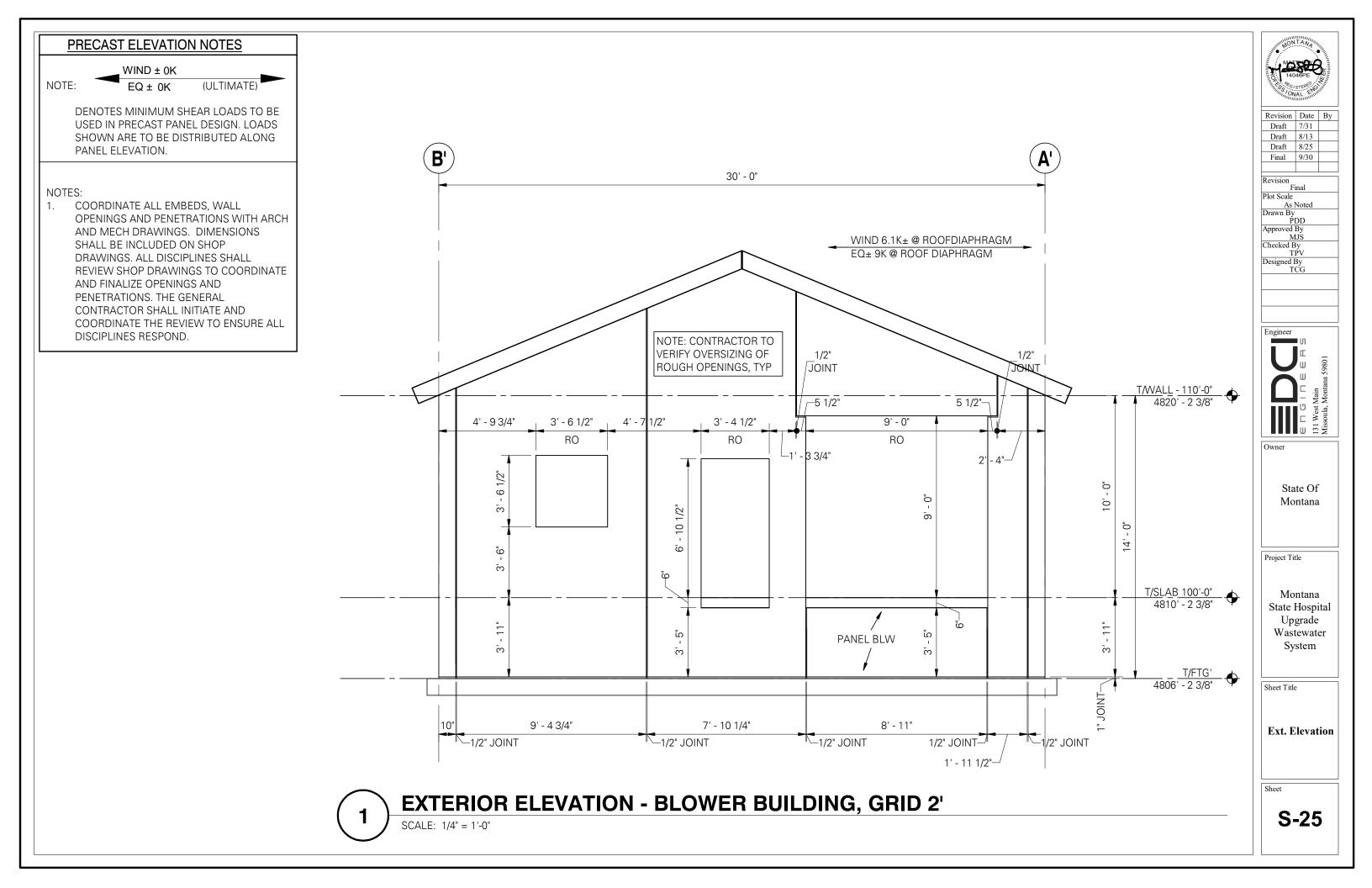


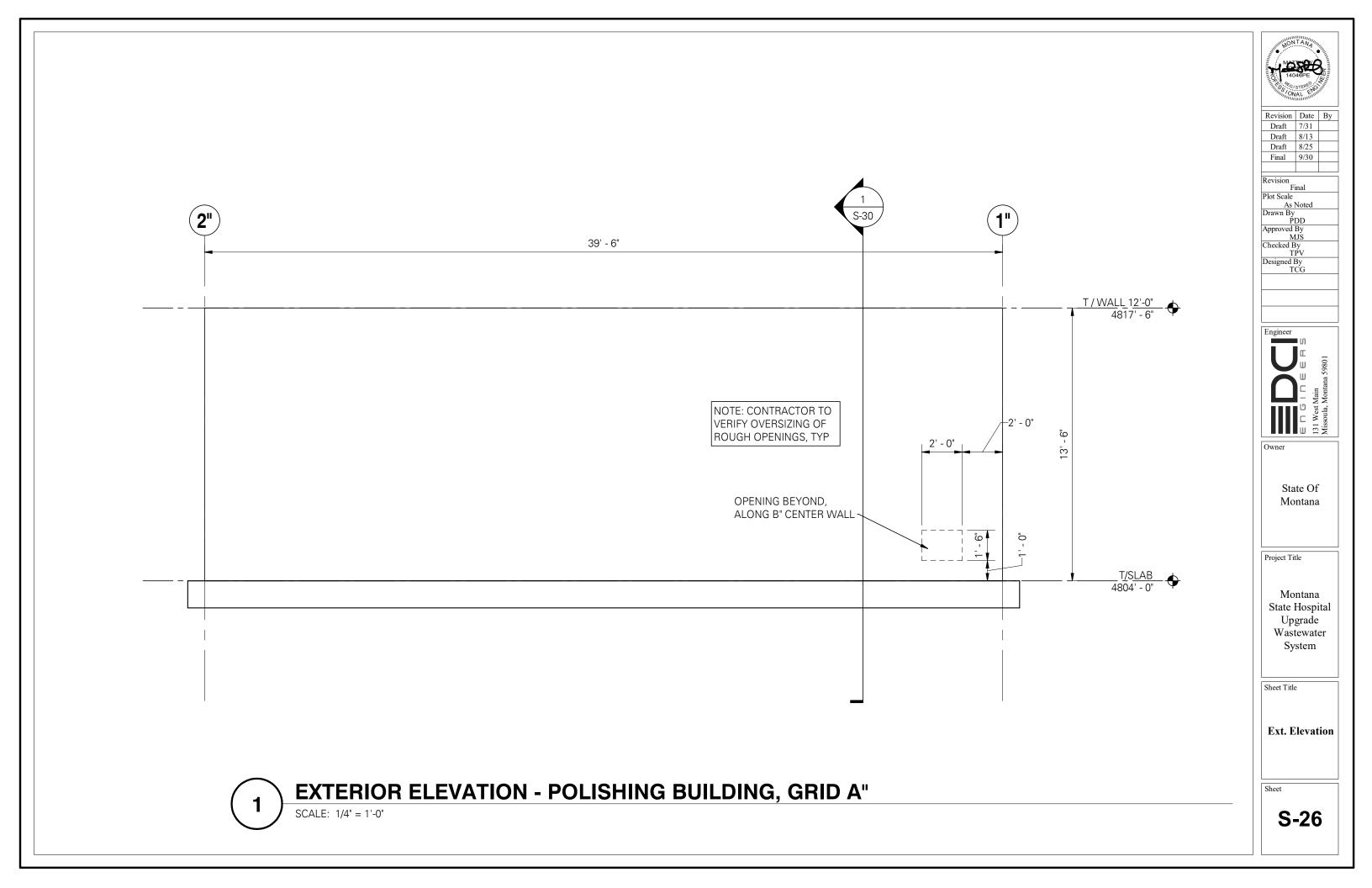


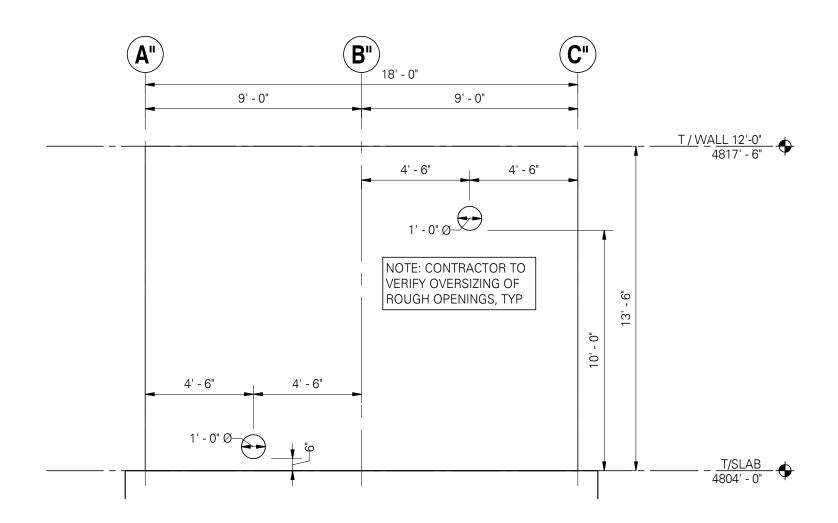
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OTE: WIND ± 0K EQ ± 0K (ULTIMATE)	14046PE
DENOTES MINIMUM SHEAR LOADS TO BE USED IN PRECAST PANEL DESIGN. LOADS SHOWN ARE TO BE DISTRIBUTED ALONG PANEL ELEVATION.	RevisionDateByDraft7/31Draft8/13Draft8/25Final9/30
OTES: COORDINATE ALL EMBEDS, WALL OPENINGS AND PENETRATIONS WITH ARCH AND MECH DRAWINGS. DIMENSIONS SHALL BE INCLUDED ON SHOP DRAWINGS. ALL DISCIPLINES SHALL REVIEW SHOP DRAWINGS TO COORDINATE AND FINALIZE OPENINGS AND PENETRATIONS. THE GENERAL CONTRACTOR SHALL INITIATE AND COORDINATE THE REVIEW TO ENSURE ALL DISCIPLINES RESPOND.	Revision Final Plot Scale As Noted Drawn By PDD Approved By MJS Checked By TPV Designed By TCG
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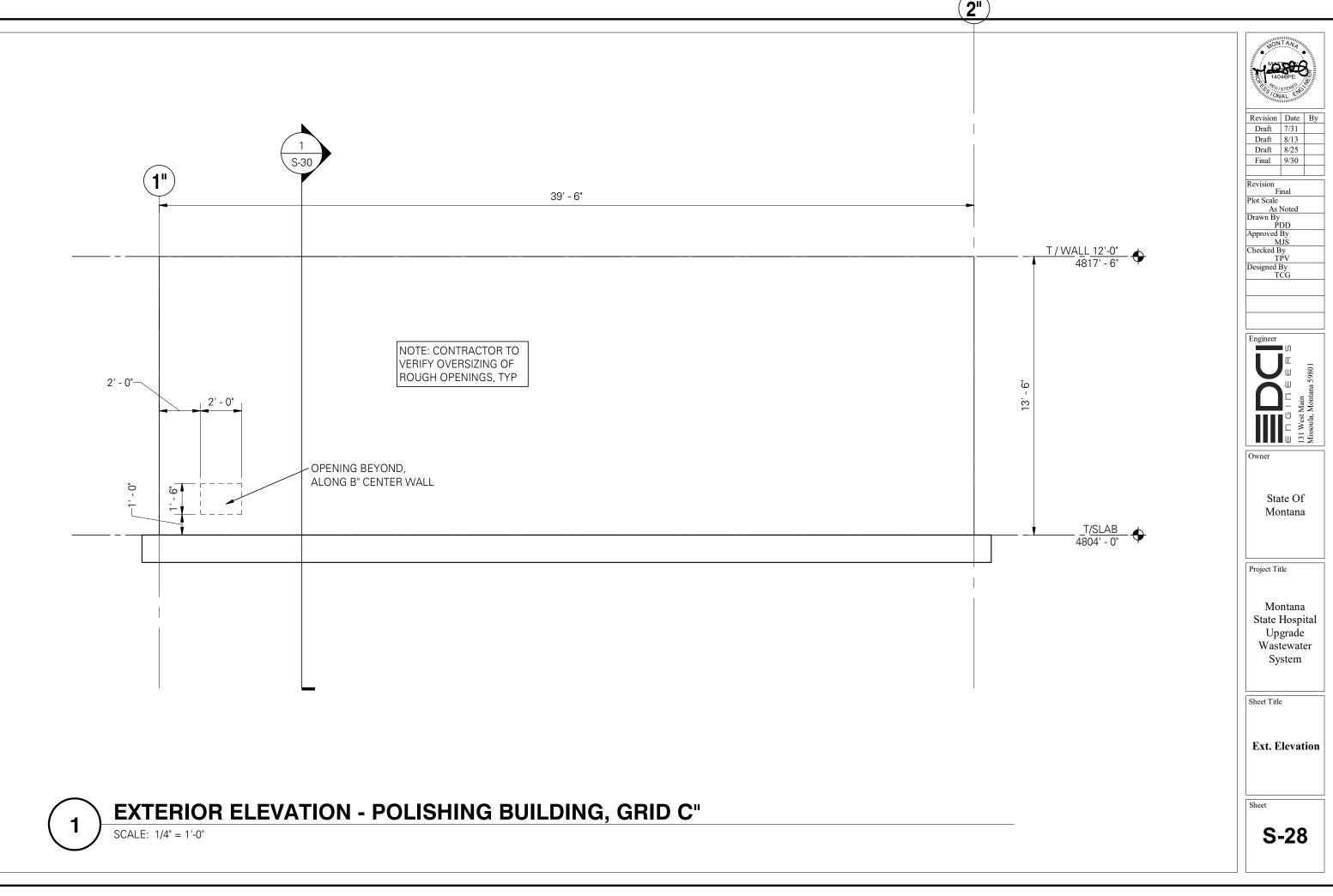


**EXTERIOR ELEVATION - POLISHING BUILDING, GRID 1**"

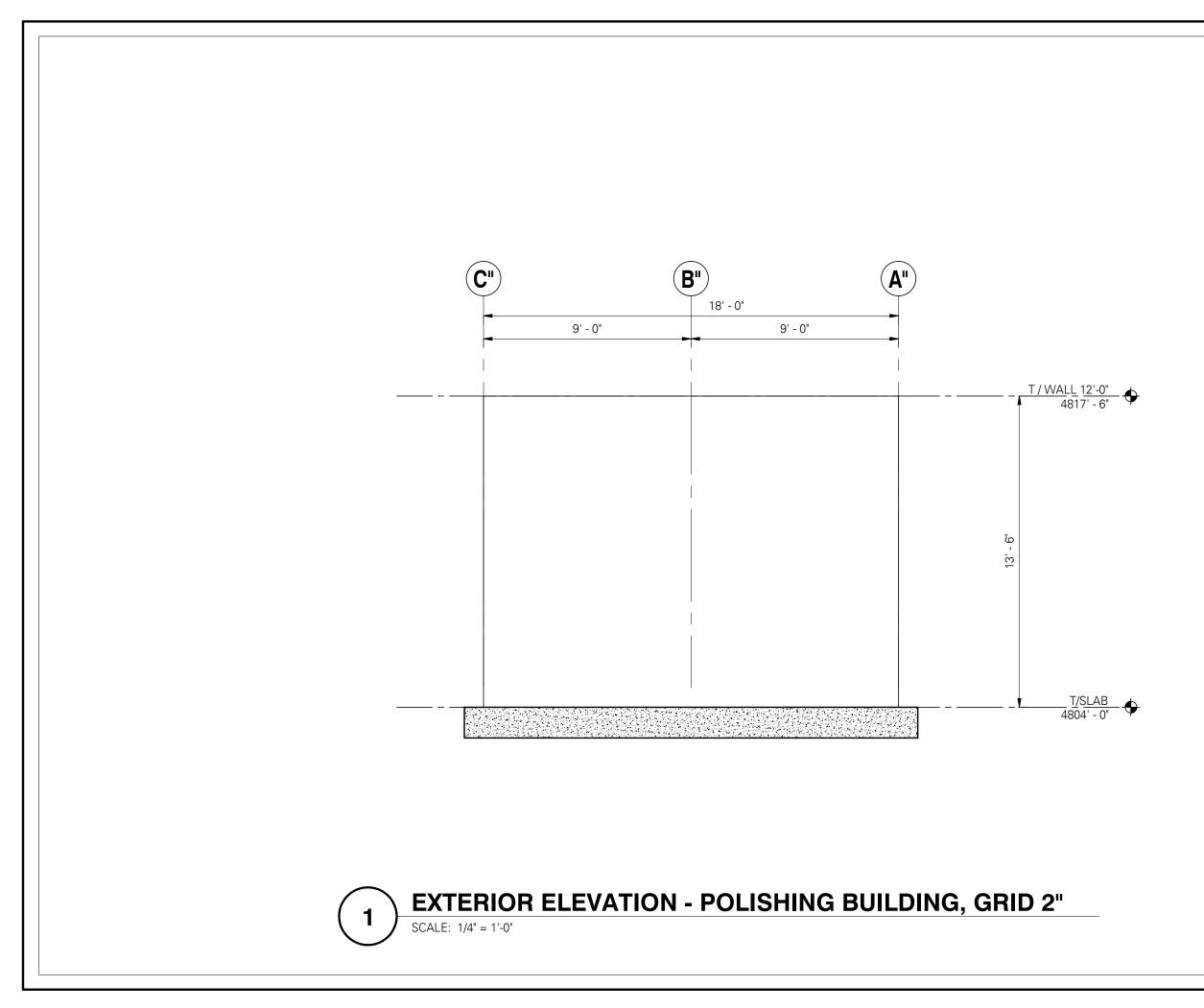
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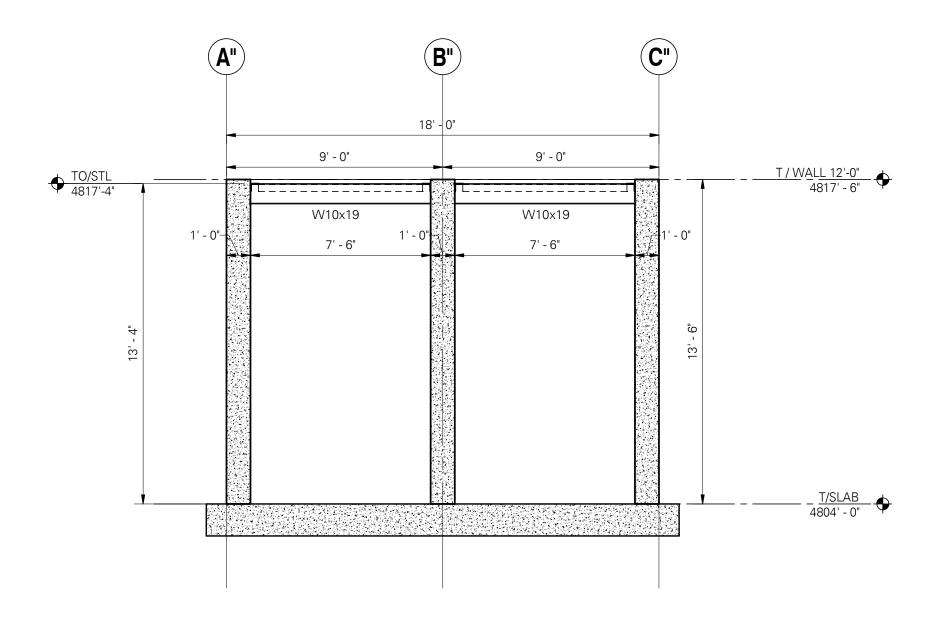
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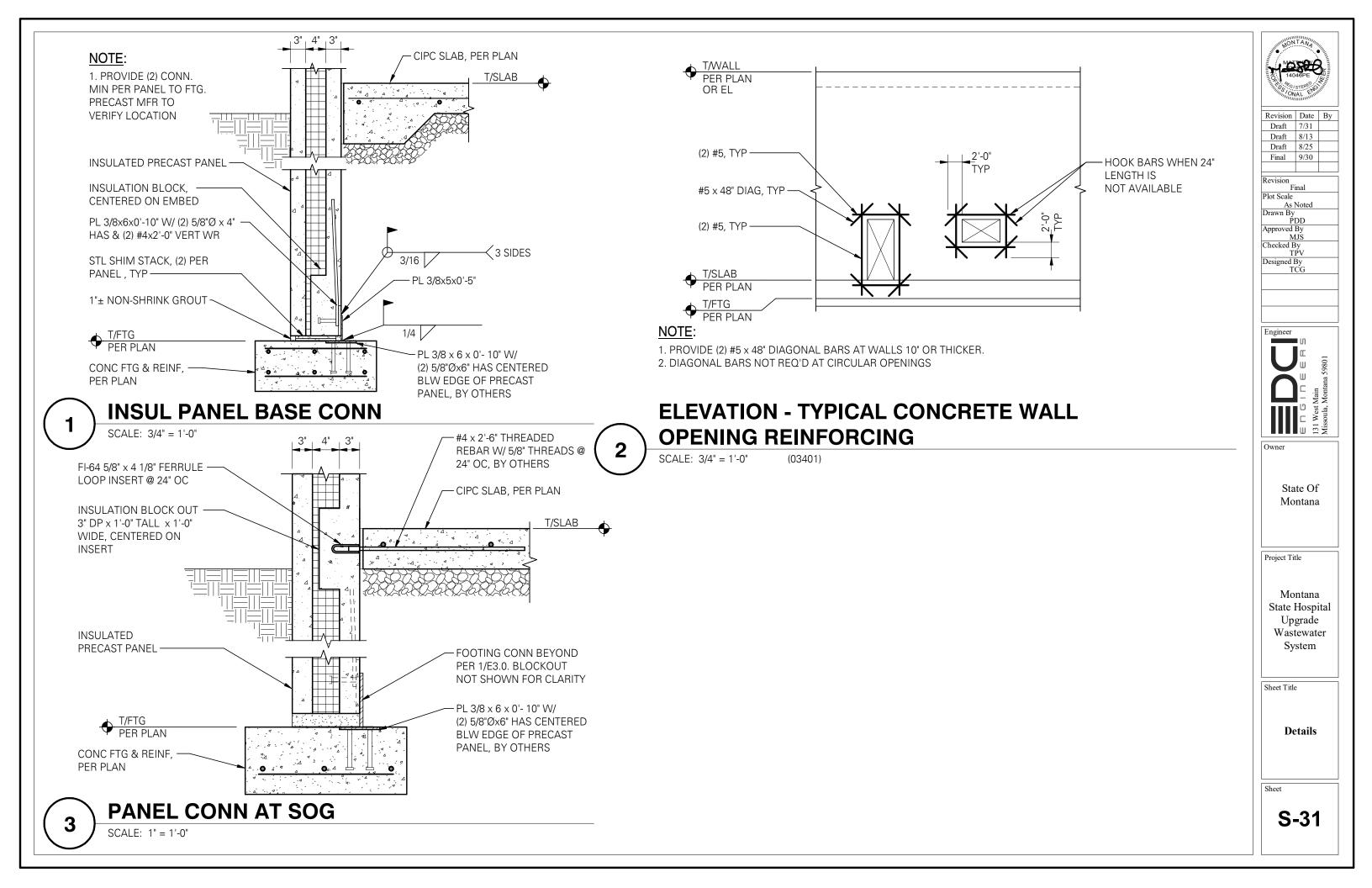


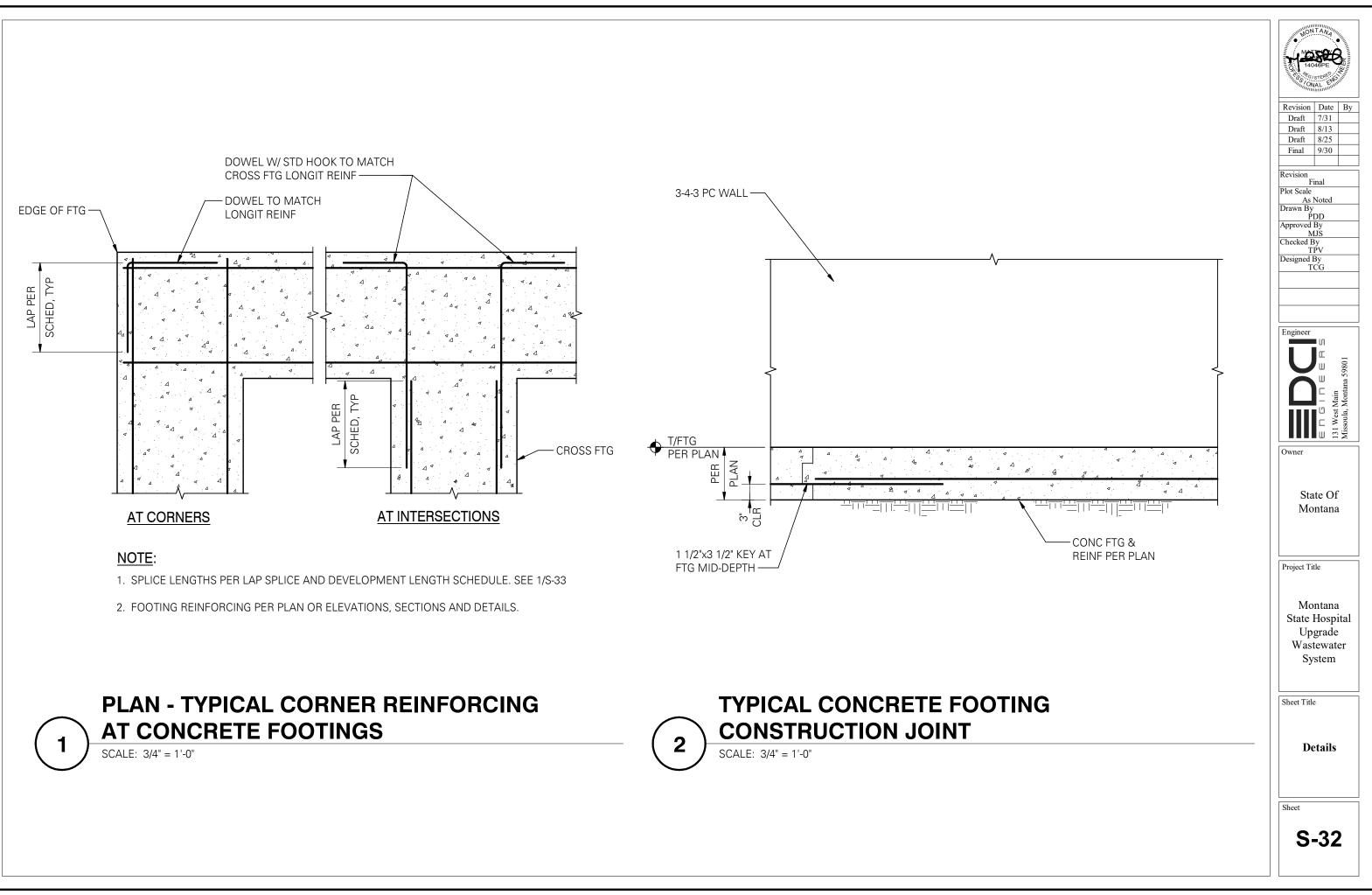
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State Hospital Upgrade Wastewater System Sheet Title <b>Ext. Elevation</b>

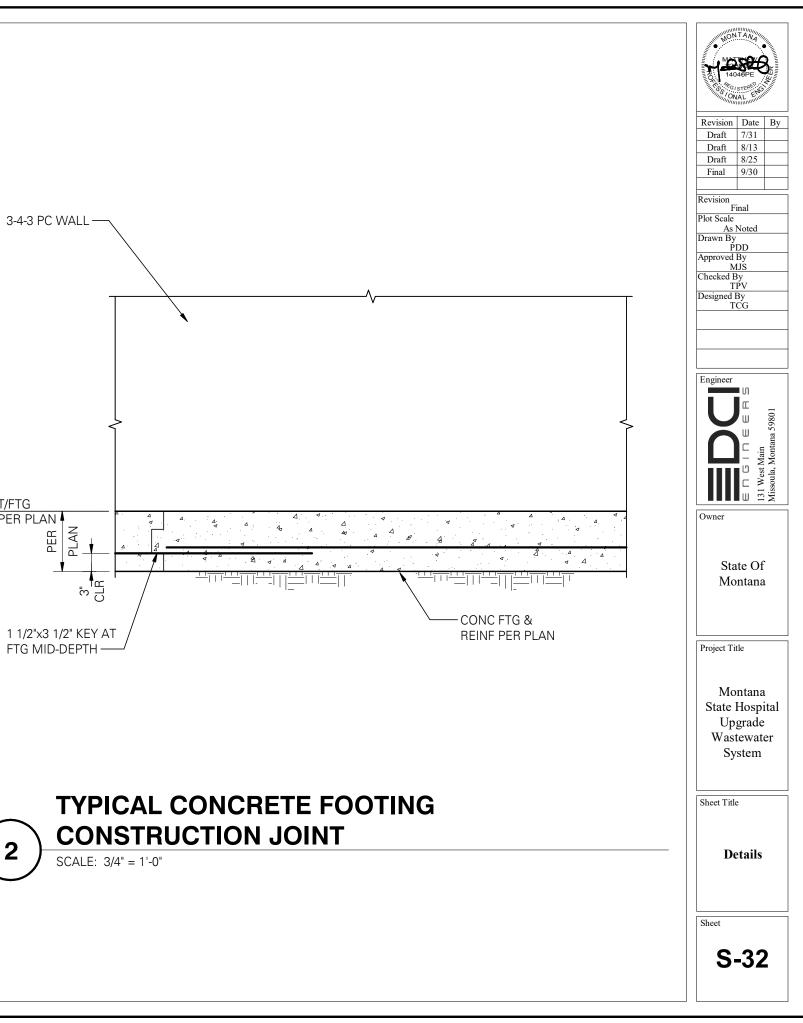


**POLISHING BUILDING SECTION** SCALE: 1/4" = 1'-0" 1

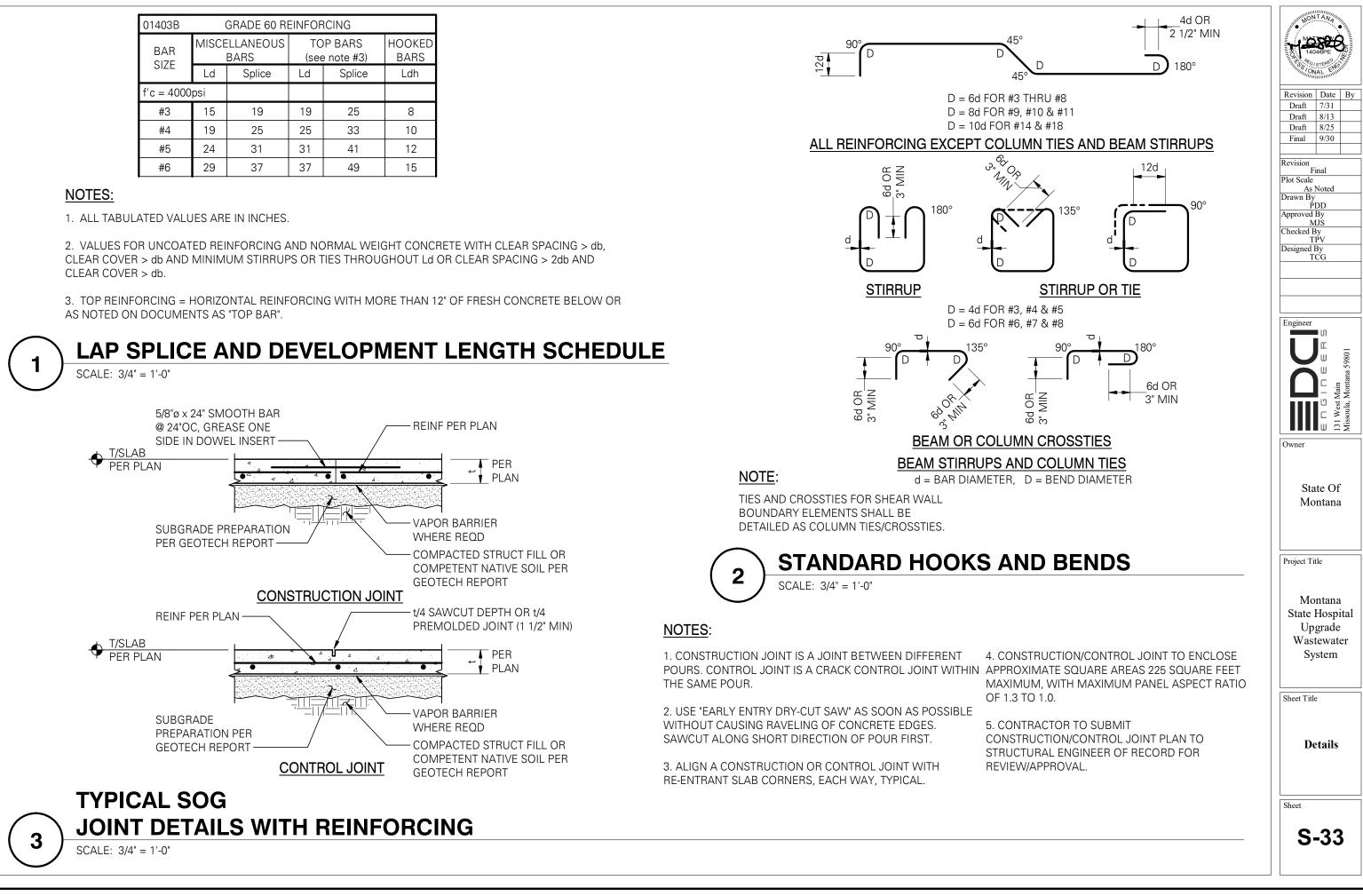
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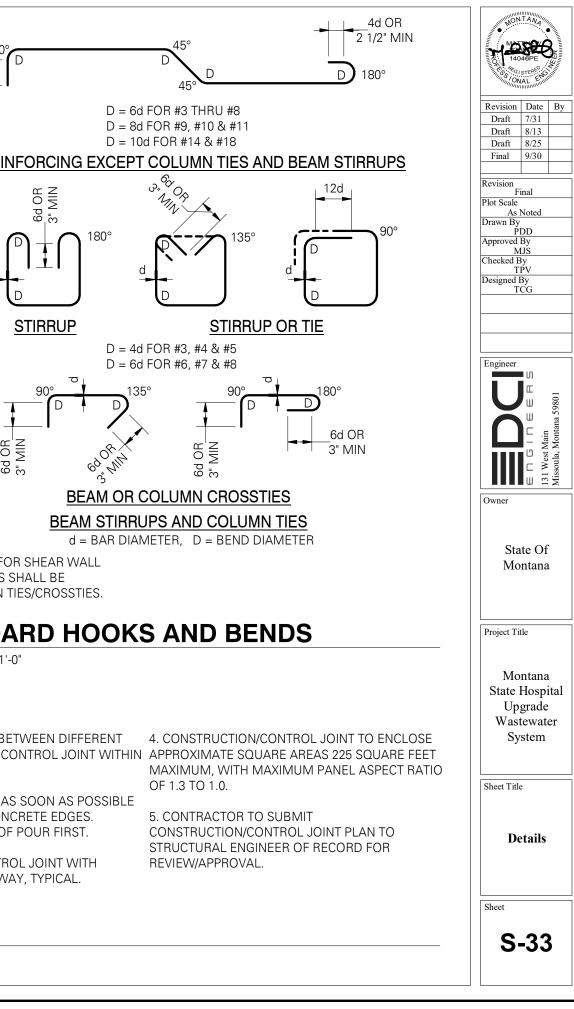


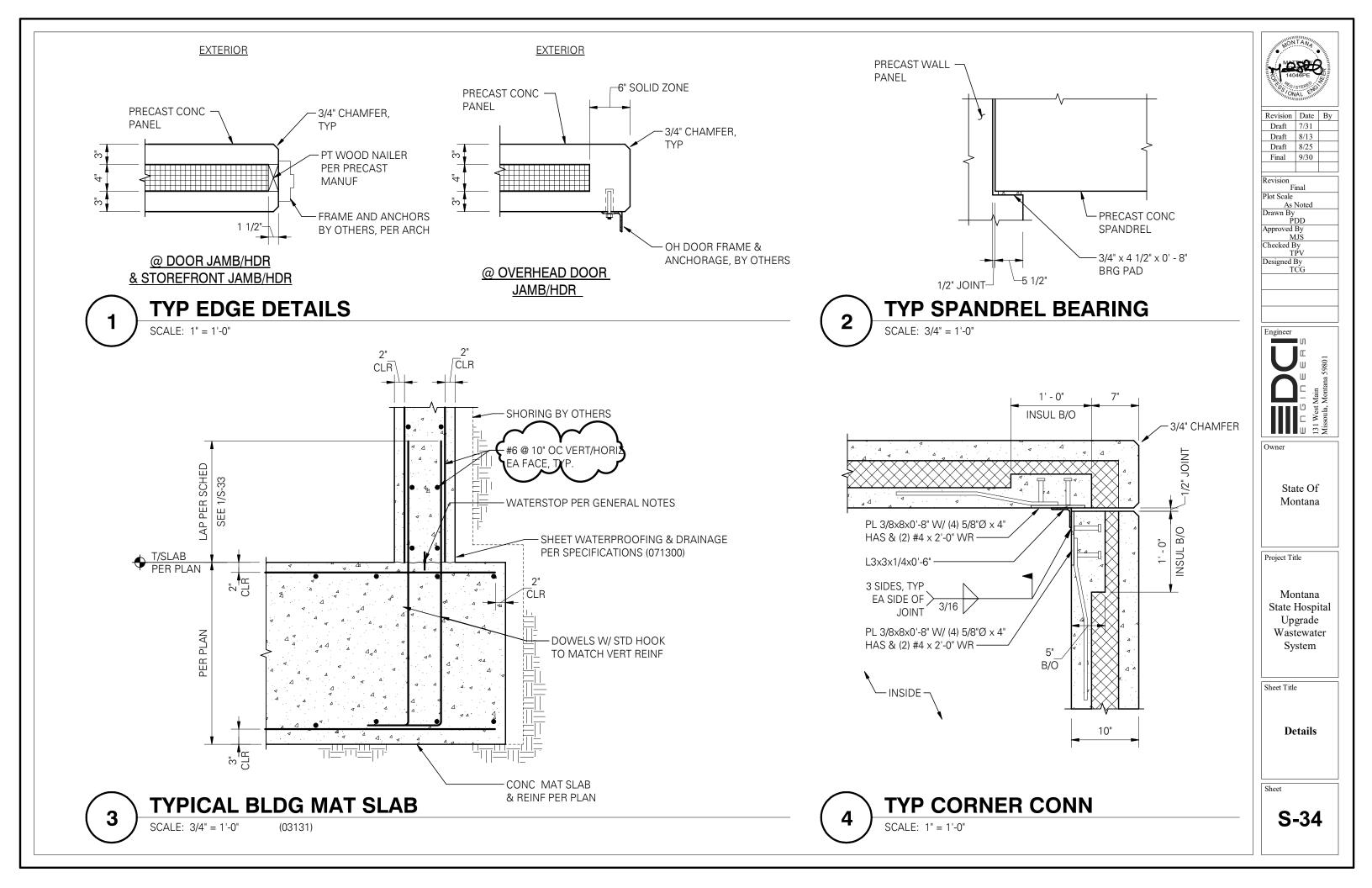


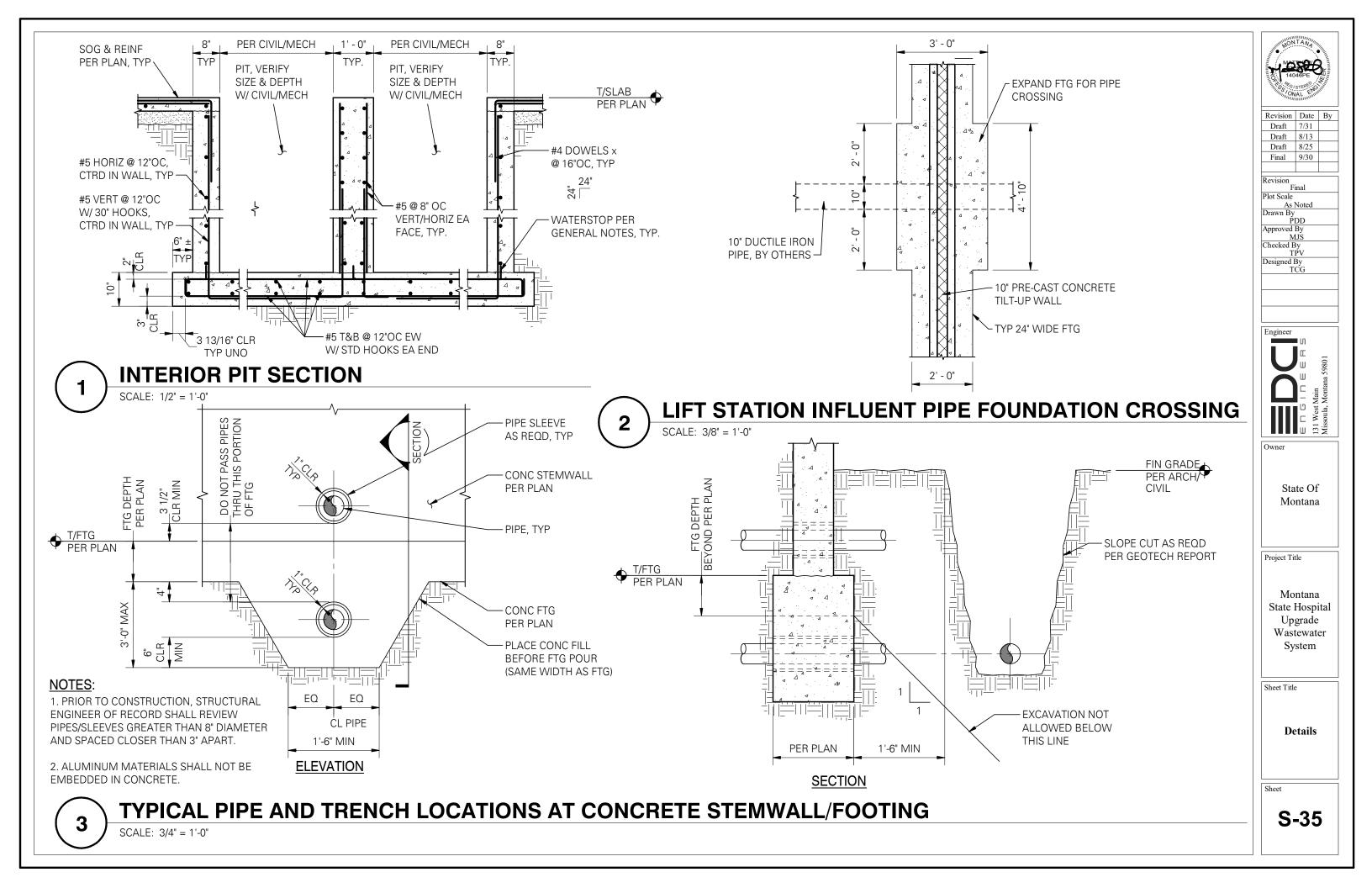


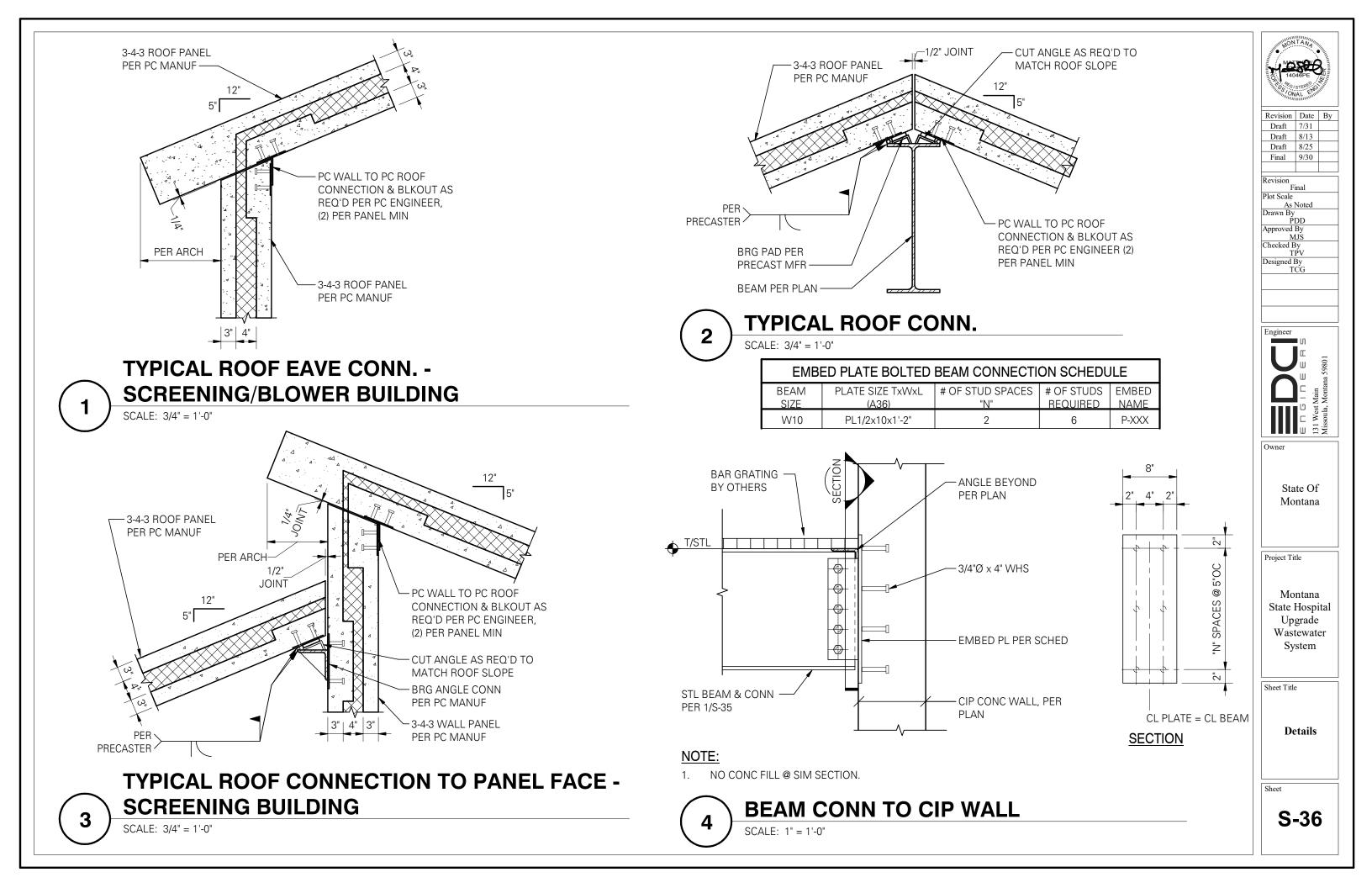
01403B GRADE 60 REINFORCING					
BAR SIZE	MISCELLANEOUS TOP BARS BARS (see note #3)			HOOKED BARS	
SIZE	Ld	Splice	Ld	Splice	Ldh
f'c = 4000	psi				
#3	15	19	19	25	8
#4	19	25	25	33	10
#5	24	31	31	41	12
#6	29	37	37	49	15











	BOLTED SINGLE SHEAR PLATE CONNECTION - SCHEDULE "A"										
3/4"Ø -	A325-N	SINC	GLE ROW		BEAM F	y=50KSI - CONNEC	TION PLATE F	y=36KSI			
BEAM	"N" BOLTS	MIN SHEAR PLATE OR WT	MIN HSS COLUMN	WELD	MAX SINGLE	MAX DOUBLE	CONNECT	ON CAPACI (KIPS)	ry - ASD (3)		
SIZE	(1)	REQUIRED		• • = • • •	WALL THICKNESS(10)	SIZE t(7)	COPE DEPTH (9)	COPE DEPTH (9)	UNCOPED	COPED	
	(1)	THICKNESS		(77	(8)	(0)	UNCOFED	SINGLE	DOUBLE		
C8,C9,C10	2	1/4"	1/4"	3/16"	1 1/4"	NR (11)	13.2	7.6	NR (11)		
W8	2	1/4"	1/4"	3/16"	1 1/4"	NR (11)	13.2	7.6	NR (11)		
W10	2	1/4"	1/4"	3/16"	2 1/2"	1 1/4"	13.2	11.0	11.0		

# **BOLTED SINGLE ROW SHEAR PLATE CONNECTION NOTES:**

1. PROVIDE EITHER STANDARD OR HORIZONTAL SHORT SLOTTED HOLES AS PERMITTED BY AISC J3.2 IN THE BEAM WEB AND/OR THE SHEAR PLATE.

2. WHERE SHORT-SLOTTED HOLES ARE USED, PROVIDE HARDENED WASHERS PER AISC J3.2.

3. CAPACITIES BASED ON AISC 13TH EDITION WITH ASTM A325-N BOLTS.

4. HORIZONTAL DISTANCE FROM SUPPORT FACE TO CENTERLINE OF BOLT GROUP SHALL BE AS SHOWN IN THE DETAILS, BUT SHALL NOT EXCEED 3 1/2" IN THE AS-BUILT CONDITION. SUPPORT FACE FOR TEE IS THE INSIDE FACE OF FLANGE.

5. VERTICAL EDGE DISTANCE FROM BOLT CENTERLINE TO EDGE OF STEEL SHALL BE 1 1/2" TYPICALLY, EXCEPT THAT 1 1/4" IS PERMITTED PER AISC TABLE J3.4 FOR 3/4" DIAMETER BOLTS WITHOUT ANY REDUCTION IN THE TABULATED CAPACITIES

6. GAP BETWEEN BEAM END AND SUPPORT FACE SHALL BE 1/2" EXCEPT FOR "WT" CONNECTORS USED WITH HSS COLUMNS. WHERE "WT" ARE USED AS SHEAR TAB ELEMENTS. THE GAP BETWEEN FACE OF COLUMN AND END OF BEAM SHALL NOT EXCEED THE LESSER OF 1 1/2" OR THE "k" DISTANCE OF THE "WT" PLUS 1/4".

7. WELD SIZES SHALL BE THE LARGER OF THE SIZE (t), TABULATED IN SCHEDULE "A" OR MINIMUM SHOWN IN TABLE 1.

8. FIELD FILLET WELDS SHALL BE SIZED TO BE AT LEAST 1/8" LARGER THAN THE WELD SIZE SHOWN IN SCHEDULE "A", UNLESS PROPER FIT-UP IS VERIFIED BY A SPECIAL INSPECTOR PRIOR TO WELDING.

9. COPE DEPTHS (SINGLE AND DOUBLE) SHALL NOT EXCEED THE LESSER OF THOSE SHOWN IN SCHEDULE "A", NOR AS ALLOWED BY BOLT HOLE SPACING AND MINIMUM EDGE DISTANCE REQUIREMENTS. SINGLE COPE LENGTH SHALL NOT EXCEED 6 1/2". DOUBLE COPE LENGTHS SHALL NOT EXCEED THAT REQUIRED TO ACCOMMODATE GIRDER FLANGE + 1/2" MAX GAP BETWEEN FLANGES.

10. UNCOPED CAPACITIES OF WT CONNECTIONS ARE VALID WITH MINIMUM NOMINAL HSS COLUMN WALL TABULATED THICKNESS. THE EFFECTIVE THROAT OF FLARE BEVEL GROOVE WELDS IS BASED ON OUTSIDE RADIUS OF HSS, AND IS TAKEN AS 5/8 TIMES THE HSS WALL THICKNESS BASED ON AWS D1.1, TABLE 2.1. WHEN 3/4" A325-N BOLTS ARE USED, A 3/16" HSS COLUMN WALL THICKNESS IS PERMITTED WITH A 20% REDUCTION OF THE WT CONNECTION CAPACITY.

11. NR = NOT RECOMMENDED, DOUBLE COPES FOR THESE BEAMS ARE RESTRICTED BY CONNECTION GEOMETRY AND/OR LARGE REDUCTIONS IN SHEAR CAPACITY. DOUBLE COPES ARE POSSIBLE, BUT CAPACITIES MUST BE CALCULATED FOR SPECIFIC BEAM AND GIRDER GEOMETRIES AND MUST BE DETAILED SEPARATELY.

# SINGLE SHEAR PLATE (SINGLE ROW) CONNECTIONS

SCALE: 1" = 1'-0"

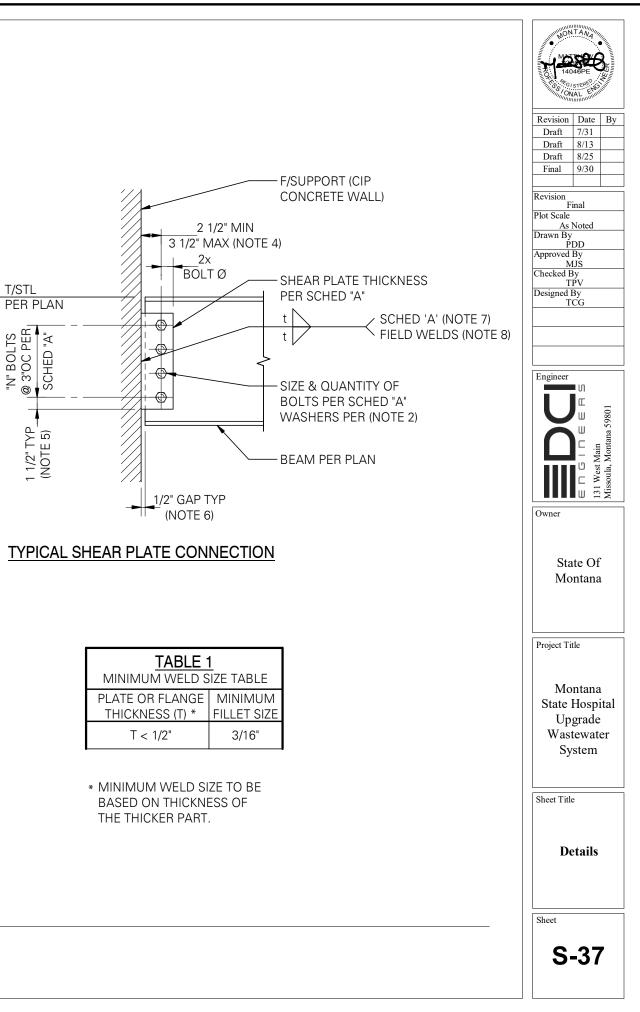
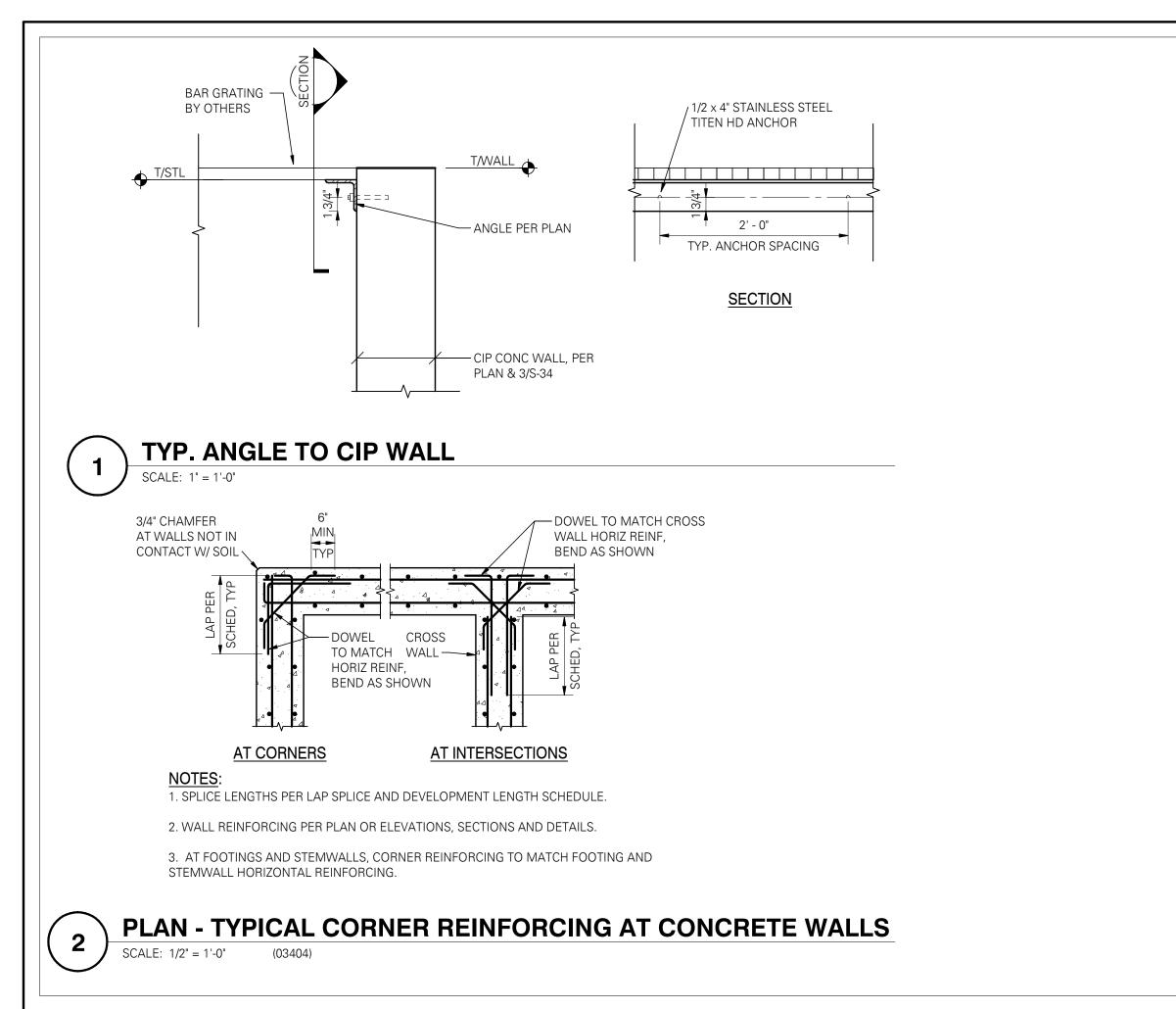
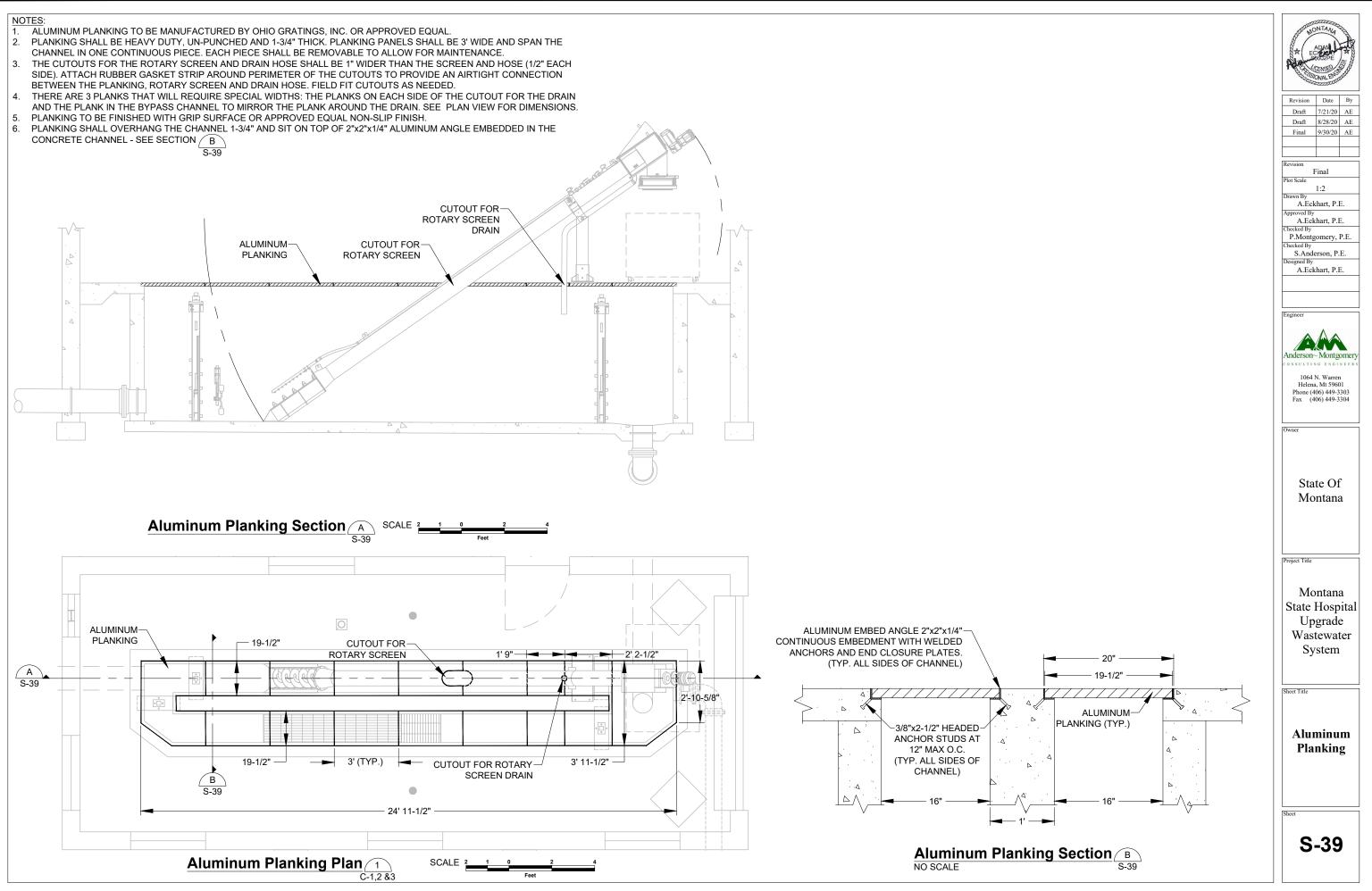
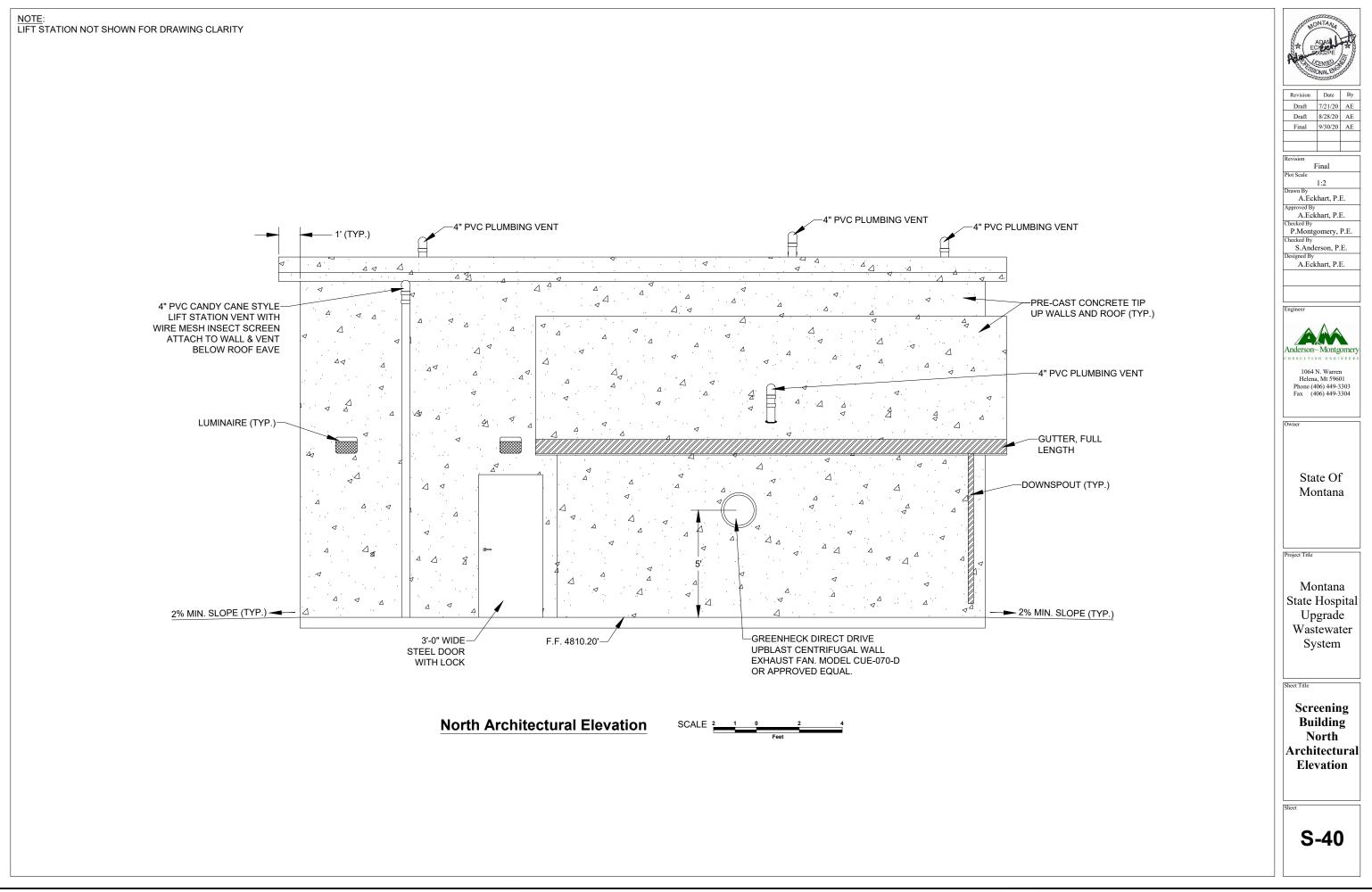


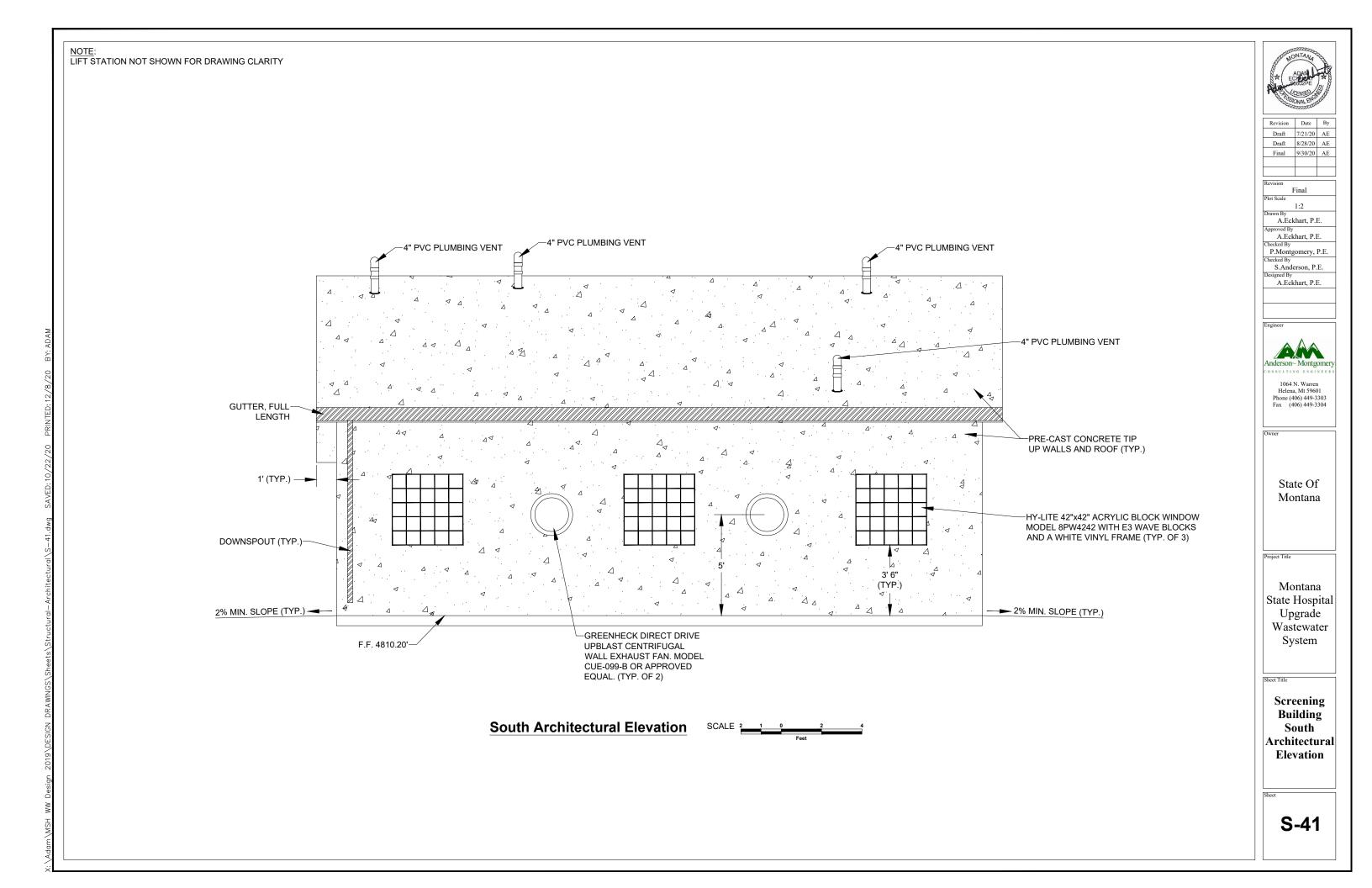
TABLE ¹	1
MINIMUM WELD S	IZE
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THICKNESS (T) *	FILL
T < 1/2"	
	PLATE OR FLANGE THICKNESS (T) *

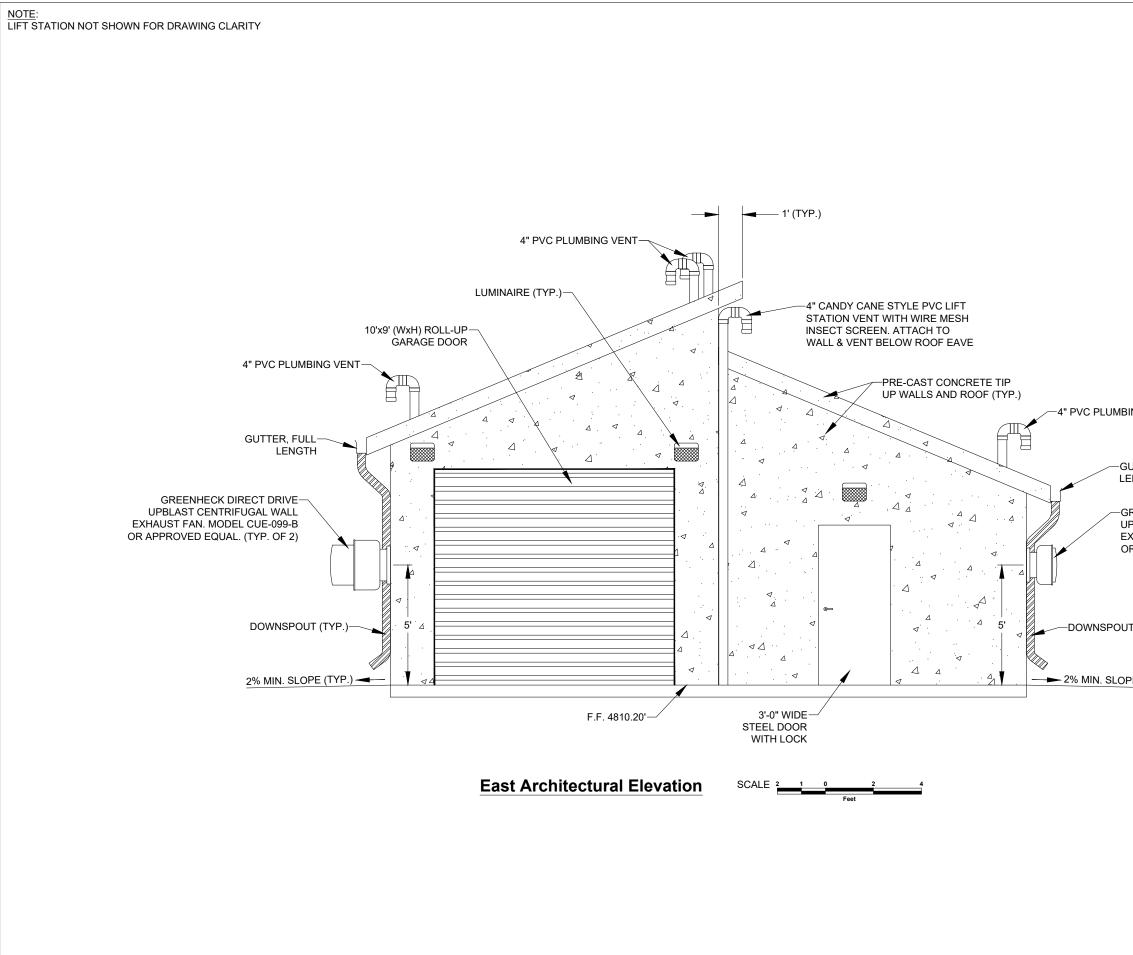


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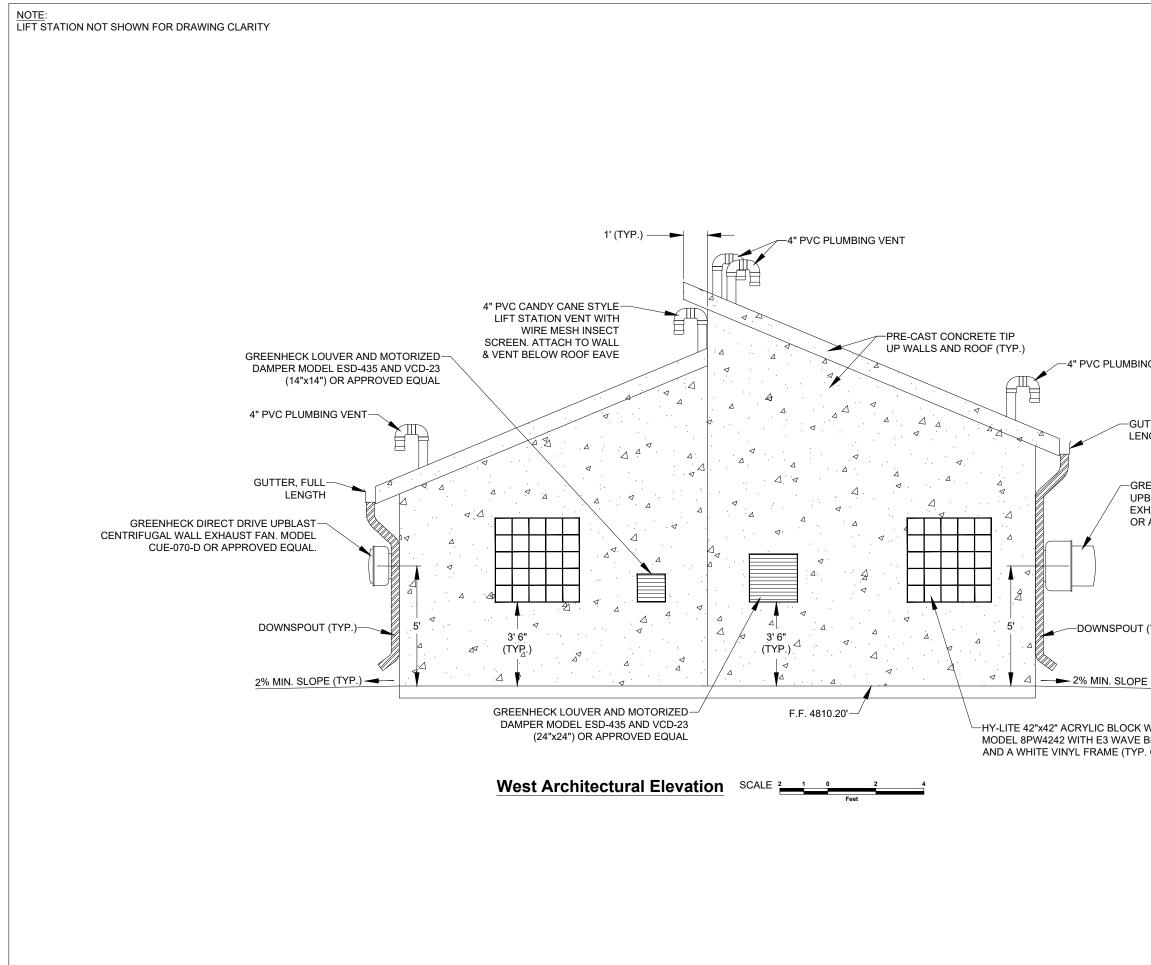




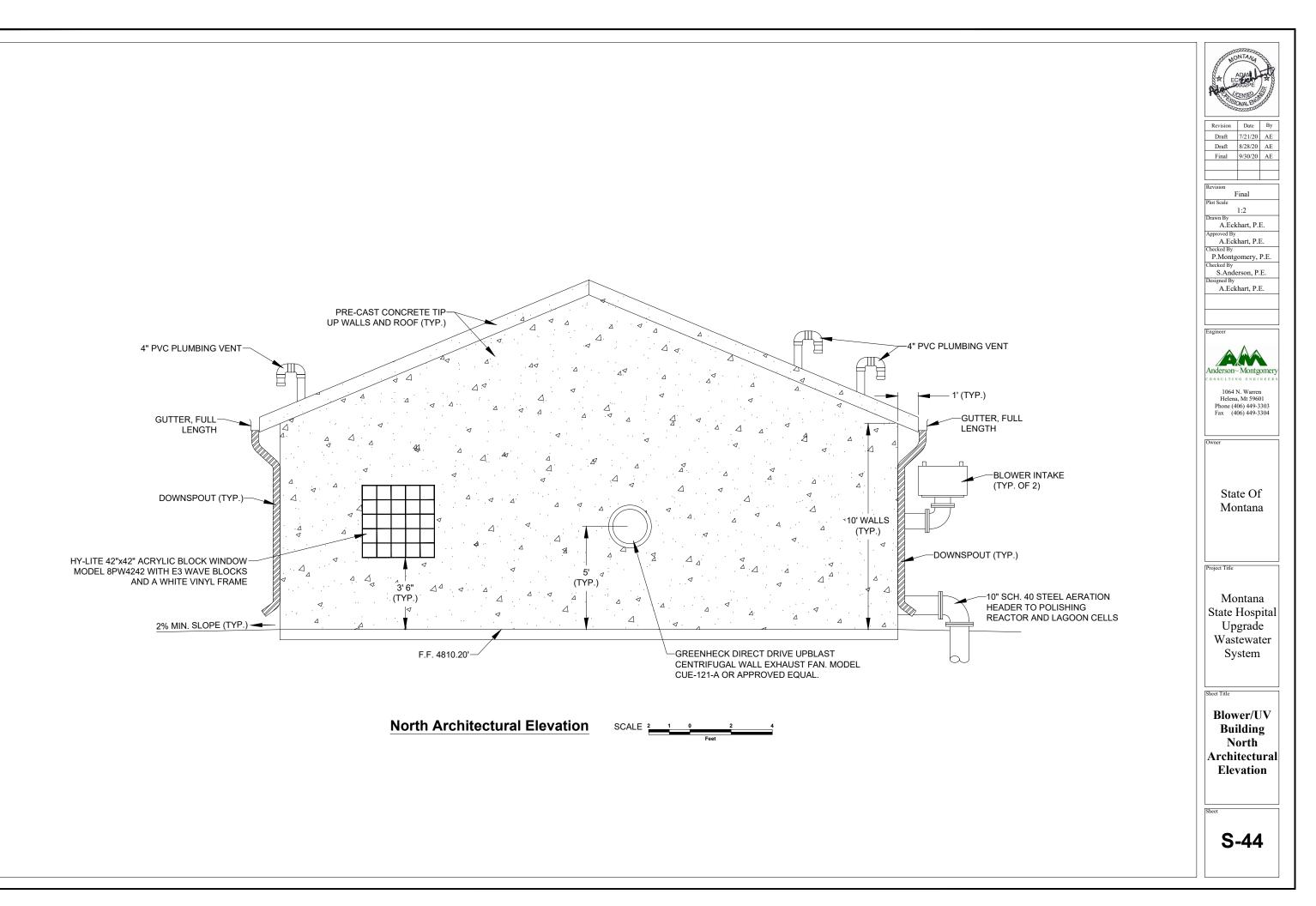




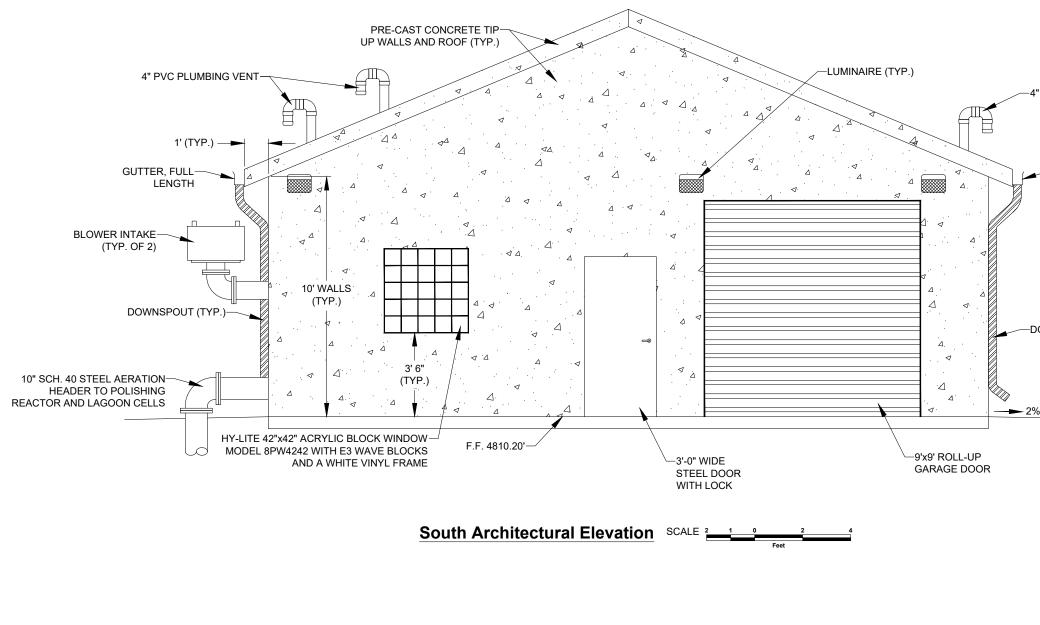
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	A.Eckhart, P.E.
	Anderson~ Montgomery
BING VENT	1064 N. Warren Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
GUTTER, FULL LENGTH	Owner
GREENHECK DIRECT DRIVE UPBLAST CENTRIFUGAL WALL EXHAUST FAN. MODEL CUE-070-D OR APPROVED EQUAL.	State Of Montana
UT (TYP.)	Project Title
DPE (TYP.)	Montana State Hospital Upgrade Wastewater System
	Sheet Title
	Screening Building East Architectural Elevation
	Sheet S-42



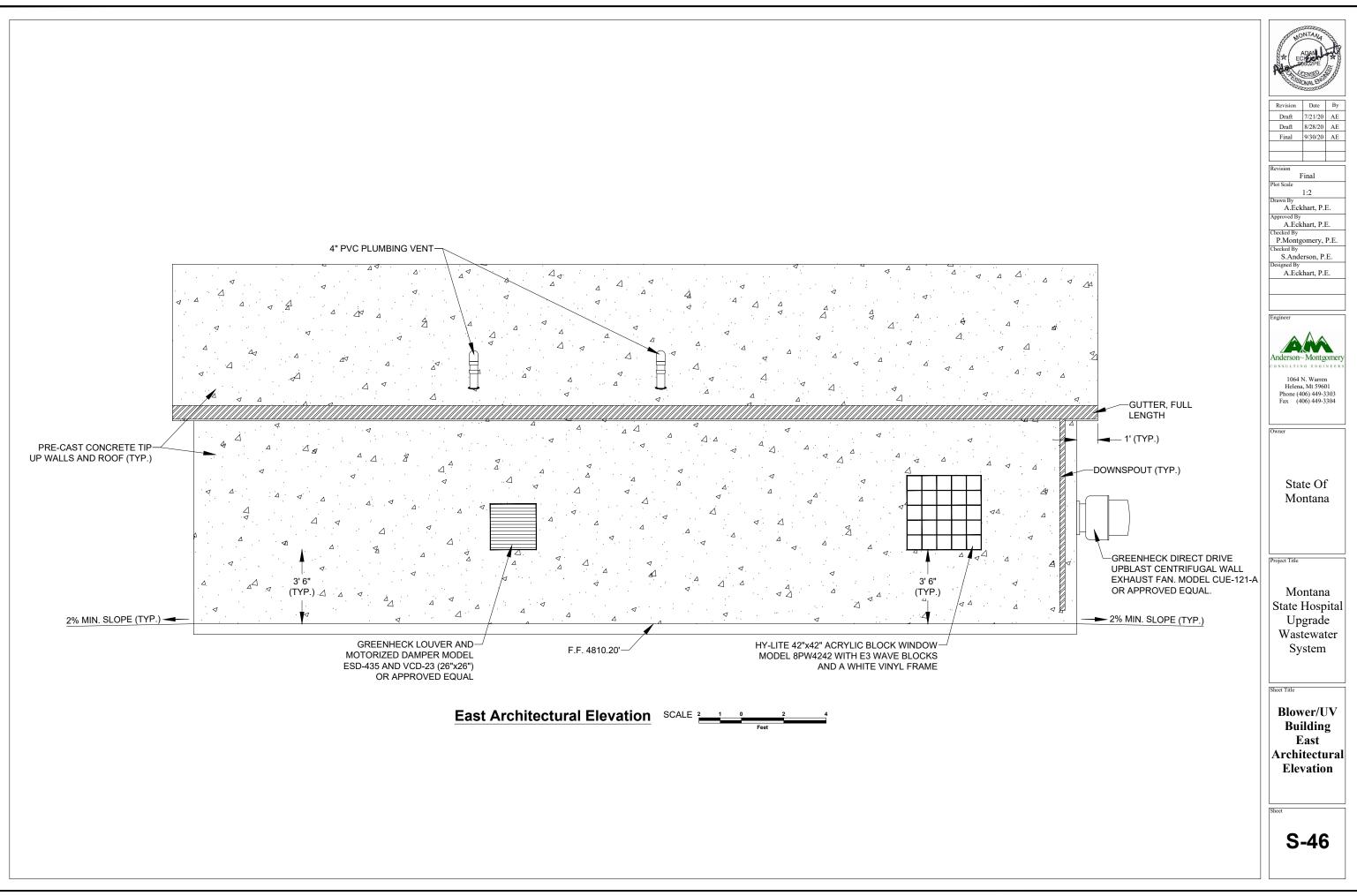
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	Approved By A.Eckhart, P.E.
	Checked By P.Montgomery, P.E.
	Checked By S.Anderson, P.E.
	Designed By A.Eckhart, P.E.
	Engineer
IG VENT	
	Anderson~ Montgomer
	CONSULTING ENGINEER
TTER, FULL	1064 N. Warren Helena, Mt 59601
NGTH	Phone (406) 449-3303 Fax (406) 449-3304
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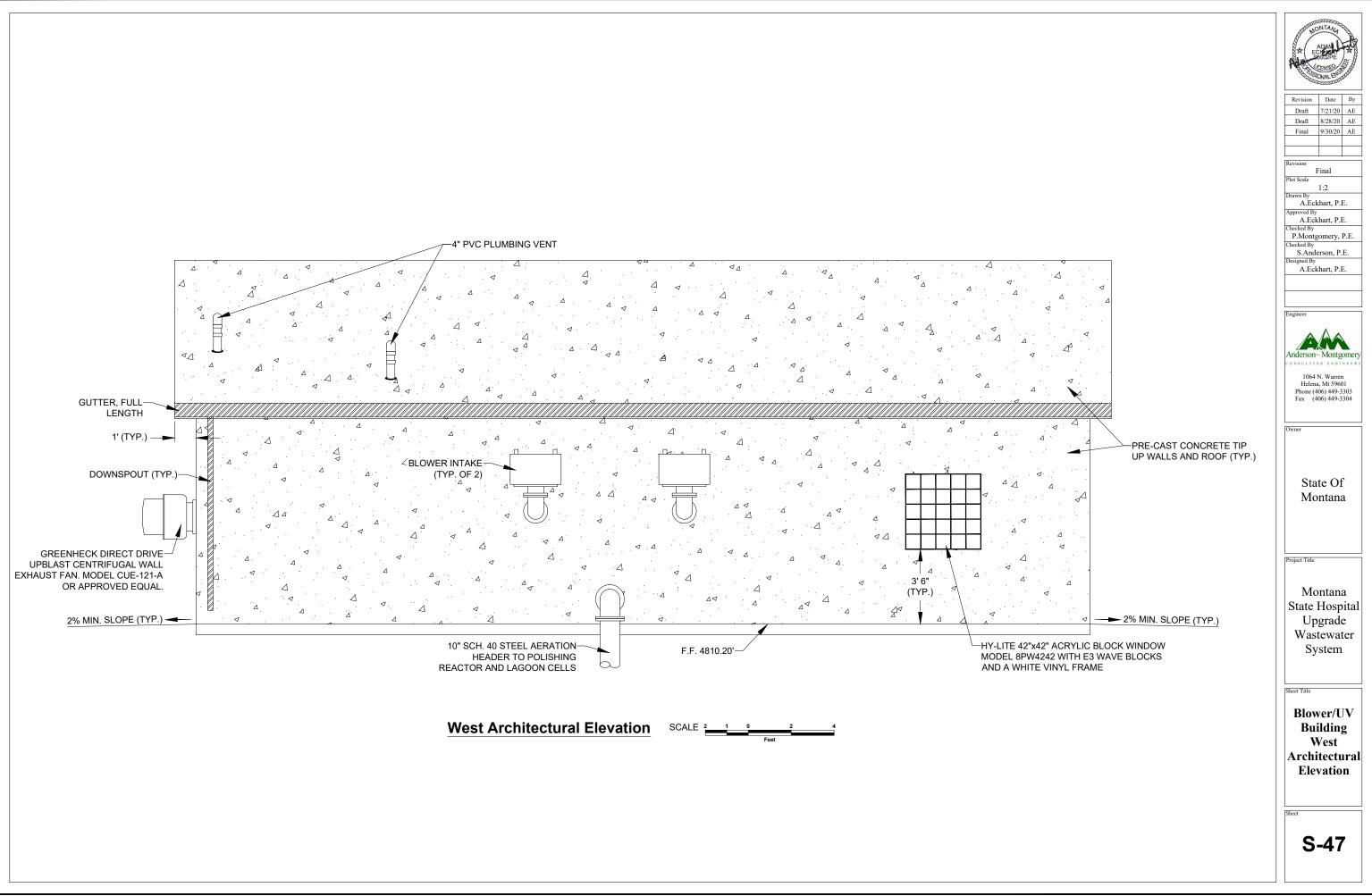






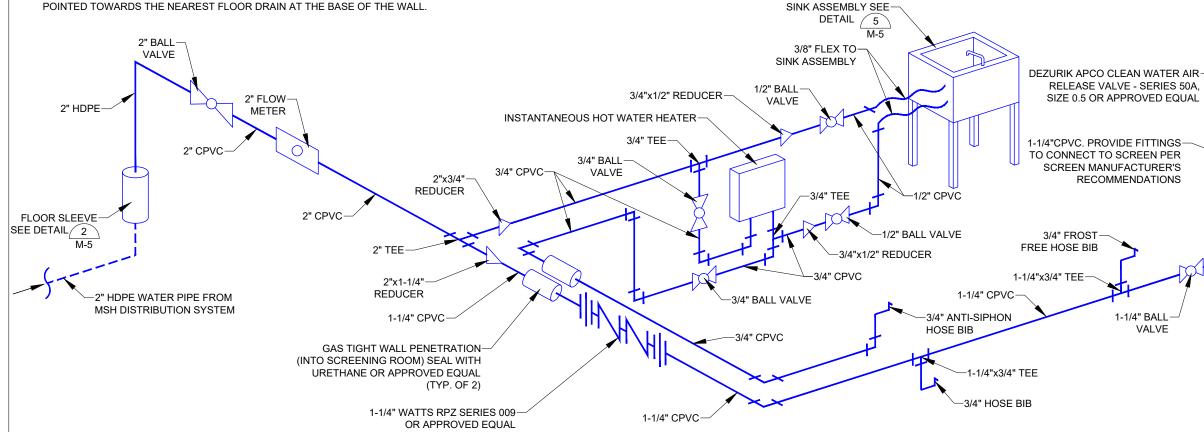
GUTTER, FULL LENGTH OWNSPOUT (TYP.) OWNSPOUT (TYP.) Project 1016 Montana State Of Montana State Hospital Upgrade Wastewater System Swett Tite Blower/UV Building South Architectural Elevation		Sheet 8-45
PPVC PLUMBING VENT  PVC PLUMBING VENT  GUTTER, FULL  LENGTH  OWNSPOUT (TYP.)  Project Tite  Montana  State Of Montana  State Hospital  Upgrade Wastewater System		Building South Architectural
P PVC PLUMBING VENT  PVC PLUMBING VENT  GUTTER, FULL LENGTH  PUC PLUMBING TYP.)  Proyet Title  Prove the set of Montana  P	MIN. SLOPE (TYP.)	State Hospital Upgrade Wastewater System
PVC PLUMBING VENT  PVC PLUMBING VENT  GUTTER, FULL LENGTH  Draft 7/21/20 AE Draft 8/38/20 AE Final Plot Scale 1:2 Drawn By A.Eckhart, P.E. Phontgomery, P.E. Checked By S.Anderson, P.E. Designed By A.Eckhart, P.E. The scale 1:2 Designed By Checked By S.S.Anderson, P.E. Designed By A.Eckhart, P.E. Checked By S.S.Anderson, P.E. Designed By A.Eckhart, P.E. Designed By	OWNSPOUT (TYP.)	
PVC PLUMBING VENT  PVC PLUMBING VENT  GUTTER, FULL LENGTH		
PVC PLUMBING VENT		Helena, Mt 59601 Phone (406) 449-3303 Fax (406) 449-3304
Draft       7/21/20       AE         Draft       8/28/20       AE         Final       9/30/20       AE         Revision	PVC PLUMBING VENT	Anderson~Montgomery
NONTANA S		Revision       Date       By         Draft       7/21/20       AE         Draft       8/28/20       AE         Final       9/30/20       AE         Exclose       1       2         Drawn By       A.Eckhart, P.E.       AEckhart, P.E.         Approved By       A.Eckhart, P.E.       Checked By         S.Anderson, P.E.       Designed By       Designed By

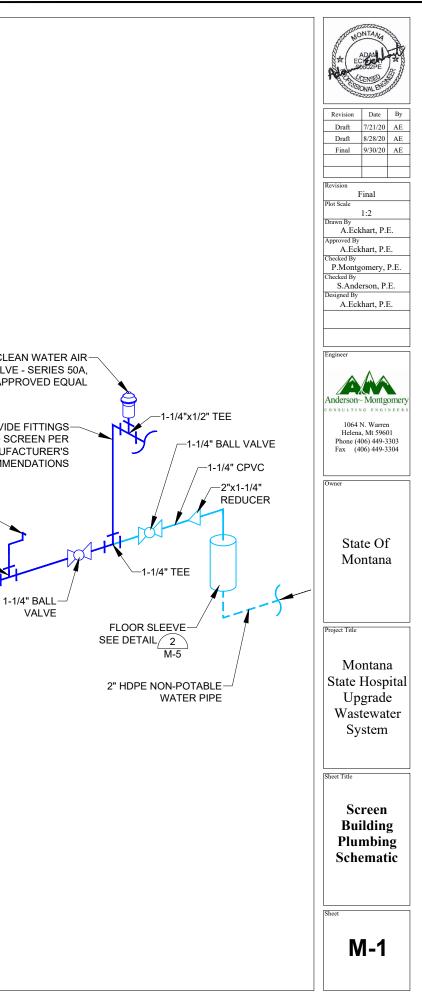






- RPZ SHALL BE WATTS SERIES 009 OR APPROVED EQUAL. CONTRACTOR TO PROVIDE AND INSTALL DRAINAGE PIPING FROM INTERNAL RELIEF VALVE TO RPZ FLOOR DRAIN LOCATED DIRECTLY BELOW THE RPZ. AIR GAP REQUIRED ON DRAIN PIPING PER MANUFACTURER'S REQUIREMENTS. RPZ TO BE INSTALLED A MINIMUM OF 12" ABOVE FINISHED FLOOR.
- ALL WATER PIPING TO BE INSTALLED 3'-0" ABOVE FINISHED FLOOR AND ATTACHED TO THE WALL WITH UNI-STRUT 4' O.C. UNLESS NOTED OTHERWISE.
- INSTANTANEOUS HOT WATER HEATER TO BE RHEEM MODEL RTEX-08 OR APPROVED EQUAL.
- SINK ASSEMBLY TO BE PLASTIC UTILITY SINK WITH LEGS AND A FAUCET. SINK TO BE MUSTEE 14CP UTILATUB COMBO OR APPROVED EQUAL.
- ALL CPVC WATER PIPING SHALL BE SCHEDULE 80 CPVC UNLESS SPECIFIED OTHERWISE.
- INSTALL "NON-POTABLE WATER" SIGNS OVER HOSE BIBS.
- INSTALL "NON-POTABLE WATER" SIGN OVER NON-POTABLE WATER 1-1/4" BALL VALVE.
- CONTRACTOR TO PROVIDE NECESSARY FITTINGS AND PIPE SIZES TO PIPE TO ALL PLUMBING FIXTURES PER MANUFACTURER'S REQUIREMENTS AND IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE.
- HOT WATER HOSE BIB SHALL BE ANTI-SIPHON.
- INSTALL A TEE AT THE HIGH POINT IN THE WATER LINE FEEDING THE ROTARY SCREEN. INSTALL AIR RELEASE VALVE ON TEE AS PER MANUFACTURER'S RECOMMENDATIONS.
- PLUMB AIR RELEASE VALVE DISCHARGE TO THE FLOOR ALONG THE WALL. INSTALL A 90° BEND POINTED TOWARDS THE NEAREST FLOOR DRAIN AT THE BASE OF THE WALL.

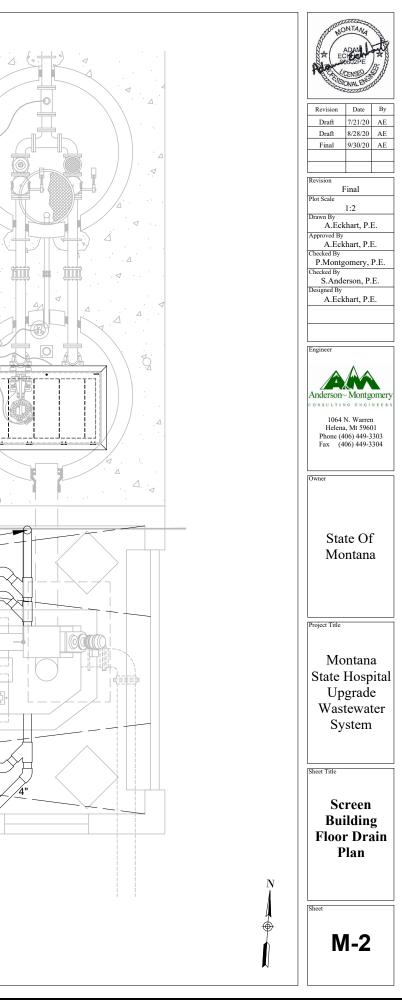


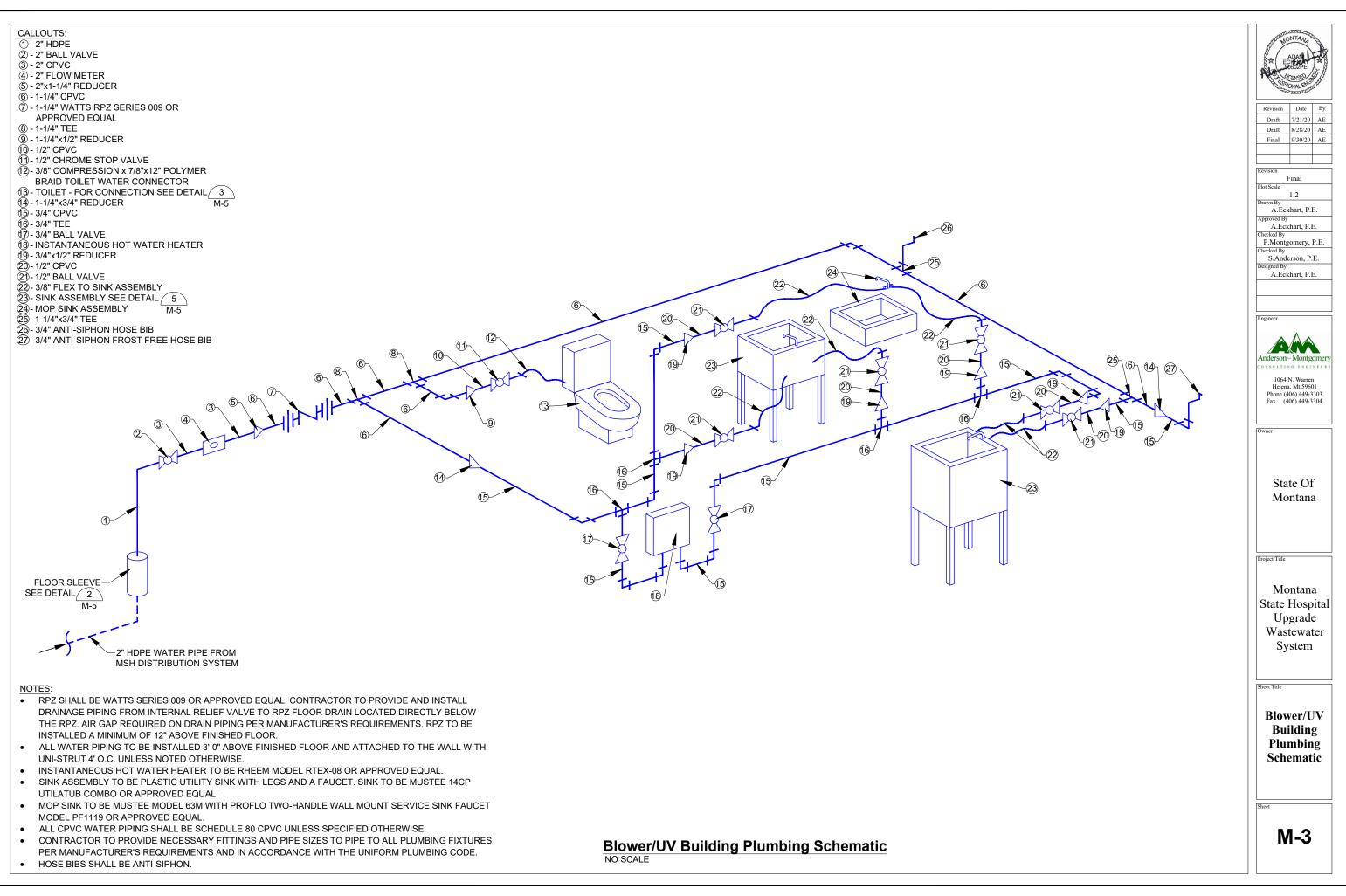


### NOTES:

- 1. ALL DRAINAGE PIPE AND FITTINGS SHALL BE PVC SCH. 40 AND SLOPE AT A MINIMUM 1/4" PER FOOT UNLESS OTHERWISE NOTED.
- 2. SECURE ALL VERTICAL PIPING AND VENTS TO CONCRETE WALLS.
- 3. ALL PLUMBING SHALL BE INSTALLED PER UNIFORM PLUMBING CODE.
- 4. THERE SHALL BE A FLOOR DRAIN LOCATED DIRECTLY BELOW THE RPZ. THERE SHALL BE AN AIR GAP BETWEEN THE FLOOR DRAIN AND RPZ AS PER MANUFACTURER'S RECOMMENDATIONS.

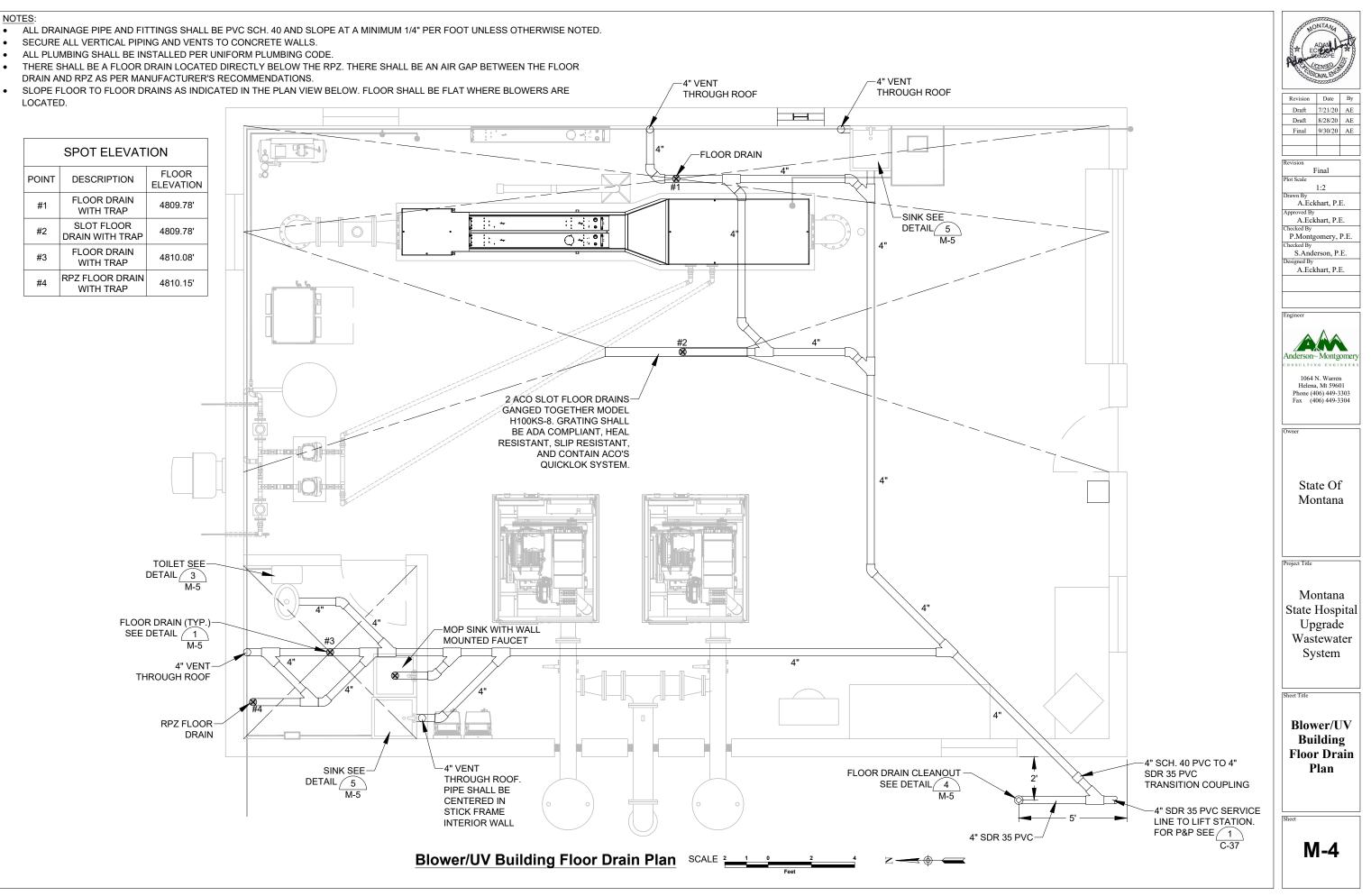
POINT	SPOT ELEVAT	ION FLOOR ELEVATION	4" VENT THROUGH ROOF	
#1	FLOOR DRAIN WITH TRAP	4809.87'		
#2	FLOOR DRAIN WITH TRAP	4809.87'		
#3	FLOOR DRAIN WITH TRAP	4809.97'		
#4	RPZ FLOOR DRAIN WITH TRAP	4810.15'		
			FLOOR DRAIN SINK SEE DETAIL 5 M-5 4"	
			4" VENT THROUGH ROOF	
			4" VENT THROUGH ROOF DRAIN 4" 4" 4" 4" 4" 4" 4" 4" 4" 4" 4" 4" 4" 4	4"
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			FLOOR DRAIN (TYP.) SEE DETAIL 1 4" VENT THROUGH ROOF	7
			Screening Building Floor Drain Plan SCALE 2 1 0 2 4 Feet	

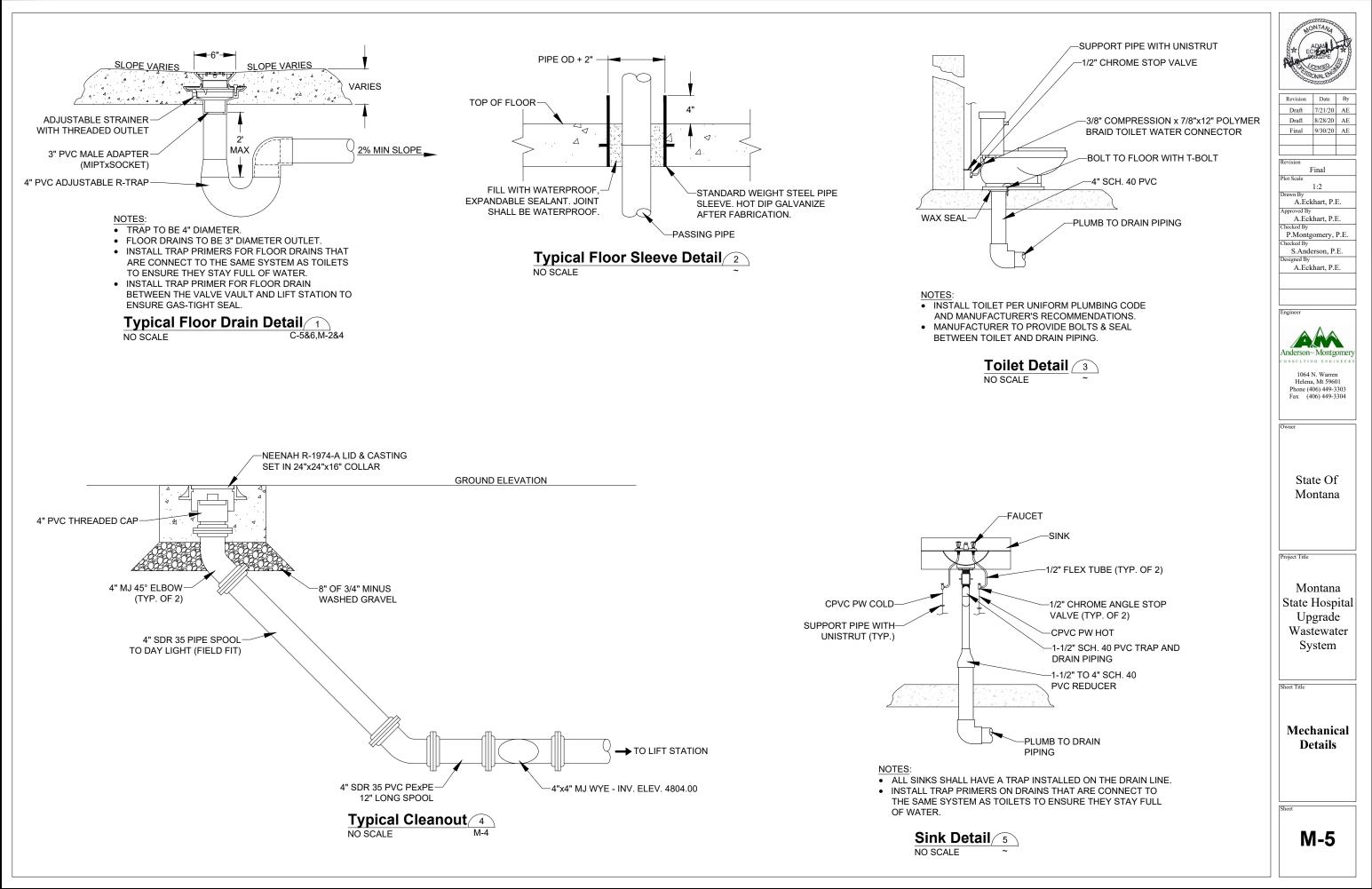


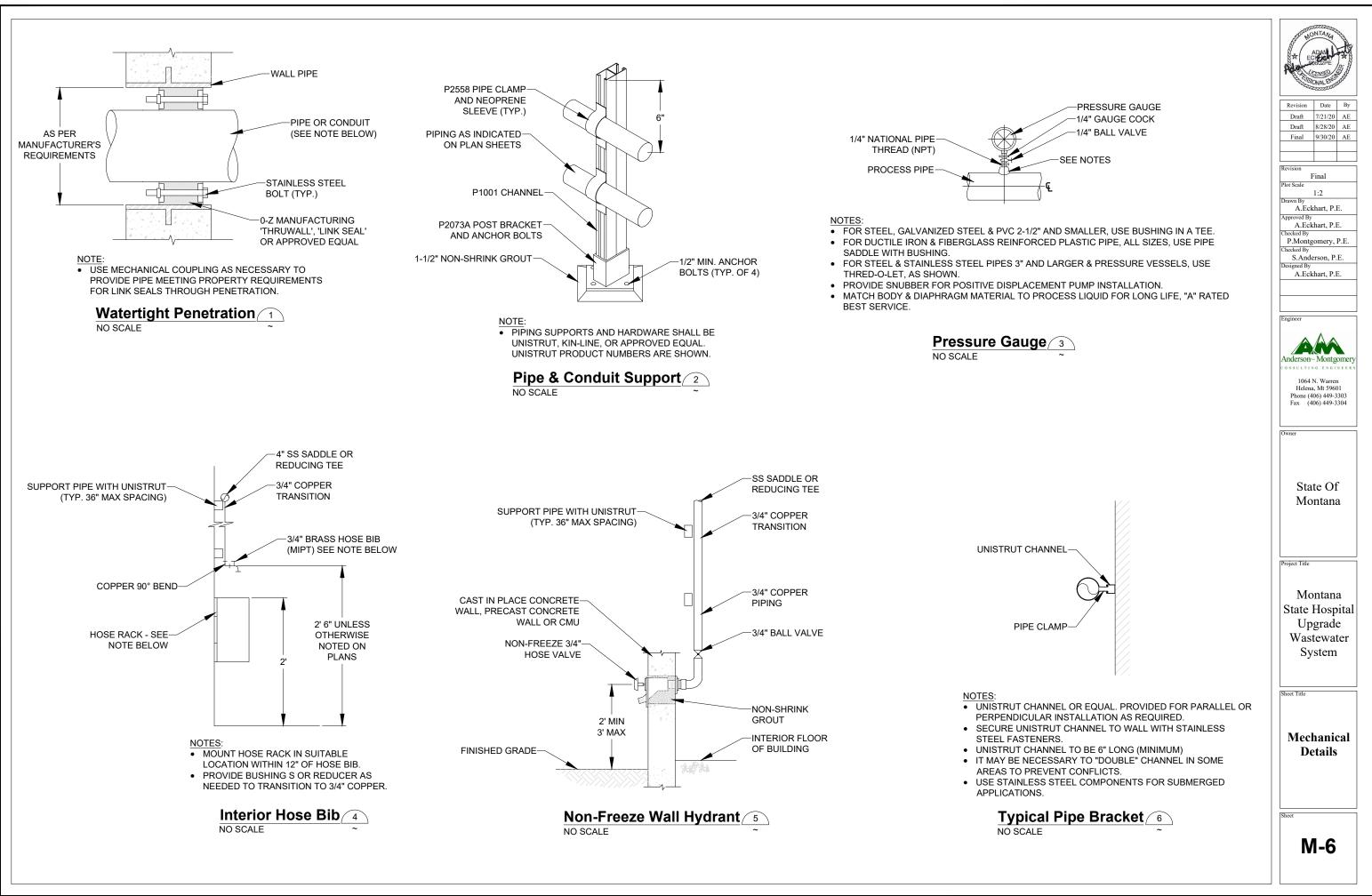


### NOTES:

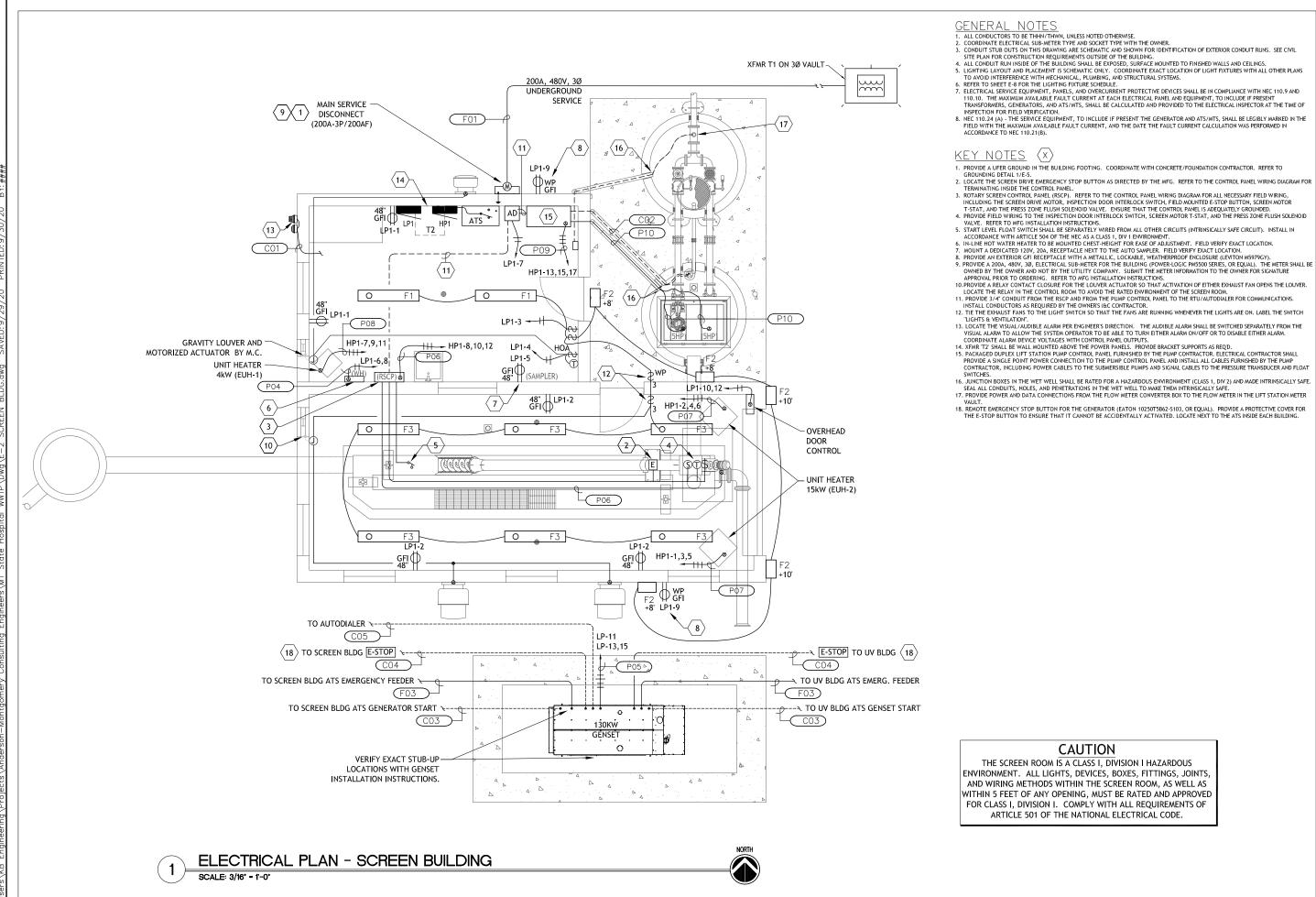
- SECURE ALL VERTICAL PIPING AND VENTS TO CONCRETE WALLS.
- .
- . DRAIN AND RPZ AS PER MANUFACTURER'S RECOMMENDATIONS.







	ELECTRICAL S	YMBOLS		GENERAL ELECTRICAL NOTES		ABBI	REVIATIONS LEGENI	)	
		TMDOLO			RACEWAYS: RACEWAYS SHALL BE CONCEALED AND APPROVED FOR USE AND LOCATION. DRY LOCATIONS - GRC, IMC, EMT.	A – AMPERE A/C – AIR CONDITIONING	N - NEUTRAL N/A - NOT APP		N. N. 000000000000000
	LINEAR STRIP		HOMERUN TO PANEL A, CKT 1. ARROWHEADS INDICATE # OF CIRCUITS. HASH MARKS INDICATE # OF CONDUCTORS.	CONTRACTOR SHALL INCREASE CONDUIT AND CONDUCTOR SIZE TO ALLOW FOR A 3% MAXMUM VOLTAGE DROP WHERE NECESSARY. SHOULD THE CONTRACTOR EXCEED THE SPECIFIC ROUTING INDICATED ON THE PLANS, THEN THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN WRITING PRIOR TO ANY DEVIATION FROM THE PLANS.	UNDERGROUND - GRC, PVC FLEXIBLE CONDUIT - GALVANIZED, LIQUID TIGHT STEEL. JUNCTION AND PULL BOXES:	A/C – AIR CONDITIONING ACP – AIR COMPRESSOR AFF – ABOVE FINISHED FLOOR AHU – AIR HANDLING UNIT ARCH – ARCHITECTURAL	NC – NORMALI	LY CLOSED AL ELECTRIC CODE LY OPEN	DANIEL LEE A
0	SURFACE-MOUNT LIGHT	-+++T	= NEUTRAL; I = HOT; ⊺ = ISOLATED GND; ⊫ RETURN	ALL WORK SHALL COMPLY WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE THAT HAS BEEN ADOPTED BY THE STATE OF MONTANA.	DRY LOCATIONS - STEEL WITH COVERS. WET LOCATIONS - CAST ALUMINUM.	AMP – AMPLIFIER ATS – AUTOMATIC TRANSFER SV		JRRENT PROTECTION	The DNAL ENTITIES
Ø	RECESSED LIGHT		CONDUIT TURNED UP	ALL CONDUCTORS SHALL BE TYPE THHN, UNLESS NOTED OTHERWISE.	SIZE PER NEC. COUPLINGS AND CONNECTORS:	AUX — AUXILIARY BLDG — BUILDING	P – POLE PH – PHASE		Revision Date By
0	RECESSED EMERGENCY LIGHT		CONDUIT TURNED DOWN	RECEPTACLES SHALL BE NEMA 5-20R.	GRC - THREADED IMC - THREADED	BLR – BOILER	PNL – PANEL PP – POWER F PVC – POLY VIN	PACK	Draft 9/18/20 DT
$\oslash$	RECESSED CAN LIGHT		UNDERGROUND CONDUIT	PRIOR TO BID, ROUGH-IN, AND INSTALLATION, THE CONTRACTOR SHALL FIELD VERIFY THE LOCATION AND REQUIREMENTS OF ALL ELECTRICAL ITEMS.	EMT - COMPRESSION OR SET SCREW, BOTH OF STEEL PVC - CEMENT JOINT TYPE INDENTER TYPE CONNECTORS PROHIBITED.	CB – CIRCUIT BREAKER CCTV – CLOSED CIRCUIT TELEVISI CKT – CIRCUIT CP – CONTROL PANEL	ION PWR - POWER RA - RANGE		Final 9/30/20 DT
	RECESSED EMERGENCY CAN LIGHT		CONDUIT HIDDEN IN WALLS/CEILING	CONTRACTOR SHALL FURNISH ALL LABOR AND MATERIALS AND PERFORM ALL OPERATIONS NECESSARY FOR THE INSTALLATION OF COMPLETE AND OPERATING ELECTRICAL SYSTEMS SUBJECT TO THE CONDITIONS OF	WIRING DEVICES AND PLATES:	CP – CUNTROL PANEL CT – CURRENT TRANSFORMER CU – COPPER	RH – RANGE H RCPT – RECEPTA RM – ROOM		
-¢-	PENDANT LIGHT		PANEL BOARD	THE CONTRACT. PROVIDE SATISFACTORY OPERATION OF ALL EQUIPMENT AND CONTROLS TO THE ENGINEER UPON	DUPLEX OUTLETS - INDUSTRIAL GRADE, 20 AMP, 5-20R (HUBBELL #HBL5362 OR LEVITON #3362) GFCI OUTLETS - COMMERCIAL GRADE, 20 AMP, 5-20R (HUBBELL #HBLG5362 OR LEVITON #7899) AC SWITCHES GENERAL - INDUSTRIAL GRADE, 20 AMP (HUBBELL #HBL1221 OR LEVITON #121-12)	DB – DIRECT BURIED DEF – DUEL ELEMENT FUSE	SA – SURGE A SPEC – SPECIFIC	ATION	Revision
-0	WALL MOUNTED SCONCE	$\cap$	CIRCUIT BREAKER	REQUEST.	EXPLOSION PROOF OUTLETS: 20 AMP, 125VAC (APPLETON #EFSC175-2023) EXPLOSION PROOF SWITCHES: 20 AMP, 125VAC (APPLETON #EDSC175-F1/F3W) DEVICE COLOR - STAINLESS STEEL	DP – DIMMABLE LIGHT PACK DPDT – DOUBLE POLE DOUBLE TH DR – DRYER	HROW SPST - SINGLE F SV - SOLENOI	POLE SINGLE THROW ID VALVE	Plot Scale 1:2
Q	BOLLARD LIGHT		UTILITY METER	CONTRACTOR IS REQUIRED TO VISIT THE PREMISES BEFORE SUBMITTING BID, AS NO EXTRAS WILL BE ALLOWED FOR LACK OF KNOWLEDGE OF EXISTING CONDITIONS.	PLATES - STAINLESS STEEL	DPIS – DOOR POSITION INDICATO DVR – DIGITAL VIDEO RECORDER DW – DISHWASHER		OCK	Drawn By D.Tintzman, P.E.
-¢-⊡	POLE-MOUNTED LIGHT, SINGLE HEAD	J	UTILITY POLE	ELECTRICAL DRAWINGS ARE DIAGRAMMATIC AND BECAUSE OF THE SMALL SCALE, IT IS NOT POSSIBLE TO INDICATE EVERY REQUIRED OFFSET, FITTING, ETC. VERIFY ALL SPACE REQUIREMENTS, COORDINATING WITH OTHER TRADES, AND INSTALL THE SYSTEMS IN THE SPACE PROVIDED WITHOUT EXTRA CHARGES TO	WIRE: COPPER ONLY WITH THHN/THWN TYPE INSTALLATION. NO ALUMINUM CONDUCTORS ALLOWED. UL LISTED LUGS AND CONNECTORS. ALL COLOR-CODING SHALL BE NEC APPROVED. ALL WIRE SIZES BASED ON 75 DEGREE C TERMINALS.	DWG - DRAWING EA - EACH	TVSS – TRANSIE	DNE TERMINAL BOARD NT VOLTAGE SURGE SUPP.	Approved By D.Tintzman, P.E. Checked By
¢-⊡-¢	POLE-MOUNTED LIGHT, DOUBLE HEAD	O	ELECTRICAL JUNCTION BOX	THE OWNER.	GROUNDING: IN STRICT ACCORDANCE WITH THE NEC, UTILITY AND TELEPHONE COMPANY REGULATIONS.	EG – EARTH GROUND EL – ELECTRIC LATCH EMT – ELECTRICAL METALLIC TU	JBING UG – UNDERG	ROUND	D.Tintzman, P.E. Designed By
W	WALLPACK	$\diamond$	GENERATOR	CONTRACTOR SHALL PERFORM WORK IN ACCORDANCE WITH GOOD COMMERCIAL PRACTICE. THE GOOD APPEARANCE OF THE FINISHED WORK SHALL BE OF EQUAL IMPORTANCE WITH ITS ELECTRICAL EFFICIENCY	PROVIDE COPPER EQUIPMENT GROUNDING CONDUCTOR IN ALL RACEWAYS. SUPPORTS AND HANGERS: SUPPORTS AND HANGERS MUST BE UL LISTED AND APPROVED BY LOCAL	EQP - EQUIPMENT EX - EXISTING	UOI – UNLESS ( V – VOLT	OTHERWISE INDICATED	D.Tintzman, P.E.
•	EXIT LIGHT W/ DIRECTIONAL ARROW	7.	AUTOMATIC TRANSFER SWITCH	THE ENGINEER MAY REJECT WORK IF WORKMANSHIP AND APPEARANCE ARE NOT SATISFACTORY. INSTALL EQUIPMENT AND MATERIALS IN ACCORDANCE WITH THE MANUFACTURERS RECOMMENDATIONS UNLESS SPECIFICALLY INDICATED OTHERWISE, OR WHERE LOCAL CODES OR REGULATIONS TAKE PRECEDENCE.	INSPECTORS.	F - FAN FACP - FIRE ALARM CONTROL PAI FARA - FIRE ALARM REMOTE ANN FARA - FIRE ALARM REMOTE ANN	NEL IUNCIATOR W – WATTS	APERES	
9-	WALL-MOUNT EMERGENCY FLOODLIGHT	×***	TRANSFORMER	CONTRACTOR SHALL APPLY FOR AND PAY FOR ALL PERMITS, FEES, LICENSES AND INSPECTIONS FOR THIS DIVISION OF WORK. COMPLY WITH STATE AND LOCAL CODE REOUREMENTS AND ORDINANCES. COMPLY	HOLIOW MASONRY - TOGGLE BOLT SOLID MASONRY - EXPANSION BOLT	FBO – FURNISHED BY OTHERS FLR – FLOOR GFI – GROUND FAULT CIRCUIT I	W/ – WITH WD – WATER E INTERUPT WG – WIRE GU		
F	EXHAUST FAN	۲	GROUND ROD	WITH REQUIREMENTS OF THE UTILITY COMPANIES. IN THE CASE OF DIFFERENCES BETWEEN THESE REQUIREMENTS AND ORDINANCES. THE MOST STRINGENT SHALL GOVERN. CALL FOR INSPECTIONS REQUIRED BY LOCAL BUILDING INSPECTION AUTHORITY.	METAL - MACHINE SCREWS, BOLTS, WELDING WOOD - WOOD SCREWS	GND – GROUND GRS – GALVANIZED RIGID STEEL	WH – WATER F WL – WET LOC WP – WEATHE	HEATER CATION R PROOF	Engineer
Ð	EXHAUST FAN WITH LIGHT FIXTURE		LOW VOLTAGE	REQUIRED BY LOCAL BUILDING INSPECTION AUTHORITY. PLANS AND SPECIFICATIONS GO HAND IN HAND, WHAT IS REQUIRED IN ONE IS REQUIRED IN BOTH. WHERE	NAME PLATES: PROVIDE ON ALL PANELS, DISCONNECTS: 3/16" HIGH LETTERS ENGRAVED WITH CONTRASTING COLOR FILL. DEVICE PLATE ENGRAVING SHALL BE 1/8" HIGH LETTERS WITH CONTRASTING	HD – HAND DRYER HOA – HAND-OFF-AUTO	WS – WATERS W/O – WITHOU WTR – WATER		
Р	PHOTOCELL	Ļ	GROUND	CONFLICTS BETWEEN SPECIFICATIONS AND PLANS EXIST, THE MOST STRINGENT REQUIREMENTS SHALL APPLY.	COLOR FILL. COLORS TO CONFORM TO OWNER'S STANDARDS. DISCONNECTS: 600 VAC HEAVY DUTY, FUSIBLE, SINGLE THROW. MANUFACTURER CUTLER-HAMMER DH	HP – HORSE POWER HPS – HIGH PRESSURE SODIUM HRV – HEAT RECOVERY VENTILA	XDCR – PRESSUR		
	RECEPTACLES	Ũ	TIME CLOCK	CONTRACTOR SHALL, AT COMPLETION OF WORK, DELIVER COMPLETED PROJECT RECORD DOCUMENTS MARKED WITH FIELD CHANGES TO ENGINEER.	DECONNECTS. 000 VAC HEAVED DUTING STOLES INTO HIS MIGRACIONE DUTING CONTROLLANDAMENDIT SERIES OR EQUIVALENT. NEMA 12 ENCLOSUBE INDOORS OR NEMA 3R ENCLOSURE OUTDOORS. COMPLETE WITH TYPEWRITTEN DIRECTORY, CIRCUIT BREAKERS (MULTIPLE-POLE INTERNAL TRIP), DEAD FRONT, LOCKING DOORS, UL LISTING, ETC. PROVIDE NEW PANEL TYPE WRITTEN DIRECTORIES IN PANELS WHERE	HU – HEAT UNIT HVAC – HEATING, VENTILATION, A	AIR CONDITION Y - WYE CON	NNECTED	P.O. Box 8694
÷	DUPLEX RECEPTACLE		NORMALLY OPEN CONTACT	CONTRACTOR SHALL PROVIDE A WRITTEN WARRANTY TO THE OWNER COVERING THE ENTIRE ELECTRICAL WORK TO BE FREE FROM DEFECTIVE MATERIALS, EQUIPMENT AND WORKMANSHIP FOR A PERIOD OF (ONE)	EUCKING DOURS, OL EISTING, ETC. PROVIDE NEW PANEL TYPE WRITTEN DIRECTORIES IN PANELS WHERE BRANCH CIRCUITS ARE CHANGED.	KW – KILOWATTS KVA – KILOVOLT AMPERES	Δ – DELTA C Ø – PHASE	ONNECTED	Kalispell, MT 59904 Phone (406) 212-1624
+	DUPLEX RECEPTACLE, ISOLATED GND	-N	NORMALLY CLOSED CONTACT	YEAR AFTER DATE OF ACCEPTANCE.	WHERE JOB CONDITIONS REQUIRE REASONABLE CHANGES IN INDICATED LOCATIONS AND ARRANGEMENT, MAKE SUCH CHANGES WITHOUT EXTRA COST TO OWNER. THE DRAWINGS ARE NOT INTENDED TO BE COLLED DRAWING IN MERCHANCE OF DRAWING ARE NOT INTENDED TO BE	MAX — MAXIMUM MCB — MAIN CIRCUIT BREAKER MDP — MAIN DISTRIBUTION PANE			KBengineers@centurytel.net
<b>—</b>	FOURPLEX RECEPTACLE	37	RELAY SWITCH	CONTRACTOR SHALL CLEAN EXPOSED SURFACES OF LIGHT FIXTURES, SWITCHGEAR AND OTHER EXPOSED ITEMS OF GREASE, DIRT OR OTHER FOREIGN MATERIAL. REMOVE RUBBISH AND DEBRIS RESULTING FROM THE OPERATIONS AND LEAVE EQUIPMENT SPACES CLEAN AND READY FOR USE.	SCALED FOR ROUGHING IN MEASUREMENTS AND NOT TO SERVE AS SHOP DRAWINGS. <u>PANELBOARDS</u> : PANELS SHALL BE OF TYPE AND SIZE AS INDICATED ON THE DRAWINGS. PANEL	MFG – MANUFACTURER MH – METAL HALIDE MIN – MINIMUM			Owner
$\Box$	DUPLEX RECEPTACLE, FLOOR MOUNTED		PUMPS/MOTORS	CONTRACTOR SHALL MAINTAIN ALL CEILING, FLOOR AND WALL FIRE AND SMOKE PROTECTION RATINGS.	ENCLOSURES SHALL BE RATED FOR THE SURROUNDING ENVIRONMENT, NEMA 12 FOR INDOOR, NEMA 3R FOR OUTDOOR, AND NEMA 4X FOR CORROSIVE ENVIRONMENTS. PANELS SHALL BE FULLY RATED TO INTERRUPT SYMMETRICAL SHORT-CIRCUIT CURRENT AVAILABLE AT TERMINALS. TRIM CLAMPS AND HINGES	MON - MONITOR			
€ _{xx}	SPECIALTY RECEPTACLE, SEE NOTES	Ø	PUMP	SEAL ALL CONDUIT AND ENCLOSURE PENETRATIONS TO COMPLY WITH UL ASSEMBLY AND BUILDING CODE REQUIREMENTS. ALL SEALANTS AND CONSTRUCTIONS SHALL BE APPROVED BY ENGINEER PRIOR TO APPLICATION. ALL OPENINGS SHALL BE SEALED DAILY.	SHALL BE CONCEALED. LOAD CENTERS ARE NOT ACCEPTABLE.		<b></b>	]	
	SWITCHES		MOTOR	CONTRACT DRAWINGS FOR ELECTRICAL WORK ARE IN PART DIAGRAMMATIC, INTENDED TO CONVEY THE SCOPE OF WORK AND INDICATE GENERAL ARRANGEMENT OF EQUIPMENT, CONDUITS, AND APPROXIMATE	OWNER SUPPLIED EQUIPMENT: COORDINATE ELECTRICAL CONNECTIONS FOR OWNER SUPPLIED EQUIPMENT WITH OWNER.		MOUNTING	G HEIGHTS	State Of
\$	SINGLE POLE SWITCH	Ø	VARIABLE SPEED PUMP	SIZES AND LOCATIONS OF EQUIPMENT AND OUTLETS. ELECTRICAL TRADES SHALL FOLLOW THESE DRAWINGS IN LAYING OUT THEIR WORK, CONSULT GENERAL CONSTRUCTION DRAWINGS TO FAMILIARIZE	SUBSTITUTIONS: ALL SUBSTITUTIONS TO BE APPROVED BY OWNER, ARCHITECT, AND ENGINEER. ALL LIGHTING SUBSTITUTIONS MUST BE SUBMITTED IN WRITING TO THE ENGINEER FOR CONSIDERATION.		DESCRIPTION WALL SWITCH	HEIGHT 48"	Montana
\$	TWO CIRCUIT SWITCH	Û	PUMP CONTROL PANEL	THEMSELVES WITH ALL CONDITIONS AFFECTING THER WORK, AND SHALL VERIFY SPACES IN WHICH THEIR WORK WILL BE INSTALLED. COORDINATE WORK WITH OTHER TRADES AS JOB CONDITIONS REASONABLY REQUIRE.	LIGHT FIXTURES: PROVIDE NEW LIGHT FIXTURES AS SCHEDULED COMPLETE WITH TRIM, LAMPS, FUSES, GASKETS, BALLASTS, ETC. AS SCHEDULED.		CONVENIENCE OUTLET TELEPHONE OUTLET	16" 16"	
\$	THREE CIRCUIT SWITCH		EQUIPMENT DISCONNECT	NO MORE THAN ONE OF EACH PHASE CONDUCTOR, ONE NEUTRAL, TWO TRAVELERS, TWO SWITCH LEGS,	MECHANICAL EQUIPMENT: SEE PLANS FOR CONNECTION OF MECHANICAL EQUIPMENT. PROVIDE LIQUIDTIGHT FLEXIBLE CONDUIT (WITH EQUIPMENT GROUND CONDUCTOR) CONNECTION AT ALL MOTORS.		FIRE ALARM PULL STATION FIRE ALARM HORN STROBE	42" 12" BELOW CEILING (AS LONG AS 80"-96" AFF)	
₹ ₂	DOUBLE POLE SWITCH		MAGNETIC MOTOR STARTER	AND GROUNDING CONDUCTORS SHALL BE INSTALLED IN A SINGLE RACEWAY UNLESS PRIOR APPROVAL IS OBTAINED FROM THE ENGINEER. CONDUIT FILL SHALL NOT EXCEED 40%.	THESE ARE BASIC REQUIREMENTS. SEE DIVISION 26 SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.		FIRE ALARM HORN EXIT SIGN	90" AFF, 6" BELOW CEILING CENTER, 12" ABOVE DOOR	Project Title
₹3	THREE-WAY SWITCH		MAGNETIC MOTOR STARTER WITH DISCONNECT	ALL RACEWAYS SHALL BE SURFACE-MOUNTED, EXPOSED ON EXISTING WALLS AND GYP BOARD CEILINGS. ALL EXPOSED RACEWAYS SHALL BE ROUTED PLUMB AND SQUARE TO BUILDING SURFACES.	NOTE: THIS IS A STANDARD ELECTRICAL LEGEND SHEET. THEREFORE, MANY OF THE SYMBOLS AND		INTERCOM SPEAKER MOTOR CONTROL SWITCHES	88" 42"	
₹4	FOUR-WAY SWITCH	20/3 F	20A, 3 POLE, DUEL ELEMENT FUSE WITH DISCONNECT		ABBREVIATIONS ON THIS SHEET MAY NOT BE USED ON THIS PROJECT		PANELBOARDS, ENCLOSURES MOUNTING HEIGHTS ARE FROM FINIS	72" TO TOP SHED FLOOR TO BOTTOM OF	Montana
₽  ĸ	KEY OPERATED SWITCH		FUSE	LIGHTING NOTES: COORDINATING THE PROPER TYPES OF TRIMS TO FIT THE RECESSED FIXTURES IN THE CEILING TYPE			BOX UNLESS NOTED OTHERWISE.		State Hospital
¢ _T	SWITCH WITH TIMER		FUSE WITH DISCONNECT	INDICATED BY THE ENGINEER SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ALL LIGHT FIXTURE COLORS AND FINISHES SHALL BE COORDINATED BETWEEN THE CONTRACTOR AND THE			SHEET IN	NDEX	Upgrade Wastewater
² мc ≁	MOTION CONTROLLED SWITCH	T	THERMOSTAT	ENGINEER.			E-1 ELECTRICAL SYMBOL	.S & LEGENDS	System
°€ +			PHONE/DATA	ALL LAMPS NOT SPECIFIED IN THE LIGHTING FIXTURE SCHEDULE SHALL OF THE LED TYPE. REFER TO LIGHTING FIXTURE SCHEDULE FOR LIGHTING DESCRIPTION, MFG, AND PART NUMBER.			E-2 SCREEN BUILDING EL	I	
₽ _{DH}	DEHUMIDITY SWITCH		TELEPHONE PORT	CONTRACTOR SHALL BE RESPONSIBLE FOR SUPPLYING MOUNTING BRACKETS TO FIT CEILING CONDITIONS.			E-4 ELECTRICAL SITE PLA E-5 ELECTRICAL RISER DI	AGRAM	[ [Shoot Title
\$ _{DLS}	DIGITAL LIGHTING SWITCH		DATA PORT	FIXTURES IN CONTACT WITH INSULATION SHALL HAVE A U.L. LISTED THERMAL BARRIER.				UV & BLOWER BUILDING	Sheet Title
	SECURITY/INTERCOM		DATA/PHONE PORT				E-8 ELECTRICAL SCHEDU E-9 ELECTRICAL DETAILS	I	Flootrical
1	RECESSED DOOR CONTACT	Δ	DATA/PHONE PORT, FLOOR MOUNTED						Electrical Symbols &
K	KEYPAD	DJ	DATA/PHONE JUNCTION BOX	ALTERNATE #1:					Legends
	EMERGENCY PANEL		TELEPHONE TERMINAL BOARD	NON-POTABLE WATER 2" ELECTROMAGI					
<u>(</u> )	SPEAKER		FIRE ALARM SYSTEM	ALTEDNATE 40.					
РВ	PUSHBUTTON STATION	3	SMOKE DETECTOR	ALTERNATE #2: • AIR COMPRESSOR					Sheet
PB	PUSHBUTTON STATION W/ SPEAKER	H	HEAT DETECTOR						
VC	VOLUME CONTROL	DH	MAGNETIC DOOR HOLD						
WD	WATER LEVEL DETECTOR								
5									



- FIELD WITH THE MAXIMUM AVAILABLE FAULT CURRENT, AND THE DATE THE FAULT CURRENT CALCULATION WAS PERFORMED IN
- 1. PROVIDE A UFER GROUND IN THE BUILDING FOOTING. COORDINATE WITH CONCRETE/FOUNDATION CONTRACTOR. REFER TO
- GROUNDING DETAIL 1/E-5. 2. LOCATE THE SCREEN DRIVE EMERGENCY STOP BUTTON AS DIRECTED BY THE MFG. REFER TO THE CONTROL PANEL WIRING DIAGRAM FOR TERMINATING INSIDE THE CONTROL PANEL. 3. ROTARY SCREEN CONTROL PANEL (RSCP). REFER TO THE CONTROL PANEL WIRING DIAGRAM FOR ALL NECESSARY FIELD WIRING, INCLUDING THE SCREEN DRIVE MOTOR, INSPECTION DOOR INTERLOCK SWITCH, FIELD MOUNTED E-STOP BUTTON, SCREEN MOTOR T-STAT, AND THE PRESS ZONE FLUISH SOLENDID ALV.E. ENSURE THAT THE CONTROL PANEL IS ADOQUATELY CROUNDED. 4. PROVIDE FIELD WIRING TO THE INSPECTION DOOR INTERLOCK SWITCH, SCREEN MOTOR T-STAT, AND THE PRESS ZONE FLUISH NOTROR 1. ROVIDE FIELD WIRING TO THE INSPECTION DOOR INTERLOCK SWITCH, SCREEN MOTOR T-STAT, AND THE PRESS ZONE FLUISH SOLENDID VIENCE MOTOR, INSTAL VIENTIMETRUCTORIES.
- "LIGHTS & VENTILATION". 13. LOCATE THE VISUAL/AUDIBLE ALARM PER ENGINEER'S DIRECTION. THE AUDIBLE ALARM SHALL BE SWITCHED SEPARATELY FROM THE VISUAL ALARM TO ALLOW THE SYSTEM OPERATOR TO BE ABLE TO TURN EITHER ALARM ON/OFF OR TO DISABLE EITHER ALARM. COORDINATE ALARM DEVICE VOLTAGES WITH CONTROL PANEL OUTPUTS. 14. XFMR TZ SHALL BE WALL MOUNTED ABOVE THE POWER PANELS. PROVIDE BRACKET SUPPORTS AS REQD. 15. PACKAGED DUPLEX LIFT STATION PUMP CONTROL PANEL FURNISHED BY THE PUMP CONTRACTOR. ELECTRICAL CONTRACTOR SHALL PROVIDE A SINGLE POINT POWER CONNECTION TO THE PUMP CONTROL PANEL AND INSTALL ALL CABLES FURNISHED BY THE PUMP CONTRACTOR, INCLUDING POWER CABLES TO THE SUBMERSIBLE PUMPS AND SIGNAL CABLES TO THE PRESSURE TRANSDUCER AND FLOAT
- SWITCHES. 16. JUNCTION BOXES IN THE WET WELL SHALL BE RATED FOR A HAZARDOUS ENVIRONMENT (CLASS 1, DIV 2) AND MADE INTRINSICALLY SAFE SEAL ALL CONDUITS, HOLES, AND PENETRATIONS IN THE WET WELL TO MAKE THEM INTRINSICALLY SAFE. 17. PROVIDE POWER AND DATA CONNECTIONS FROM THE FLOW METER CONVERTER BOX TO THE FLOW METER IN THE LIFT STATION METER VILLE
- VAULT. 18. REMOTE EMERGENCY STOP BUTTON FOR THE GENERATOR (EATON 10250T5862-S103, OR EQUAL). PROVIDE A PROTECTIVE COVER FOR THE E-STOP BUTTON TO ENSURE THAT IT CANNOT BE ACCIDENTALLY ACTIVATED. LOCATE NEXT TO THE ATS INSIDE EACH BULLDING.

## CAUTION

THE SCREEN ROOM IS A CLASS I, DIVISION I HAZARDOUS ENVIRONMENT. ALL LIGHTS, DEVICES, BOXES, FITTINGS, JOINTS AND WIRING METHODS WITHIN THE SCREEN ROOM, AS WELL AS WITHIN 5 FEET OF ANY OPENING, MUST BE RATED AND APPROVED FOR CLASS I, DIVISION I. COMPLY WITH ALL REQUIREMENTS OF ARTICLE 501 OF THE NATIONAL ELECTRICAL CODE.

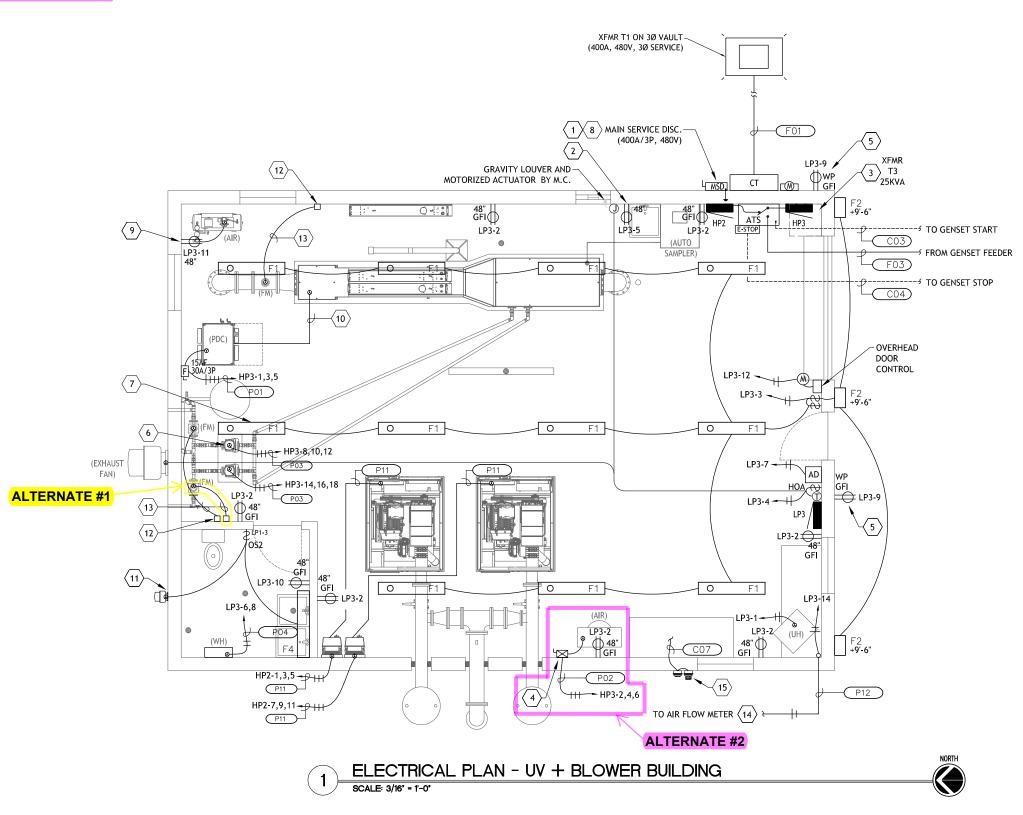
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### **ALTERNATE #1:**

NON-POTABLE WATER 2" ELECTROMAGNETIC FLOW METER

### ALTERNATE #2:

AIR COMPRESSOR



# GENERAL NOTES

1. ALL CONDUCTORS TO BE THHN/THWN, UNLESS NOTED OTHERWISE. 2. COORDINATE ELECTRICAL SUB-METER TYPE AND SOCKET TYPE WITH THE OWNER.

 CONDUCT STUB OUTS ON THIS DRAWING ARE SCHEMATIC AND SHOWN FOR IDENTIFICATION OF EXTERIOR CONDUIT RUNS. SEE CIVIL SITE PLAN FOR CONSTRUCTION REQUIREMENTS OUTSIDE OF THE BUILDING. 4. ALL CONDUIT RUN INSIDE OF THE BUILDING SHALL BE EXPOSED, SURFACE MOUNTED TO FINISHED WALLS

ALL CONDUIT RUN INSIDE OF THE BUILDING SHALL BE EXPOSED, SURFACE MOUNTED TO FINISHED WALL AND CEILINGS.
 LIGHTING LAYOUT AND PLACEMENT IS SCHEMATIC ONLY. COORDINATE EXACT LOCATION OF LIGHT FIXTURES WITH ARCHITECTURAL REFLECTED CEILING PLAN TO AVOID INTERFERENCE WITH MECHANICAL, PLUBBING, AND STRUCTURAL SYSTEMS.
 REFER TO SHEET E-8 FOR THE LIGHTING FIXTURE SCHEDULE.
 LIGHTING CUITAL SYSTEMS.
 REFER TO SHEET E-10.9 AND TO 10.10. THE MAXIMUM AVAILABLE FAULT CURRENT AT EACH ELECTRICAL SERVICE EQUIPMENT, TO INCLUDE IF PRESENT TRANSFORMERS, GENERATORS, AND ATS/MTS, SHALL BE CALCULATED AND PROVIDED TO THE ELECTRICAL INSPECTION FOR FIELD VERIFICATION.
 NEC 110.24 (A) - THE SERVICE EQUIPMENT, TO INCLUDE IF PRESENT THE GENERATOR AND ATS/MTS, SHALL BE LGIBLY MARKED IN THE FIELD WITH THE MAXIMUM AVAILABLE FAULT CURRENT, AND THE DATE THE FAULT CURRENT CALCULATED AND REVICE TO INCLUDE IF PRESENT THE GENERATOR AND ATS/MTS, SHALL BE LGIBLY MARKED IN THE FIELD WITH THE MAXIMUM AVAILABLE FAULT CURRENT, AND THE DATE THE FAULT CURRENT CALCULATION WAS PERFORMED IN ACCORDANCE TO NEC 110.21(B).



1. PROVIDE A UFER GROUND IN THE BUILDING FOOTING. COORDINATE WITH CONCRETE/FOUNDATION CONTRACTOR. REFER TO GROUNDING DETAIL 1/E-5. 2. MOUNT A DEDICATED 120V, 20A, RECEPTACLE NEXT TO THE AUTO SAMPLER. FIELD VERIFY EXACT

LOCATION. 3. XFMR T2' SHALL BE WALL MOUNTED ABOVE THE POWER PANELS. PROVIDE BRACKET SUPPORTS AS

REQ'D. 4. PROVIDE A 480V, 3Ø ELECTRICAL CONNECTION TO THE MAGNETIC STARTER FURNISHED WITH THE AIR COMPRESSOR. COMPLETE ALL WIRING FOR THE COMPRESSOR AND ASSOCIATED DRYER. 5. PROVIDE AN EXTERIOR GFI RECEPTACLE WITH A METALLIC, LOCKABLE, WEATHERPROOF ENCLOSURE (LEVITON M5979GY).

(LEVITON M5979CY). 6. NON-POTABLE WATER PUMP. PROVIDE A SINGLE POINT ELECTRICAL CONNECTION TO THE INTEGRATED CONTROLLER IN THE MOTOR TERMINAL BOX ABOVE THE PUMP. PROVIDE LFMC RACEWAY BETWEEN THE WALL/CEILING AND THE CONTROLLER. (TYP 2) 7. LIGHTS MAY BE SUSPENDED FROM OR SUBFACE MOUNTED TO THE CENTER BEAM (TYP 4). 8. PROVIDE A 200A, 480V, 30, ELECTRICAL SUB-METER FOR THE BUILDING (POWER-LOGIC PM5500 SERIES,

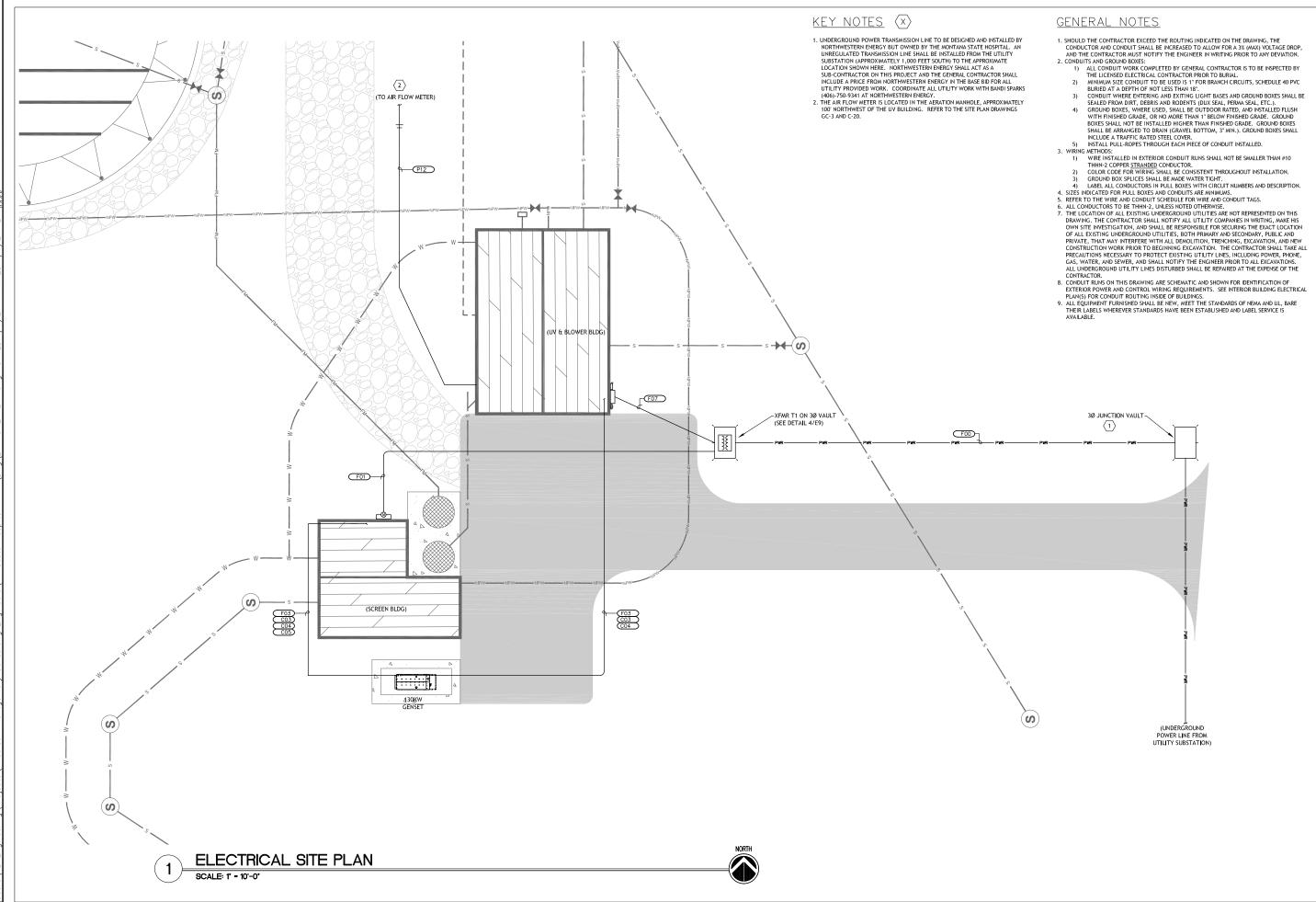
OR EQUAL). THE METER SHALL BE OWNED BY THE OWNER AND NOT BY THE UTILITY COMPANY. SUBMIT THE METER INFORMATION TO THE OWNER FOR SIGNATURE APPROVAL PRIOR TO ORDERING.

SUBMIT THE METER INFORMATION TO THE OWNER FOR SIGNATURE APPROVAL PRIOR TO ORDENIG. REFER TO MG INSTALLION INSTRUCTIONS. 9. DEDICATED RECPT FOR THE UV WIPING SYSTEM AIR COMPRESSOR. FIELD COORDINATE EXACT ELECTRICAL CONNECTIONS IF A HARDWIRE CONNECTION IS REQUIRED. 10. FLEXIBLE CONDUIT AND INTERCONNECT WIRES BETWEEN THE UV CONTROL POWER PANEL (CPP AND THE UV CHAMBER (INCLUDING UV SENSOR, TEMPERATURE SWITCH, END CAP SWITCH, AND LAMP CABLES) SHALL BE SUPPLIED BY THE UV MFG AND INSTALLED BY CONTRACTOR. REFER TO THE MFG'S INSTALLATION INSTRUCTIONS AND THE UV DISINFECTION FOURMENT SPEC SECTION 46 6656

SAMPLER. 13.INSTALL THE FACTORY PROVIDED McCROMETER CABLE FROM THE FLOW METER TO THE REMOTE CONVERTER BOX IN 1/2" CONDUIT. (TYP 3) 14. DEDICATED CIRCUIT FOR THE AIR FLOW METER IN THE AERATION MANHOLE. REFER TO THE SITE PLAN

 DEDICATED CIRCUIT FOR THE AIR FLOW METER IN THE AERATION MANHOLE. REFER TO THE SITE PLAN DRAWINGS GC-3 AND C-20 FOR THE MANHOLE LOCATION, APPROXIMATELY 100' NORTHWEST OF THE UV BUILDING.
 LIOCATE THE VISUAL/AUDIBLE ALARM PER ENGINEERS DIRECTION. THE AUDIBLE ALARM SHALL BE SWITCHED SEPARATELY FROM THE VISUAL ALARM TO ALLOW THE SYSTEM OPERATOR TO BE ABLE TO TURN EITHER ALARM ON/OFF OR TO DISABLE EITHER ALARM. COORDINATE ALARM DEVICE VOLTAGES NUTLICED ADVICE DIRECTORY WITH CONTROL PANEL OUTPUTS.

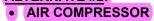


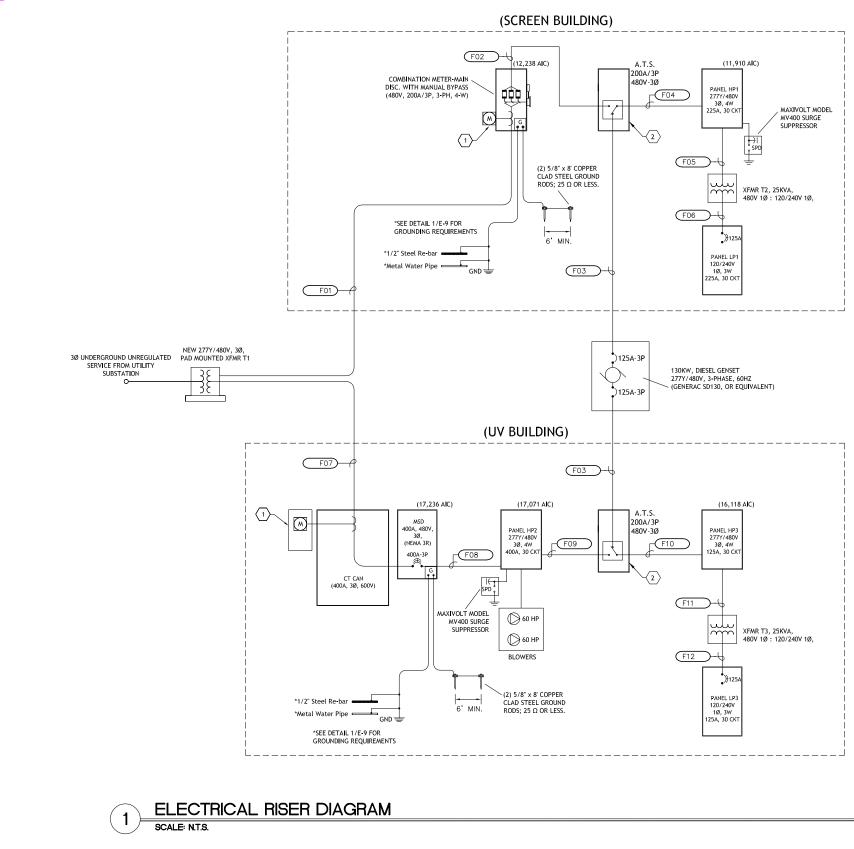


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## ALTERNATE #1: • NON-POTABLE WATER 2" ELECTROMAGNETIC FLOW METER

## ALTERNATE #2:





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	MAIN BREAKER: N/A				PANEL: HP1		011		TOT	AL CALCULATED LOA	D 68.63 K	VA
	MOUNTING: SURFACE				277/480,3							
	BRACING: 22 Kaic				225 AI	· ·						
	CIRCUIT		I	LOAD			LOAD			CIRCUIT		
NO.	DESCRIPTION	OCP	TYPE	(VA)	(A) PH	(A)	(VA)	TYPE	OCP	DESCRIPTION		NO.
1	Unit Heater 15kW	25A-3P	N	5000	18.0 A	18.0	5000	Н	25A-3P	Unit Heater 15kW		2
3	"	"	N	5000	18.0 B	18.0	5000	Н	"	"		4
5	"	"	N	5000	18.0 C	18.0	5000	Н	"	"		6
7	Unit Heater 4kW	15A-3P	н	1333	4.8 A	2.0	560	N	15A-3P	Headworks Screen Mo	otor (1HP)	8
9	"	"	Н	1333	4.8 B	2.0	560	N	"	"		10
11	11	"	Н	1333	4.8 C	2.0	560	N	"	"		12
	Lift Station Pump Control Panel	30A-3P	N	4739	17.1 A	28.1	7796		70A-2P	Panel LP1 via XFMR T	2	14
15		"	N	4739	17.1 B	36.8	10192		"	"		16
17		"	N	4739	17.1 C				20A-1P			18
	SPARE	15A-3P			A				20A-1P			20
	SPARE	"			В				20A-1P			22
	SPARE	"			С				20A-1P			24
	SPARE	20A-1P			A				20A-1P			26
27	SPARE	20A-1P			В				20A-1P			28
29	SPARE	20A-1P			С				20A-1P			30
					A							
					В							
					С							
					A							
					B							
					С							
								LOAD:		CONNECTED	CALCULATE	D
NO	ES:							(C)ontir	uous:	2996 x 1.25	= 3745 V	Ά
								(R)ec (1	lst 10 kva)	2640 x 1.00	= 2640 V	'A
								(R)ec (r	emainder):	: x 0.50	= V	'A
								(N)on-c	ontinuous:	41249 x 1.00	= 41249 V	'A
								(H)eatir	ig:	20999 x 1.00	= 20999 V	'A
								(A)ir co	nditioning:	x 1.00	= V	'A
								(L)arges	st motor:	x 1.25	= V	Ά
								TOTAL	ADDITION	IAL LOAD: VA	68633 V	Ά
											83 A	MPS
									NOTE: HEATIN	IG AND COOLING LOADS ARE NON-	SIMULTANEOUS	

				PANELBOAR	D SCHEDI	JLE		-			
MAIN BREAKER: 125 AMP				PANEL: LP1				TOT	AL CALCULATED LOAD	18.74 K	٧A
MOUNTING: SURFACE				120/240V,1							
BRACING: 22 KAIC				225 AN	1P						
CIRCUIT			LOAD			LOAD			CIRCUIT		
O. DESCRIPTION	OCP	TYPE	(VA)	(A) PH	(A)	(VA)	TYPE	OCP	DESCRIPTION		Ν
1 Recpt - Admin Room	20A-1P	R	360	3.0 A	7.5				Recpt - Screen Room		
3 Lights, Exhaust Fan (1/2 HP)	20A-1P	С	1760	14.7 B	5.8		С	20A-1P	Exhaust Fan (1/4 HP)		
5 Auto Sampler	20A-1P	С	180	1.5 A	33.3	4000	N	40A-2P	Water Heater		
7 RTU/Autodialer/Flow Meter	20A-1P	С	360	3.0 B	33.3	4000	N	"	"		Т
9 Recpt - Exterior	20A-1P	R	180	1.5 A	9.8	1176	N	20A-2P	Overhead Door		
11 Generator Battery Charger	20A-1P	R	1200	10.0 B	9.8	1176	N	"	"		
13 Generator Block Heater	20A-2P	н	1000	8.3 A				20A-1P	SPARE		
15 "	"	н	1000	8.3 B				20A-1P	SPARE		
17 SPARE	20A-1P			А				20A-1P	SPARE		
19 SPARE	20A-1P			В				20A-1P	SPARE		
21 SPARE	20A-1P			А				20A-1P	SPARE		
23 SPARE	20A-1P			В				20A-1P	SPARE		
25 SPARE	20A-1P			А				20A-1P	SPARE		
27 MAIN	125A-2P			В				20A-1P	SPARE		T
29 "				А				20A-1P	SPARE		
				В							
				A							-
				B							
				A							-
				B							+
				A							-
<b>!</b> ,				. ^ .			LOAD:		CONNECTED	CALCULATE	Ľ
							(C)ontin		2996 x 1.25 =		
OTES:							(-)	st 10 kva)			
0128.								emainder):			
							· / ·	ontinuous:			
							(H)eatin		2000 x 1.00 =		
								nditioning:			
								st motor:	x 1.00 = x 1.25 =		
							TOTAL		17988	18737 V	
							IOIAL	LOAD.	17300	78 AI	
											VIE
									G AND COOLING LOADS ARE NON-SI		

PANEL SCHEDULE 'HP1' (SCREEN BLDG)

SCALE: N.T.S.

(1)



				P/	NELBOARD	SCHED	ULE						
	MAIN BREAKER: N/A				PANEL: HP2				TOT	AL CALCULATED	LOAD	203.37 KV	A
	MOUNTING: SURFACE				277/480,3F	9,4W							
	BRACING: 22 Kaic				400 AM	P							
	CIRCUIT			LOAD			LOAD			CIRC	UIT		
NO.	DESCRIPTION	OCP	TYPE	(VA)	(A) PH	(A)	(VA)	TYPE	OCP	DESCRIPTION			NO
1	Blower #1	110A-3P	С	21339	77.0 A	55.2	15291		125A-3P	Panel HP3 via A1	S		2
3	"	"	С	21339	77.0 B	64.4	17855		"	"			4
5	"	"	С	21339	77.0 C	32.7	9059		"	"			6
7	Blower #2	110A-3P	С	21339	77.0 A								8
9	"	"	С	21339	77.0 B								10
11	"	"	С	21339	77.0 C								12
13					A								14
15					В								16
17					С								18
19					A								20
21					В								22
23					С								24
25					A								26
27					В								28
29					С								30
					A								
					В						-		
					С						-		
					A								
					В								
					C								
								LOAD:		CONNECTED	0	CALCULATED	
NO.	TES:							(C)ontir	nuous:	132514 x	1.25 =	165643 VA	
-									lst 10 kva)	2796 x	1.00 =	2796 VA	
									emainder)		0.50 =	VA	
									ontinuous:		1.00 =	34316 VA	
								(H)eatin		612 x		612 VA	
									nditioning:		1.00 =	VA	
									st motor:		1.25 =	VA	
										AL LOAD: V		203367 VA	
I												245 AM	
i										G AND COOLING LOADS AF	F NON-SIMI		2
L											2		

MAIN BREAKER: N/A				PANEL: HP3		-		TOT	AL CALCULA	TED LOAD	45.68 K	(VA
MOUNTING: SURFACE				277/480,3P	,							
BRACING: 22 Kaic		-		125 AM								
CIRCUIT			LOAD			LOAD				CIRCUIT		_
O. DESCRIPTION	OCP	TYPE	(VA)	(A) PH	(A)	(VA)	TYPE	OCP	DESCRIPTIO			1
1 UV Power Dist. Center (PDC)	15A-3P	С	1450	5.2 A	14.0	3880		20A-3P	Air Compres	sor (10HP)		
3 "	"	С	1450	5.2 B	14.0	3880	N	<u> </u>	"			
5 "	"	С	1450	5.2 C	14.0	3880			"			
7 SPARE	20A-1P			A	7.6	2106		15A-3P	Non-Potable	Water Pump	#1	
9 SPARE	20A-1P			В	7.6	2106		"	"			
11 SPARE	20A-1P			С	7.6	2106		"	"			
13 SPARE	20A-1P			A	7.6	2106		15A-3P	Non-Potable	Water Pump	#2	
5 SPARE	20A-1P			В	7.6	2106	N	"	"			
17 SPARE	20A-1P			С	7.6	2106	N	"	"			
19 SPARE	20A-1P			А				20A-1P				
21 SPARE	20A-1P			В				20A-1P				
23 SPARE	20A-1P			С				20A-1P				
25 SPARE	20A-1P			А	24.4	6772		70A-2P	Panel LP3 vi	a XFMR T3		
27 SPARE	20A-1P			В	31.7	8796		"	"			
29 SPARE	20A-1P			С				20A-1P	SPARE			
				А								
				В								30000
				С								
				A								,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
				В								
				С								
							LOAD:		CONNECTE	D (	CALCULATE	D
OTES:							(C)ontin	uous:	593	30 x 1.25 =	7413 V	/A
							(R)ec (1	st 10 kva)	: 33	36 x 1.00 =	3336 V	/A
								emainder):		x 0.50 =	V	/A
								ontinuous:		16 x 1.00 =	34316 V	/A
							(H)eatin			12 x 1.00 =	612 V	/A
								nditioning:		x 1.00 =		/A
								t motor:		x 1.25 =	V	/A
									AL LOAD:	VA	45677 V	
											55 A	
									GAND COOLING LO	ADS ARE NON-SIMI		

PANEL SCHEDULE 'HP2' (UV BLDG) SCALE: N.T.S.

(1)

# ALTERNATE #1:

• NON-POTABLE WATER 2" ELECTROMAGNETIC FLOW METER

ALTERNATE #2: • AIR COMPRESSOR

				PANELBOARD	SCHEDU	JLE					
MAIN BREAKER: 125 AMP				PANEL: LP3				TOT	AL CALCULATED LOAD	15.96 KV	/A
MOUNTING: SURFACE				120/240V,1	P,3W						
BRACING: 22 KAIC				125 AM	Р						
CIRCUIT			LOAD			LOAD			CIRCUIT		
NO. DESCRIPTION	OCP	TYPE	(VA)	(A) PH	(A)	(VA)	TYPE	OCP	DESCRIPTION		N
1 Unit Heater	15A-1P	Н	612	5.1 A	10.5	1260	R	20A-1P	Recpt - Utility		
3 Lights	20A-1P	С	1220	10.2 B	9.8	1176	N	20A-1P	Exhaust Fan		
5 Auto Sampler	20A-1P	С	180	1.5 A	33.3	4000	N	40A-2P	Water Heater		
7 Autodialer, Flow Meter	20A-1P	R	360	3.0 B	33.3	4000	N		"		
9 Recpt - Exterior	20A-1P	R	360	3.0 A	1.5	180	R	20A-1P	Recpt - Restroom		1
11 UV Air Compressor	20A-1P	R	1176	9.8 B	7.2	864	N	20A-1P	Overhead Door		
13 Ceiling Fan (Future)	20A-1P			А	1.5	180	С	20A-1P	Air Flow Meter		1
15 SPARE	20A-1P			В				20A-1P	SPARE		1
17 SPARE	20A-1P			А				20A-1P	SPARE		1
19 SPARE	20A-1P			В				20A-1P	SPARE		2
21 SPARE	20A-1P			А				20A-1P	SPARE		2
23 SPARE	20A-1P			В				20A-1P	SPARE		2
25 SPARE	20A-1P			А				20A-1P	SPARE		2
27 MAIN	125A-2P			В				20A-1P	SPARE		2
29 "	"			А				20A-1P	SPARE		3
				В				-	-		
				A							
				B							
				A							
				B							
				A							
		II		~			LOAD:		CONNECTED	CALCULATED	-
							(C)ontin	NIOUS.	1580 x 1.25 =	1975 VA	
IOTES:								lst 10 kva)		3336 VA	
								emainder)		VA	
								ontinuous:		10040 VA	-
							(H)eatir		612 x 1.00 =	612 VA	
								nditioning:		VA	
								st motor:	x 1.00 = x 1.25 =	VA	
							TOTAL		15568	15963 VA	
								LOAD.	15500	67 AN	
									G AND COOLING LOADS ARE NON-SIN		
								NOTE HEATIN			
		—									
PANEL S	CHED	ULĒ	~LP3'	(UV BL	_DG)	)					
(3) SCALE: NT.S.											-

PANEL SCHEDULE 'LP3' (UV BLDG) SCALE: N.T.S.

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				IGH IIN(	3 FI	XIU	re sc	HEDULE	
TYPE	DESCRIPTION	LAMPS PER FIXTURE	WATTS PER LAMP	LAMP SIZE	VOLTS	MAX WATTS	MOUNTING	MFG & P/N	NOTES
F1	Vaportight Industrial Surface LED	1	107	11,000 Lumen LED 4000k	120	107	Surface	Lithonia VAP-12000LM-PCL-MD- MVOLT-GZ10-40K-80CRI	
F2	Wall Pack	1	50	6,600 Lumen LED 4000k	120	50	Wall	Lithonia WST LED P3 40K VW MVOLT PE DDBXD	Switch on photo-cell; Feed-thru wiring; Bronz in color
F3	Class I, Div I Hazardous Fixture	1	40	4,000 Lm/4ft LED 4000k	120	40	Surface	IRL: IR4-4-2-LED-UNV	Fixture must be explosion proof
F4	Vanity Light	1	30	4,000 Lumen LED 4000k	120	30	Wall	Williams: WMA-4-L40-840-AFDRV-UNV	

			TR,	ANSFOF	RMER SC	CHEDULE	-
TAG	KVA	PHASE	PRIMARY VOLTAGE	SECONDARY VOLTAGE	MOUNTING	GROUND CONDUCTOR	NOTES
T1	300	3 PH	12,470	480Y/277	VAULT	#1/0	
T2	25	1 PH	480	120/240	FLOOR/WALL	#6	
Т3	25	1 PH	480	120/240	FLOOR/WALL	#6	

### ALTERNATE #1:

NON-POTABLE WATER 2" ELECTROMAGNETIC FLOW METER

# ALTERNATE #2:

• AIR COMPRESSOR

TAG	CONDUIT SIZE	WIRE SIZE	FROM	то	AMPS
F00	[1] 4"	3#2 EPR AL	POWER POLE	XFMR T1	
F01	[1] 4"	3#4/0, 1#1/0 AL	XFMR T1	SCREEN BLDG SERV. DISC.	200A, 3Ø,4W
F02	2"	4#3/0, 1#6 GND	SCREEN BLDG SERV. DISC.	ATS	200A, 3Ø,4W-
F03	1-1/2"	4#1, 1#6 GND	GENERATOR	ATS	125A, 3Ø,4W-
F04	2"	4#3/0, 1#6 GND	ATS	PANEL HP1	200A, 3Ø,4W
F05	1"	2#4, 1#8 GND	PANEL HP1	XFMR T2	70A, 1Ø, 2W+
F06	1-1/4"	3#1, 1#6 GND	XFMR T2	PANEL LP1	125A, 1Ø,3W-
F07	[1] 4"	4#350 AL	XFMR T1	UV BLDG SERV. DISC.	400A, 3Ø,4W
F08	[2] 2"	[2] 4#3/0, 1#3 GND	UV BLDG SERV. DISC.	PANEL HP2	400A, 3Ø,4W
F09	1-1/2"	4#1, 1#6 GND	PANEL HP2	ATS	125A, 3Ø,4W
F10	1-1/2"	4#1, 1#6 GND	ATS	PANEL HP3	125A, 3Ø,4W
F11	1"	2#4, 1#8 GND	PANEL HP3	XFMR T3	70A, 1Ø, 2W+
F12	1-1/4"	3#1, 1#6 GND	XFMR T3	PANEL LP3	125A, 1Ø,3W
P01	3/4"	4#12, 1#12 GND	PANEL HP1	UV PDC	20A, 3Ø, 4W-
P02	3/4"	3#12, 1#12 GND	PANEL HP1	AIR COMPRESSOR	20A, 3Ø, 3W+
P03	3/4"	3#12, 1#12 GND	PANEL HP1	NON-POT. WATER PUMP	20A, 3Ø, 3W-
P04	3/4"	2#8, 1#10 GND	PANEL LP1	WATER HEATER	40A, 1Ø, 2W-
P05	3/4"	2#12, 1#12 GND	PANEL LP1	GENSET BATT. CHARGER	20A, 1Ø, 2W-
		2#12, 1#12 GND	PANEL LP1	GENSET ENGINE HEATER	20A, 1Ø, 2W+
P06	3/4"	3#12, 1#12 GND	PANEL HP1	SCREEN MOTOR	20A, 3Ø, 3W+
P07	3/4"	3#10, 1#10 GND	PANEL HP1	15 KW UNIT HEATERS	25A, 3Ø, 3W+
P08	3/4"	3#12, 1#12 GND	PANEL HP1	4 KW UNIT HEATER	20A, 3Ø, 3W+
P09	3/4"	3#10, 1#10 GND	PANEL HP1	LIFT STATION CNTRL PNL	30A, 3Ø, 3W+
P10	3" SCH 80	3#12, 1#12 GND	LIFT STATION CNTRL PNL	LIFT STATION PUMP #1	20A, 3Ø, 3W+
		3#12, 1#12 GND	LIFT STATION CNTRL PNL	LIFT STATION PUMP #2	20A, 3Ø, 3W+
P11	1-1/4"	3#1, 1#6 GND	PANEL HP2	BLOWERS	110A, 3Ø, 3W
P12	1"	2#10, 1#10 GND	PANEL LP3	AIR FLOW METER	20A, 1Ø, 2W+
C01	1/2"	4#14 Cu STRANDED	LIFT STATION CNTRL PNL	AUDIO/VISUAL ALARMS	
C02	3" SCH 80	4#14 Cu STRANDED	LIFT STATION CNTRL PNL	WET WELL FLOATS	
		4#18 Cu TSP	LIFT STATION CNTRL PNL	WET WELL XDUCER	
C03	3/4"	4#14 Cu STRANDED	ATS GENERATOR START	GENERATOR	
C04	3/4"	4#14 Cu STRANDED	GENERATOR E-STOP	GENERATOR	
C05	3/4"	4#18 Cu STRND/SHIELD	GENERATOR ALARM/RUN	AUTODIALER	
C07	1/2"	4#14 Cu STRANDED	UV CNTRL PNL	AUDIO/VISUAL ALARMS	

### NOTES:

ALTERNATE #2

1. All other branch circuits are 2#12, 1#12 GND - 3/4"C.

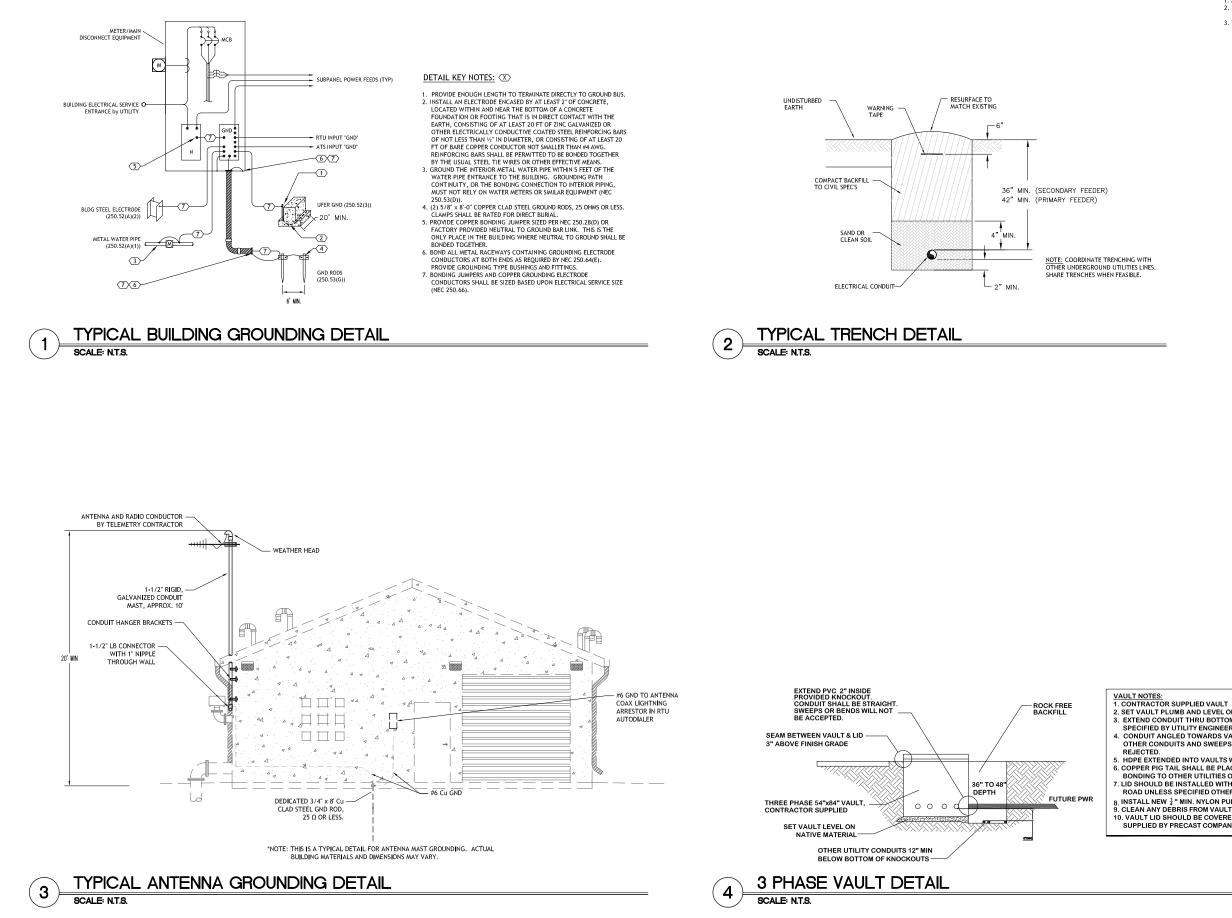
2. All conductors are sized per AWG and shall be 75°C copper wire with 60°C terminals up to 100 amps and 75°C wire and terminals thereafter.

3. Aluminum conductors are acceptable for all feeders 200 Amps or larger. Upsize wire and conduit sizes accordingly to

Additional to the required ampacity.
 Wire sizes and combinations are suggestions based upon available load information at the time of drawing release. The contractor shall verify all equipment name plates for actual load ratings.
 #10AWG and smaller conductors shall be solid wire. #8AWG and larger conductors shall be stranded.

6. The contractor shall derate conductor ampacity for elevated temperatures over ambient and for multiple conductors in raceways or conduit per NEC requirements.

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#### GENERAL NOTES

- ALL CONDUCTORS TO BE THHN, UNLESS NOTED OTHERWISE.
   REFER TO WRITTEN SPECIFICATIONS SECTION 13500 FOR COMPLET TELEMETRY SYSTEM REQUIREMENTS.
   THE REMOTE TELEMETRY UNIT AND RADIO ANTENNA SHALL BE FURNISHED AND INSTALLED BY THE TELEMETRY CONTRACTOR.

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2. SET VAULT PLUMB AND LEVEL ON UNDISTURBED EARTH 3. EXTEND CONDUIT THRU BOTTOM KNOCKOUT UNLESS SPECIFIED BY UTILITY ENGINEER.

4. CONDUIT ANGLED TOWARDS VAULT WALL, FLOOR; OTHER CONDUITS AND SWEEPS INTO VAULT WILL BE

5. HDPE EXTENDED INTO VAULTS WILL BE REJECTED. 6. COPPER PIG TAIL SHALL BE PLACED FIELD SIDE (FOR BONDING TO OTHER UTILITIES OF VAULT) 7. LID SHOULD BE INSTALLED WITH OPENING FACING THE

LID SHOULD BE INSTALLED WITH OPENING FACI ROAD UNLESS SPECIFIED OTHERWISE.
 INSTALL NEW ¹/₄ " MIN. NYLON PULL ROPE.
 CLEAN ANY DEBRIS FROM VAULT.
 VAULT LID SHOULD BE COVERED WITH COVER SUPPLIED BY PRECAST COMPANY.

# **APPENDIX B**

# **DEQ Stormwater & Dewatering Permit Forms**

# Montana Department of Environmental Quality – Water Protection Bureau Construction Dewatering General Permit Daily Log

Construction dewatering activities authorized under the Construction Dewatering General Permit (CDGP, MTG070000) must be monitored in accordance with the CDGP. The permittee is responsible for recording required data on a daily log -- either on the attached form ("Daily Log") or a site-specific log that includes all the data required by the CDGP.

Records, including the daily log, must be maintained for at least three (3) years and be available for inspection by the Montana Department of Environmental Quality (DEQ). Permittees do not need to submit the logs to the DEQ unless requested.

In addition to the daily log, the permittee must submit completed Discharge Monitoring Reports (DMRs) to DEQ by the 28th of the month following each reporting month, as stated in the CDGP. **Monthly DMRs must be submitted until the Construction Dewatering authorization is terminated whether or not there is a discharge.** 

Once dewatering is complete and the permittee determines that authorization to discharge under the CDGP is no longer required, they must submit a request for termination to DEQ. Based on this request, DEQ will terminate the permit authorization and the corresponding requirement to complete the daily log and monthly DMRs.

# **Specific Instructions for Daily Log:**

If no dewatering discharge occurred for any period of record, indicate "no discharge" on the daily log.

## Footnotes from Daily Log form:

- 1) Indicate yes for any visual observations of either elevated turbidity or an oil sheen. Visual observation of either parameter triggers the need for the permittee to cease discharging, take a grab sample for analysis, investigate the cause, and address the problem.
- 2) If any turbidity or oil & grease off-site analysis is performed, the permittee is required to maintain records of the date the analysis was performed, the name of the individual who performed the analysis, and what 40 CFR Part 136 analytical technique/method was used [see ARM 17.30.1342(10)(c).] For instance, EPA Method 180.2 is an acceptable method for turbidity, and EPA Method 1664A is an acceptable analysis for oil & grease.
- 3) For any visual observations or numeric turbidity exceedances, the permittee must follow their corrective action plan and include a summary of observations and follow-up actions on additional pages.

# **Construction Dewatering General Permit - Daily Log**

Name of Permittee:	Name of Project:

MPDES Permit Number: MTG070		_Outfall Number_	Month	Year
	/			

(one form must be filled out per permitted outfall)

Day of Month/ Time	Name / Initials	Discharge Turbidity High ⁽¹⁾ ? (Visual - Y/N)	Discharge Turbidity ⁽²⁾ (NTU)	Oil & Grease Sheen (Visual - Y/N) ⁽¹⁾	BMP Failures Observed? (Visual - Y/N)	Corrective Action Report Attached? ⁽³⁾
1/						
2/						
3/						
4/						
5/						
6/						
7/						
8/						
9/						
10/						
11/						
12/						
13/						
14/						
15/						
16/						
17/						
18/						
19/						
20/						
21/						
22/						
23/						
24/						
25/						
26/						
27/						
28/						
29/						
30/						
31/						

						Agency Use	
Montana De of Environm	partment ental Quality		P	WATER ROTECTI BUREAU	ON	Permit No.: Date Rec'd Amount Rec'd Check No. Rec'd By	
		Not	ice	of Intent H	Form		
FORM <b>NOI-07</b>	Construction Dewatering General Permit						
1101-07	MTG070000						
<b>READ BEFORE COMPLETING THIS FORM:</b> Before completing this form, the applicant needs to read the Construction Dewatering General Permit (CDGP). Certification of this Notice of Intent (NOI) is certification with the requirements in the CDGP. This NOI must be completed by the owner/operator responsible for construction dewatering activities who are seeking coverage under the CDGP. Please read the attached instructions before completing this form. You must print or type legibly; forms that are not legible, incomplete, or unsigned will be returned. You must maintain a copy of the completed NOI Form for your records.							
Section A – Appl	lication Status (Check one):						
🗌 New - No prie	or CDGP authorization or autho	rizatio	n re	equest for this p	roject/ac	tivity.	
Resubmitted -	- Permit Number: M T G 0 7 0						
Renewal - Per	rmit Number: M T G 0 7 0			-			
Modification	- Permit Number: M T G 0 7 0			(Discuss M	<i>Iodificat</i>	ion in Section I)	
Section B – Site	or Activity Information:						
Site Name:							
Location (site phy	vsical address or directions):						
Nearest City or Town: Zip Code: Co					_ County	/:	
Latitude:		Longitude:					
	Section (optional): T						
Is this site or activ	vity located on Tribal Lands?	N	Э	Yes (If yes,	stop and	d read instructions)	
Standard Indust	rial Classification (SIC) Code	s:					
Provide at least or	he SIC code and description which			1 5	2		
Code 1	A. Primary Description		Сс 2	ode	B. Seco	ondary Description	
	line (One and one) Infor	- 4: 0					
	licant (Owner/Operator) Infor						
	ormal Name:						
City, State, and $\Sigma$	ip Code:			T'41-			
	Contact Name: Title:						
Phone Number: (   )    Email Address:							

## Section D – Authorized Representative:

In order for future reports, including Discharge Monitoring Reports (DMRs), to be signed by anyone other than the signatory for this NOI, a duly authorized individual(s) or position(s) must be identified. If one is not designated then all reports must be signed by the signatory until such designation is made in writing [ARM 17.30.1323(2)].( <i>Check the appropriate box</i> ):								
I designate the Contact listed in Section C as a duly authorized individual Or								
🗌 I desig	I designate the following duly authorized representative for this permit ( <i>complete information below</i> ):							
Name and Title, or Position Title:								
Co	ompany Name (if differe	ent than the applicant):						
Ma	ailing Address:							
Cit	ty, State, and Zip Code:							
Ph	one Number: ( ) _	E	Email Address:					
Or								
No du	ly authorized representa	tive for this permit is de	esignated at this time.					
Section E	– Outfalls and Receiv	ing Water(s):						
after all tr initial rec unnamed <b>Each out</b>	Provide the latitude and longitude to the nearest second for each dewatering outfall. The specified location should be after all treatment and before release to the receiving water. Provide the name of the <u>initial</u> receiving water. If the initial receiving water is unnamed, please also indicate the closest named drainage the receiving water flows into (i.e. unnamed tributary to Clear Creek). Attach additional sheets if necessary for more outfalls. <b>Each outfall to a different receiving water segment is subject to additional application fees and annual fees.</b>							
Outfall No.	Latitude	Longitude	<b>Receiving Surface Waters (Name)</b>					
001								

**MAP:** Attach a USGS topographic map or aerial photo extending one mile beyond the property boundaries of the site or facility/activity identified in Section B depicting the facility or activity boundaries, any treatment area(s), outfall(s), major drainage patterns, and the receiving surface waters stated above.

] Map Attached

Section F – Proximity to Contaminated Site(s):					
Will construction dewatering for this project occur in or near a known contamination site (SUPERFUND, leaking tank, etc.) or do you suspect the site has contamination? ( <i>See instructions for further guidance</i> )					
$\Box$ No. (Proceed with Section G.)					
<ul> <li>☐ Yes: distance from nearest suspected area of contamination to construction dewatering is: feet.</li> <li>→ Delineate suspected area of contamination on Section E map, or provide an additional map.</li> </ul>					
The permittee must take a pre-discharge sample of the groundwater and/or surface water that is representative of what is proposed for discharge. The sample must be analyzed for any known or suspected pollutants of concern in accordance with 40 CFR 136. The laboratory's detection level should be able to report at or below Required Reporting Value (RRV) contained in Department Circular DEQ-7. The laboratory results need to be submitted with the NOI.					
Copy of Lab Results enclosed. Sample date					
If analysis shows contaminants present at concentrations above the RRV, the authorization request for coverage under the CDGP will be denied. If there are no contaminants present at concentrations above the RRV, DEQ will continue to process the request. DEQ may require additional future testing in the authorization letter. If any testing results show contamination at levels higher than the RRV for any contaminant contained in Circular DEQ-7, the permittee must cease discharge and notify DEQ.					
Section G – Description of Expected Discharge Duration and Mitigation Measures:					
Date construction dewatering discharge is anticipated to begin:					
Date construction dewatering discharge is anticipated to end*:					
Rough estimate of average discharge flow rate [gallons per minute (gpm)] gpm					
<ul> <li>Dewatering Plan: will be completed prior to beginning construction dewatering, and implemented as part of the dewatering project. The Dewatering Plan will be maintained, and available to DEQ for on-site inspection. (<i>DEQ does not require submittal of this Plan.</i>)</li> <li>Dewatering discharge to state surface waters will be controlled by Best Management Practices evaluated in the Dewatering Plan, including (<i>indicate which of the following will be employed to the extent known</i>):</li> </ul>					
YesNoUnknownRun-on prevention/diversionYesNoUnknownPumping process pretreatment (i.e. filtering sump or submersible					
<ul> <li>Yes No Unknown</li> <li>Yes No Othraw</li> <li>Yes No Othraw</li> <li>Yes No Othraw</li> <li>Yes No Othraw</li> <li>Yes Other, describe:</li> </ul>					

Section H – Selection of Dewatering Category & Mixing Zone					
<b>Outfall</b> (*A separate Section H needs to be completed for each outfall listed in Section E)					
<b>Category Selection:</b> The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall ( <i>PICK ONE CATEGORY PER OUTFALL</i> ):					
A. "Minimal Impact" with discharge to (also select one of the three subcategories if Category A):					
A.1 Ephemeral waterbody A.2 Dry intermittent segment A.3 Large river					
B. "Discharge Turbidity Limited to Prevent Impact" – Turbidity effluent limit for discharge to rivers, lakes, wetlands.					
C. "Real-Time Turbidity Demonstration" – Demonstration of no increase above background.					
By selecting the appropriate category (above), the owner/operator certifies that they will comply with the effluent limits and monitoring requirements associated with that category for this outfall, as provided in the CDGP. (SEE INSTRUCTIONS IF THE RECEIVING WATER FOR YOUR DISCHARGE IS A-1 or A-CLOSED.)					
**************************************					
Mixing Zone (for Categories A.3 and B, only): A mixing zone for category A.3 (large rivers) or B (variable flows) is granted under ARM 17.30.516(4) for rivers, and ARM 17.30.518(3) for lakes. ( <i>If not A-3 or B-Categories indicate "NA" for this section.</i> ) Indicate the amount of ambient surface water, at the driest time expected for the dewatering activity.					
Stream width (at lowest flow expected): ft x $10 =$ ft mixing zone length					
Lake/wetland area (at lowest volume): ft ² x 5% = ft ² mixing zone area (note: capped at 200 feet radius)					
Section H (con't) – Additional Outfalls Category & Mixing Zone					
Section H (con't) – Additional Outfalls Category & Mixing Zone Outfall (*A separate Section H needs to be completed for each outfall listed in Section E)					
Outfall (*A separate Section H needs to be completed for each outfall listed in Section E) Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall ( <i>PICK ONE CATEGORY PER OUTFALL</i> ):					
Outfall (*A separate Section H needs to be completed for each outfall listed in Section E)         Category Selection: The owner/operator selects the following category as representative of the conditions during					
Outfall (*A separate Section H needs to be completed for each outfall listed in Section E) Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall ( <i>PICK ONE CATEGORY PER OUTFALL</i> ):					
Outfall (*A separate Section H needs to be completed for each outfall listed in Section E)         Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall (PICK ONE CATEGORY PER OUTFALL):         A. "Minimal Impact " with discharge to (also select one of the three subcategories if Category A):					
Outfall (*A separate Section H needs to be completed for each outfall listed in Section E)         Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall ( <i>PICK ONE CATEGORY PER OUTFALL</i> ):         A. "Minimal Impact " with discharge to (also select one of the three subcategories if Category A):         A.1 Ephemeral waterbody       A.2 Dry intermittent segment         A.3 Large river					
Outfall (*A separate Section H needs to be completed for each outfall listed in Section E)         Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall ( <i>PICK ONE CATEGORY PER OUTFALL</i> ):         A. "Minimal Impact " with discharge to (also select one of the three subcategories if Category A):         A.1 Ephemeral waterbody A.2 Dry intermittent segment A.3 Large river         B. "Discharge Turbidity Limited to Prevent Impact" – Turbidity effluent limit for discharge to rivers, lakes, wetlands.					
Outfall					
Outfall(*A separate Section H needs to be completed for each outfall listed in Section E)         Category Selection: The owner/operator selects the following category as representative of the conditions during the period of construction dewatering discharge from this outfall ( <i>PICK ONE CATEGORY PER OUTFALL</i> ):					
Outfall					

## Section J – CERTIFICATION

Applicant Information: This form must be completed, signed, and certified as follows:

- For a corporation, by a principal officer of at least the level of vice president;
- For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

#### All Applicants Must Complete the Following Certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA].

#### Certification of this form indicates conformance with the Construction Dewatering General Permit.

Name (Type or Print)

Title (Type or Print)	Phone Number
Signature	Date Signed

DEQ will not process this form until all of the requested information is supplied, and the appropriate fees are paid.

Return this NOI-07 Form and the applicable fee payment to:

Department of Environmental Quality Water Protection Bureau PO Box 200901 Helena, MT 59620-0901 (406) 444-3080

## **INSTRUCTIONS FOR**

# Montana's Construction Dewatering General Permit (MTG070000) Notice of Intent Form NOI-07

**IMPORTANT** A Notice of Intent (NOI) Form will not be considered complete unless you answer every question. If an item does not apply to you, enter "NA" (not applicable) to show that you considered the question. Responses must be self-explanatory and must not refer exclusively to attached maps, plans, or documents. The appropriate fees must accompany this NOI Form. Do not submit these items separately.

Mail the NOI Form and fee to the Montana Department of Environmental Quality (DEQ) address stated on the NOI Form. Forms and additional information on construction dewatering discharges are available from the Water Protection Bureau at (406) 444-3080 or on the DEQ website at: <a href="http://deq.mt.gov/wqinfo/MPDES/ConstructionDewatering.mcpx">http://deq.mt.gov/wqinfo/MPDES/ConstructionDewatering.mcpx</a>. Please type or print legibly; NOI Forms that are not legible, incomplete, or unsigned will be returned.

#### SPECIFIC ITEM INSTRUCTIONS

#### Section A – Application Status

Check the box that applies and provide the requested information.

- If this activity has not been authorized previously, and you have not previously requested authorization for it, check the box next to "New." DEQ will assign a permit authorization number when you submit the NOI Form. The permit authorization number is a 9-digit code beginning with MTG070 that is unique to your facility or site. If you submitted an NOI Form that the DEQ returns as incomplete the permit authorization number will be written on the upper right hand corner of the NOI Form and on any correspondence sent to you by DEQ.
- If you are resubmitting a NOI Form that DEQ returned to you as deficient or incomplete, check the box next to "Resubmitted."
- If your current discharge authorization is due to expire and you want to maintain coverage, check the box next to "Renewal."
- If there is a change in the facility or site information, check the box next to "Modification."

Please include the permit authorization number for any resubmitted, renewal, or modification applications and on any correspondence with DEQ regarding this site/activity.

#### Section B – Site or Activity Information

Identify the name of the site or activity that is the source of construction dewatering discharge. The location of the site is the specific area where the activity is physically conducted. Give the address or location and the geographical coordinate information. Sources for geographical coordinate information include: "CWAIC" at <u>http://deq.mt.gov/wqinfo/CWAIC/default.mcpx</u>, a USGS Topographic Map, GIS, a "GPS" handheld navigation device, or other locational sources. The location may be a physical mailing address or description of how the site may be accessed (PO Boxes are not acceptable).

If the facility or site is located on or within the boundaries of a federally-recognized Tribal Lands DEQ is not the permitting authority. You must contact the Environmental Protection Agency (EPA) Montana's Region 8 Operation Office in Helena at (406) 457-5000.

## Nature of the Business or Activity and Standard Industrial Classification Code

List in descending order of significance, the four-digit Standard Industrial Classification SIC code(s) and corresponding description(s) that best describes the activity relative to this location. At least one SIC code and description must be provided.

Indicate only one SIC code in the space provided in each box (i.e., only one primary SIC code). For instance, there are different SIC codes for Building Construction (1521 through 1542), Heavy Construction (1611 through 1629), Excavation (1794), and water well drilling (1781). A complete list of SIC codes can be obtained at <u>http://www.osha.gov/pls/imis/sicsearch.html</u> or in paper form from the document entitled "Standard Industrial Classification Manual," Office Management and Budget, 1987.

## Section C – Applicant (Owner/Operator) Information

Organizational Formal Name - give the name, as it is legally referred to, of the business, public organization, person, or other entity that owns, operates, controls or supervises the site or activity described in Section B of this form. The permit will be issued to the entity identified in this section (Section C). *The owner or operator assumes all liability for discharges from the site and compliance with the terms and conditions of the permit and applicable regulations.* 

Provide information for a contact that can provide further information to DEQ, including on-site visits.

## **Section D – Authorized Representative**

Pursuant to ARM 17.30.1323(2) all reports required by permits and other information requested by DEQ must be signed by the appropriate signatory as described in ARM 17.30.1323(1) or by a duly authorized representative of that person. A person is a duly authorized representative only if:

- 1. The authorization is made in writing by a person described in [ARM 17.30.1323(1)];
- 2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company (a duly authorized representative may thus be either a named individual or any individual occupying a named position); and
- 3. The written authorization is submitted to DEQ.

In the future, if the authorization made in this NOI is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new written delegation of authorization, including a written letter satisfying the requirements above, must be submitted to DEQ prior to or together with any reports, information, or applications to be signed by an authorized representative.

Any authorized representative shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

The Responsible Official can duly authorize the person identified as a contact in Section C or another individual or position name. All reports and DMRs may be submitted under the signature of the 'duly authorized' representative. If the Responsible Official does not duly authorize anyone, all correspondence must come from him/her until a written designation is submitted to DEQ.

## Section E – Outfalls and Receiving Waters

Outfalls are defined as "a disposal system through which effluent or waste leaves the facility or site." An outfall location is considered to be a discrete channel, conveyance, structure, or flow path from which discharge leaves the facility after all treatment, prior to discharge into state surface waters.

Water bodies used solely for treating, transporting, or impounding pollutants shall not be considered surface water.

As allowed under ARM 17.30.201(6), multiple outfalls from the same source that have similar effluent characteristics may not be required to pay individual application fees, unless the discharges are to different receiving waters or stream segments, or result in multiple effluent limits or monitoring requirements. For the Construction Dewatering General Permit (CDGP), multiple discharge locations to the same stream segment, or the same receiving waters, can be considered one outfall. Provide the following information in the table on the NOI Form Section E for each outfall that you propose:

- 1. Assign a number to each outfall starting with 001. For existing permittees, ensure outfall numbers used are consistent with those identified in the past for the same outfall.
- 2. Provide the latitude/longitude of each outfall. Locations can be derived from a USGS topographic map, "CWAIC" at <u>http://deq.mt.gov/wqinfo/CWAIC/default.mcpx</u>, GIS, a "GPS" handheld navigation device, or other locational sources. Latitude and longitude must be accurate to the nearest second. However, if the dewatering effluent may be discharged at various points along a given stream segment, provide the mid-point for the receiving water segment on this table and indicate the maximum extent of the discharge as a range in Section J Supplemental Information.
- 3. Give the name of the initial receiving surface waters that receive the discharge. If the receiving water is unnamed, please also indicate the closest named drainage the receiving water flows into (i.e. unnamed tributary to Clear Creek).
- 4. Please attach a USGS topographic quadrangle map or USGS-based topographic map or an aerial photo extending one mile beyond the property boundaries of the site or facility/activity identified in Section B depicting the facility or activity boundaries, any dewatering effluent treatment areas, the outfall location(s) and the receiving surface waters stated above.

If additional space is necessary for more outfall locations, attach additional sheets with the requested information. An application fee needs to be included for each identified outfall. If questions develop on identifying these outfalls, call DEQ prior to completing this NOI.

## Section F – Proximity to Contaminated Sites

As described in the CDGP, discharge of dewatering effluent that contains contamination from a previous release is <u>not</u> allowed under the CDGP. For due diligence, the applicant must review readily available information to identify known or suspected release sites, including groundwater plumes, that may be in the vicinity of the dewatering. Information sources may include:

- Leaking Underground Storage Tank (LUST) list: <u>http://deq.mt.gov/LUST/LUSTSites.mcpx</u>
- Abandoned Mine Lands list: <u>http://deq.mt.gov/AbandonedMines/default.mcpx</u>
- Federal Superfund: <u>http://deq.mt.gov/FedSuperfund/default.mcpx</u>
- State Superfund: <u>http://deq.mt.gov/StateSuperfund/findasite.mcpx</u>

If applicant has information that an area of known or suspected contamination is near the dewatering activity, the applicant must take a pre-discharge ground water sample and supply DEQ with a copy of lab results for the pollutants in question. The analyses must be capable of detecting the suspected pollutants down to the Required Reporting Value (RRV) listed in Circular DEQ-7. *If pollutants are found to be in concentrations over their RRV, then dewatering discharge cannot be authorized under the CDGP*.

If all parameters are "nondetect" at levels below the RRV, DEQ will continue to process the request, but may require periodic testing for suspected contaminants for the life of the dewatering project. If contaminants are found in any discharge samples at concentrations above the RRV, the permittee must immediately cease construction dewatering and request to terminate coverage under the CDGP. If the

owner/operator plans to have future dewatering from this location, they need to either apply for coverage under the Petroleum Clean-up General Permit or an individual MPDES permit (unless the discharge is eligible for a short-term exemption from water quality standards as provided for by 75-5-308, MCA).

## Section G – Description of Expected Discharge Duration and Mitigation Measures

Please provide the following to the extent known:

- Provide the projected beginning and end dates for the construction dewatering activities at your site. *Please be reminded to submit a written request for termination of this authorization after all dewatering is completed, signed by the Responsible Official.* Authorizations that are not terminated are subject to annual fees accrued for every calendar year.
- Provide an estimate of the expected flow rate of the treated dewatering discharge into state surface waters, after initial purge has been completed, in gallons per minute (gpm). Use engineering assumptions to the extent available. For instance, Caltrans provides a rough estimate of pumping flow rates in their "Field Guide to Construction Site Dewatering," CTSW-RT-010:

Typical Pump Flow Rates Pump Size (submersible)	Typical Flow Rates*
1.5-inch	90 to 120 gpm
2-inch	90 to 300 gpm
3-inch	300 to 800 gpm
4-inch	400 to 1300 gpm
6-inch	400 to 1800 gpm

• The 2015 CDGP requires each applicant to certify that they will complete and implement a dewatering plan prior to initiating construction dewatering. Select all of the Best Management Practices (BMPs) that you will or might employ to reduce the turbidity/suspended sediment load. The CDGP also requires the applicant to take corrective action for failure of any BMPs.

## Section H –Selection of Dewatering Category & Mixing Zones (for each outfall):

**Dewatering Category:** for each outfall, the applicant needs to review the receiving water – discharge scenario in order to select the representative dewatering category as described in the CDGP and outlined below. *By selecting a category, the applicant acknowledges that they will comply with the applicable effluent limits and monitoring requirements for that category as described in the CDGP.* 

*A. "Minimal Impact" category* – capped at 100 NTU. If Category A is selected, the applicant also needs to indicate which subcategory applies.

A.1. Discharge to an ephemeral waterbody. Ephemeral is defined as 'a stream or part of a stream which flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice and whose channel bottom is always above the local water table.' Ephemeral waterbodies are not considered high quality water; therefore, the applicant is allowed to discharge to them regardless whether they are wet or dry.

A.2 Discharge to a dry intermittent segment. This subcategory includes dry intermittent streams or lakes. Intermittent stream is defined as 'a stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface run-off and ground water discharge.' An applicant is allowed to discharge under this subcategory <u>only if the upstream segment is dry</u>. Dewatering discharge must cease if circumstances change and there is ambient water upstream. If the applicant wants to continue to discharge, they need to select a different category and submit a modified NOI.

*A.3 Discharge to large rivers*. This subcategory includes the eight rivers listed in Department Circular DEQ-12A, Table E-1. The 100 NTU effluent turbidity limit will be protective

because of the good dilution, and typically high background turbidity, associated with these rivers. A mixing zone is applicable for this category.

**B.** "Discharge Turbidity Limited to Prevent Impact" category – the turbidity in the discharge for authorizations under this category is limited to prevent impact on any high quality water. This category has the most conservative turbidity effluent limits and therefore could apply to any state surface water, other than A-1 and A-closed, regardless of the variability in flow regimes, background turbidity, or applicable turbidity standards. Wetlands are also covered under this category due to the great variability in their sensitivity. Applicants may decide to choose this category to be conservative even if the receiving water segment might be dry in order to ensure uninterrupted operations even if conditions change during their operations.

*C. "Real-time Turbidity Demonstration" category* – the turbidity in the discharge is limited to below the upstream (ambient) turbidity in order to ensure 'no increase above background.'

*Note*: Discharges to the most protected waterbodies, A-Closed and A-1 Classifications, include the following water quality standards under ARM 17.30.621(3)(d) and ARM 17.30.622(3)(d), respectively: "No increase above naturally occurring turbidity is allowed except as permitted in 75-5-318, MCA" and "No increase above naturally occurring turbidity or suspended sediment is allowed except as permitted in 75-5-318, MCA." Therefore, unless permitted otherwise under the 318 Authorization, authorization requests for these waterbodies are limited to either Category A.1 or A.2 (dry waterbodies) or Category C (no greater than background). If the discharge may be to a more protected waterbody and the classification is unknown, applicants can check the regulations under ARM 17.30 Subchapter 6 or the Clean Water Act Information Center (CWAIC) at http://deq.mt.gov/wqinfo/CWAIC/default.mcpx.

**Mixing Zone:** For any discharge under subcategory A.3 (discharge to large rivers) or category B (discharge turbidity limited to prevent impact for variable receiving waters), the applicant needs to provide information to calculate the approved mixing zone at the driest time that will be encountered for the proposed project.

- For flowing water, a mixing zone length based on 10 times the receiving water width will be automatically applied for these dischargers.
- For standing water such as lakes or wetlands, the mixing zone area will be the smaller of 200 feet radius or 5% of the wetted area.
- Other discharges do not need and will not be authorized for mixing zones, and "NA" should be indicated.

## Section I– Additional Information

Use this space to provide additional information explaining the basis for a proposed permit modification being submitted, further description of linear projects, etc.

## Section J – Certification

The NOI Form certification must be completed by the applicant (owner/operator) responsible for the authorization as identified in Section C, and as described in ARM 17.30.1323. Certification of this NOI is certification that the applicant will comply with the applicable terms of the CDGP.

The NOI-07 Form and other forms for water discharge permitting or authorization are available at DEQ's website: <u>http://deq.mt.gov/wqinfo/MPDES/ConstructionDewatering.mcpx</u>. If you have any questions concerning how to fill out this form, or other forms related to the Montana Pollutant Discharge Elimination System (MPDES) discharge permitting program, please contact DEQ at (406) 444-3080. Mail the package to the address provided in Section J.

		AGENO	CY USE ONLY				
PERMIT NO.:	Date Rec'd	.: Amo	ount Rec'd.:	Check No.:	Rec'd By:		
DDEWATERMontana DepartmentPROTECTIONof Environmental QualityBUREAU							
FORM		Not	tice of Ter	mination			
NOT	Non-			Permit Authoriz	zations		
This form is to be submitted when a discharge permit is no longer required or necessary. The Montana Department of Environmental Quality (DEQ) will notify the permittee in writing of the date termination is effective. This form may not be used to request termination of coverage under any storm water general permit. You must type or print legibly; forms that are not legible or are unsigned will be returned. Do not leave blank spaces. It is recommended that you maintain a copy of the completed form for your records.							
Section A - Sit	te Information						
Permit/Authoriz	ation Number: MTC	G					
Facility or Site M	Name:						
Facility or Site I	Location (physical ad	ldress or Townsh	ip/Range/Secti	on):			
Facility or Site M	Mailing Address (if a	vailable)					
Nearest City or	Town	State	Zip C	ode Cour	nty		
Latitude:		Longitude:					
Section B - Ov	vner/Operator (Reg	gulated Entity) I	nformation				
Owner/Operator	Name:						
Signatory Name	and Position Title:						
Mailing Address:							
City:	State	Zip Coo	de:				
Phone:		Email:					
Section C - Annual Fees							
There are no fees associated with terminating permit coverage. However, the permittee is responsible for payment of							

There are no fees associated with terminating permit coverage. However, the permittee is responsible for payment of annual fees for each calendar year in which the discharge is authorized, and annual fees are billed in arrears. You may contact DEQ at (406) 444-3080 to receive an invoice for the outstanding annual fees associated with your effective permit coverage, or one will be mailed to you.

## Section D – Required Reports

You are required to comply with all conditions and reporting requirements until notified by DEQ that your general permit authorization is terminated, including submission of Discharge Monitoring Reports.

# Section E - Explanation

Indicate the reason for the termination of above referenced permit by checking the most detailed description in the space provided below:	st appropriate box, and provide a					
Discharge terminated or will be terminated by DATE;						
Discharge permanently terminated by connection to a wastewater treatment plant (WWTP); Date discharge connected or will connect to WWTP:						
Provide name and MPDES permit number of WWTP:						
Other						
Please provide a detailed explanation in the space below (attach additional pages if needed) of why the permit/authorization is no longer needed. Please refer to the Standard Conditions section of your permit and include any information specified in your permit required for permit termination.						
Section F - CERTIFICATION						
<ul> <li>Permittee Information: This form must be completed, signed, and certified as follows:</li> <li>For a corporation, by a principal officer of at least the level of vice president;</li> <li>For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or</li> <li>For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.</li> </ul>						
All Applicants Must Complete the Following Certification						
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA]						
A. Name (Type or Print)						
B. Title (Type or Print)	C. Phone No.					
D. Signature	E. Date Signed					
Return this form (NOT) to:						
Department of Environmental Quality Water Protection Bureau P.O. Box 200901 Helena, MT 59620-0901 (406) 444-3080						

AGENCY USE ONLY						
PERMIT NO.:	Date Rec'd.:	Amount Rec'd.:	Check No.:	Rec'd By:		
	Envir	Department of <b>ONMENTAL</b>	Quality			
FORM		Notice of Inten	t (NOI)			
NOI	Storm Water Di			struction		
2012	en e	<b>Activity MTR</b>		2		
The NOI form is to be compl Department's <i>General Permi</i> legibly; forms that are not leg completed NOI form for you	<i>it for Storm Water Discharge</i> gible or are not complete or a r records.	s Associated with Const	truction Activities. You	must print or type		
Section A - NOI Status	Check one):	And the second s				
New	No prior NOI submitted	for this site.				
Resubmitted	Permit Number: MTR10	n data ang kang kang kang kang kang kang kang				
Renewal	Permit Number: MTR1(	)				
Modification	Permit Number: MTR10		(Discuss Modification	1 in Section I)		
Section B – Facility or Sit	te Information (See instru	ction sheet):				
Site physical address, mail	ing address at location, or	directions to the site				
Township/Range/Section (	optional):					
Nearest City or Town	Zip Coc	le	_ County			
Latitude		Longitude				
Is this facility or site locate	d on Indian Lands? 🗌 Ye					
Section C – Applicant (O Owner or Operator Name (			and a second			
Mailing Address						
City, State, and Zip Code:_			-			
Phone Number Email						
Is the entity listed above th	e construction project own	er? Yes	No			
Status of Applicant (Check	one) Federal State	e Private Pu	ıblic Other (speci	fy)		

Section D	201 I.S.	nding Permits, (		s, or Approvals:  None RCRA				
PSD (A	PSD (Air Emissions)   Other							
404 Per	mit (dredge & fil	1)	n i spina na 19	Other				
Section E	- Standard Ind	lustrial Classific	cation (SIC) C	Codes:				
				f construction work.				
	A. Pr	imary		B. Second				
				A				
	С. 1	Third		D. Fourth				
Section F	– SWPPP Admi	nistrator						
<b>Primary:</b>								
Name and	Title or Position	Title						
Mailing Ac	ldress	н. 1						
City, State,	and Zip Code							
Phone			Alternate Pho	none				
Email	, d							
Secondary								
	and Zip Code			and the second				
Phone			Alternate Pho	one				
Email								
Storm Wat format (00.		rge Locations: Fo		l, list latitude and longitude in the decimal degrees g waters. <b>This section must not be left blank and</b>				
Outfall	Latitude	Longitude	Receiving Su	Surface Waters				
Number			to a di a t	the stand that the standard and				
001								
002								
003								
004								
005								

**Map:** Attach a USGS topographic quadrangle map extending one mile beyond the property boundaries of the site or activity identified in Section B depicting the facility or activity boundaries, major drainage patterns, and the receiving surface waters stated above.

**Section H – Describe the Construction Activity or Project** *Please describe the Construction Activity or Project* 

Please provide a summary of Best Management Practices (BMPs) in the SWPPP

Total site area (acres)
Area of Construction Related Disturbance (acres)
Estimated Project Start Date Estimated Project Completion Date
Estimated Project Final Stabilization Date
Does the project discharge to listed impaired waterbody? Yes No
Does the project discharge to a regulated Small Municipal Separate Storm Sewer System (MS4)? Yes No
If yes, please select the receiving regulated Small MS4
If yes, will the SWPPP be submitted to the regulated Small MS4? Yes No
Section I - Supplemental Information (For Parmit Modification Only Jagua blank around for

Section I – Supplemental Information (For Permit Modification Only – leave blank except for modification)

# Section J – Fee:

# **NEW PROJECTS:**

Indicate the acreage of construction related disturbance indicated in Section H of this NOI form. The fee for new projects includes the application and the annual fee for the calendar year in which the permit authorization is effective.

	1-5 acres	\$ 900.00
	>5-10 acres	\$1,000.00
	>10-25 acres	\$1,200.00
	>25-100 acres	\$2,000.00
	>100 acres	\$3,500.00
RESU	BMITTAL	\$ 500.00
RENE	CWAL	<b>\$ Amount specified in Rule</b> (only required if > four years since date the permit authorization is effective)
	IFICATION	<b>\$ 500.00</b> (minor modification, only if < six months from date the permit authorization is effective)

## Section K - CERTIFICATION

Authorized Signatories: This form must be completed, signed, and certified as follows:

- For a corporation, by a principal officer of at least the level of vice president;
- For a partnership or sole proprietorship, by a general partner or the proprietor, respectively; or
- For a municipality, state, federal, or other public facility, by either a principal executive officer or ranking elected official.

#### All Applicants Must Complete the Following Certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information; including the possibility of fine and imprisonment for knowing violations. [75-5-633, MCA]

A. Name (Type or Print)	
B. Title (Type or Print)	C. Phone No.
D. Signature	E. Date Signed

The Department will not process this form until all of the requested information is supplied, and the appropriate fees are paid. Return this form and the applicable fee to:

Department of Environmental Quality Water Protection Bureau PO Box 200901 Helena, MT 59620-0901 (406) 444-3080

# ATTACHMENT A - Delegation of Authority Form (Parts 3.2. and 4.15.)

This form is for use by permittees under the MPDES "General Permit for Storm Water Discharges Associated with Construction Activity". The owner/operator information and "site name" provided below must be the same as the information provided on the NOI and SWPPP Form. This form can be used for an additional and/or new SWPPP Administrator person/position not identified on the NOI Form.

#### **Delegation of Authority**

I, ______ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the MPDES "General Permit for Storm Water Discharges Associated with Construction Activity" (General Permit), at the

_____ construction site. The designee is authorized to sign any reports, Storm Water Pollution Prevention Plan, and all other documents required by the General Permit.

Name of Person or Position: _____

Owner/Operator:____

Mailing Address: _____

City, State, Zip Code: _____

Phone Number:

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Part 4.15. of the General Permit, and that the designee above meets the definition of a "duly authorized representative" as set forth in Part 4.15.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name:	 _
Title:	
Signature: _	
Date:	



# **Rainfall Erosivity Factor Calculator for Small Construction Sites**

EPA's stormwater regulations allow NPDES permitting authorities to waive NPDES permitting requirements for stormwater discharges from small construction sites if:

- the construction site disturbs less than five acres, and
- the rainfall erosivity factor ("R" in the revised universal soil loss equation, or RUSLE) value is less than five during the period of construction activity.

If your small construction project is located in an area where EPA is the permitting authority and your R factor is less than five, you qualify for a low erosivity waiver (LEW) from NPDES stormwater permitting. LEW certifications are submitted through the electronic Notice of Intent (eNOI) system. Several states that are authorized to implement the NPDES permitting program also accept LEWs. Check with your state NPDES permitting authority for more information.

- <u>List of states, Indian country, and territories where EPA's 2012 Construction General Permit (CGP)</u> and Multi-Sector General Permit (MSGP) Apply
- EPA's CGP eNOI System

The period during which small construction sites qualify for the waiver generally occurs during a relatively short time in arid and semi-arid areas. If your small construction project does not qualify for a waiver, then NPDES stormwater permit coverage is required.

To use the Rainfall Erosivity Factor Calculator to determine your eligibility for the LEW, you will need your project's location (either latitude/longitude or address) and the estimated start and end dates of construction. The period of construction activity begins at initial earth disturbance and ends with final stabilization.

- Construction Rainfall Erosivity Waiver Fact Sheet
- <u>Appendix C of the 2017 CGP Small Construction Waivers and Instructions</u>

For questions or comments, email EPA's CGP staff at cgp@epa.gov.

# **Facility Information**

- Start Date: 07/23/2018
- End Date: 08/27/2018
- Latitude: 48.4583333333333
- Longitude: -114.3522222222

# **Erosivity Index Calculator Results**

An erosivity index value Of 3.17 has been determined for the construction period of 07/23/2018 - 08/27/2018.

A rainfall erosivity factor of less than 5.0 has been calculated for your site and period of construction. Contact your permitting authority to determine if you are eligible for a waiver from NPDES permitting requirements. If you are covered under EPA's construction general permit then you can use eNOI to submit your low erosivity waiver certification.

If your construction activity extends past the project completion date you specified above, you must recalculate the R factor using the original start date and a new project completion date. If the recalculated R factor is still less than 5.0, a new waiver certification form must be submitted before the end of the original construction period. If the new R factor is 5.0 or greater, the operator must submit a Notice of Intent to be covered by the Construction General Permit before the original project completion date.

Start Over

AGI	ENCY USE ONLY		
PERMIT NO.:		Date Rec'd.:	Rec'd By:
Monta	na Department of	<b>LITY</b>	
WATER PRO	<b>DTECTION BURE</b>	U	
STORM WATER RAINFALL EROSIVITY WA for Exclusion from MPDES Permitting for Storr Discharges Associated with Construction Activit	n Water y		이 가 나는 것이다.
Important: The attached instructions must be reprint or type. This Form must be filled out comp This Form can only be used for construction pro no earlier than March 1st and completing construction than November 30th of the same calendar year.	letely. This Form ca jects initiating const	nnot be submitted electronic submitted electron-related group	ectronically. nd disturbance
A. Name and Address of Applicant (Owner or Ope	erator):		
Applicant (Owner or Operator) Name:			
Mailing Address:			
City, State, and Zip Code:			
Email Address (optional):			
Phone Number:			
Who is applying (check): Construction Project Owner	Contractor		
Contact Person (familiar with facility):			
Name:			
Title:			
<b>B. Location of the Construction Activity Site:</b> Street Address or Location Description:			
City, State, and Zip Code:			
County:			
Site Name of Construction Activity or Facility:			

Latitude of the Construction Act	ivity Site:	
----------------------------------	-------------	--

Longitude of the Construction Activity Site:

C. Briefly Describe the Nature of the Construction Activity:

D. Area of Construction-Related Disturbance at the Construction Activity Site:

**E.** Indicate the name of the receiving surface water(s): Attach a USGS topographic map showing the construction activity location and receiving surface waters. If storm water from the construction activity site enters a storm sewer system, identify that system and indicate the ultimate named receiving surface water for the storm sewer system.

#### F. Rainfall Erosivity Factor:

Indicate the determined Rainfall Erosivity Factor, otherwise known as "R Factor", rounded to the nearest tenth of a decimal place (this value must be less than five in order to qualify for the use of this Form):

The Department reserves the right to revoke or refuse to grant the waiver based on the potential for contribution to a violation of a water quality standard or for significant contribution of pollutants to state waters.

The Department may not grant waivers for construction sites located in areas where snow cover can exist at the site for extended periods of time, particularly if the construction site will remain active and unstabilized during the snowmelt runoff periods. The Department will make the decision on whether or not a project qualifies for the waiver based on information provided by the permittee, and other sources, such as local government agencies.

Check which one of the following two methods was used to determine the Rainfall Erosivity Factor:

Method #1 - Environmental Protection Agency Website Online Calculator; or

Method #2 - Using Tables & Maps from EPA's Storm Water Phase II Final Rule Fact Sheet 3.1: Low Rainfall Erosivity Waiver (EPA 833-F-00-014, published 01/01/2001)

For all applicants (using either Method #1 or #2), referring to the instructions, please provide the following information which was used in the Rainfall Erosivity Factor determination:

1.	The start date of the construction project.	
		Start Month / Day / Year
2.	The end date of the construction project (after "final stabilization" is achieved).	
		End Month / Day / Year
3.	The county the project is located in. If the project is in two or more	
	counties, the county that the	
	majority of the project lies within must be used.	County

For those applicants which used Method #1, please submit an original print-out of the result page (from the website's online R Factor calculator) demonstrating the above provided information, and which indicates the R Factor is below five. If Method #1 was used, Items #4 through #11 below do not need to be completed. For those applicants using Method #2, then items #4 through #11 do need to be completed, and the result indicated in Item #11 is the determining R Factor.

# **APPENDIX C**

# **Geotechnical Reports**



**RESTORING OUR ENVIRONMENT DESIGNING OUR FUTURE** 

# Montana State Hospital Wastewater Treatment Plant Geotechnical Report, Rev. 2

Warm Springs, Montana

Prepared for: Anderson-Montgomery Consulting Engineers 1064 N. Warren Street Helena, Montana 59601

> Prepared by: **Pioneer Technical Services, Inc.** 1309 Cole Avenue, Helena, Montana 59601

> > September 2020

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> > September 2020





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<b>Revision No.</b>	Author	Version	Description	Date
Rev 0	Adam Fetherston	Draft	Internal Review	August 2019
Rev 1	Adam Fetherston/ Mike Browne	Final	Client Submittal	September 11, 2019
Rev 2	Mike Browne			September 4, 2020





# **1** INTRODUCTION

Anderson-Montgomery Consulting Engineers contracted Pioneer Technical Services, Inc. (Pioneer) to complete a geotechnical investigation for the proposed Wastewater Treatment Plant (WWTP) for the Montana State Hospital located in Warm Springs, Montana. The purpose of the geotechnical investigation was to explore subsurface conditions at the proposed site and provide information on soil characteristics, groundwater conditions, earthwork/stabilization measures, foundation recommendations, soil bearing capacity, lateral earth loads, soil corrosivity concerns, seismic zone, material specifications, and discussion of any unusual conditions. This report provides conclusions of the investigation, results of laboratory testing and analyses, and design recommendations.

# **2** INVESTIGATION

# 2.1 Site Description

The proposed project will be located northwest of the intersection of Garnet Way and the I-90 Frontage Road on land owned by the State of Montana. The site is relatively flat and is vegetated with native grasses. The site is bounded by the I-90 Frontage Road to the east, railroad tracks to the west, Garnet Way to the south, and undeveloped agricultural property to the north. There is an abandoned home approximately 500 feet to the south. The legal description of the site is the Southeast ¹/₄ Southeast ¹/₄, Section 13, Township 05 North, Range 10 West.

# 2.2 Geotechnical Investigation

Pioneer drilled seven boreholes (BH-01 through BH-06 and MW-02) to a depth of approximately 25 feet below the ground surface. Figure 1 shows a site map with the borehole locations. The drilling work was performed July 17, 2019 through July 19, 2019 and the boreholes were advanced using Pioneer's Geoprobe 7822DT drill rig. Piezometers were installed in BH-01 and MW-02 to further monitor groundwater conditions at the site. A geotechnical engineer for Pioneer logged the borehole lithology and collected samples for laboratory testing.

The proposed building location was shifted to the north approximately 400 feet as the design progressed. Three additional boreholes (BH-01a, BH-02a, and BH-03a) were drilled on July 30, 2020 at the new location. Drilling work was performed by O'Keefe drilling using a Mobile B61 drill rig under subcontract to Pioneer. Figure 2 shows an updated site map with additional borehole locations.

In each borehole *In-situ* strengths were collected via Standard Penetration Tests (SPTs) using a 2-inch outside diameter split-spoon sampler which was driven into the soil using a standard 140-pound safety hammer falling from a height of 30 inches. Geotechnical samples were collected from each SPT interval and field classified in general accordance with American Society for Testing and Materials (ASTM) D2488 (Standard Practice for Description and Identification of Soils [Visual – Manual Procedure]). Soil sampling was not performed in MW-02.





Appendix A contains the detailed borehole logs while Appendix B presents photographs of the investigation and soil samples. The stratification lines shown on the borehole logs represent the approximate boundary between soil types as observed within the boreholes. The actual *in-situ* transition is variable because of the nature and depositional characteristics of natural soils. Interpolation of subsurface conditions beyond the location of the boreholes may be unreliable as soil conditions can change rapidly in both lateral and vertical directions.

# 2.2.1 Soil Lithology

Geologically, the site is in "glacial outwash deposits" (MBMG, 2004). Soils logged during the investigation were consistent with the mapped geology.

At the original location, the native site soils generally consisted of soft to medium stiff sandy elastic silt to a depth of between 2 feet and 5.3 feet (average depth of 3.8 feet) overlying medium dense to very dense poorly graded gravel with sand, silt, clay, and cobbles. The gravel layer extended to depths of between 10.8 feet and 15 feet. Beneath the gravel layer were alternating layers of sandy lean clay, clayey sand, and poorly graded sand extending to the bottom of the boreholes.

At the new location, native soils consisted of elastic silt and clayey sand to depths of between 3.5 feet to 6 feet underlain by poorly graded gravel with sand and cobbles. A sandy lean clay was logged at the 13-foot depth in two of the boreholes.

# 2.2.2 Groundwater Conditions

Groundwater was encountered between 5 feet and 10 feet below ground surface during the investigation. Review of local well logs on the Montana Bureau of Mines and Geology (MBMG) Ground-Water Information Center (GWIC) website indicate the static groundwater levels for nearby wells was 5 to 6 feet below ground surface at the time the wells were installed. The groundwater level likely fluctuates seasonally but can be expected to be very shallow during construction. Please note groundwater conditions shown on the borehole logs are only applicable for the dates of the drilling and may vary for different times of the year.

Piezometers were installed in BH-01 and MW-02 to further monitor groundwater conditions at the site. Pioneer personnel took groundwater measurements in the piezometers on August 27, 2019. The results are presented in Table 1.





BOREHOLE NO.	GROUNDWATER DEPTH BELOW GROUNDSURFACE			
	7/17/2019 (DURING DRILLING)	8/27/2019		
BH-01	10.0 ft	6.8 ft		
MW-02	8.8 ft	6.6 ft		

#### **Table 1: Groundwater Measurements**

# 2.3 Laboratory Testing

All collected samples were transported and analyzed at Pioneer's American Association of State Highways and Transportation (AASHTO)/ASTM accredited materials testing laboratory located in Helena, Montana. The samples were collected from select depths and were tested for their index (physical) and chemical properties. Laboratory testing was not included in Pioneer's scope of work for the second round of drilling.

## **2.3.1** Index Properties

A summary of the laboratory testing results is presented in Table 2. Appendix C provides the complete laboratory testing results.

BOREHOLE			LIQUID	PLASTIC	PLASTICITY	GRADATION ANALYSIS		
NO.	(ft)	SYMBOL     LIMIT     LIMIT     INDEX       (%)     (%)     (%)		GRAVEL (%)	SAND (%)	FINES (%)		
BH-01	0 - 1.5	MH	62	42	20	6	21	73
BH-02	0 - 1.5	MH	64	44	20	7	26	67
BH-02	15 - 16.5	SC	44	15	29	15	42	43
BH-05	0 - 1.5	MH	63	37	26	0	21	79
BH-05	15 - 16.5	CL	29	20	9	2	44	54

 Table 2: Laboratory Index Data

Moisture contents ranged from 5 to 49 percent. More specifically, the surficial elastic silts had moisture contents between 30 and 49 percent with an average of 38 percent. <u>These elastic silts have been problematic to properly moisture condition and compact in past projects in the area</u>. The underlying granular soils typically had moisture contents between 5 and 15 percent while clay soils logged below the groundwater table had typical moisture contents ranging between 26 and 42 percent.

# **2.3.2** Chemical Properties

Corrosivity testing (soluble sulfate, pH, and conductivity) was conducted to determine if the native soils may potentially be corrosive to buried concrete or metal associated with the proposed construction. The pH and soluble sulfate testing were subcontracted to Alpine Analytical located in Helena, Montana. A summary of corrosivity testing results is presented in Table 3.





BOREHOLE NO.	DEPTH (ft)	USCS SYMBOL	pH (s.u.)	CONDUCTIVITY (mmhos/cm)	SOLUBLE SULFATE (%)
BH-02	5 - 6.5	GP-GM	7.8	0.0040	0.2786
BH-04	0 - 1.5	MH	8.3	1.5300	1.5669

Table 3: Corrosivity Testing

Criteria from the American Water Works Association (AWWA) and by the Portland Cement Association (PCA) were used to evaluate soil corrosiveness. The PCA criteria for concrete exposed to sulfate-containing soils (PCA, 2007) are listed in Table 4.

SULFATE (SO4) CONTENT IN SOIL (%)	SULFATE EXPOSURE	RECOMMENDED CEMENT TYPE	MAXIMUM WATER/CEMENT RATIO
Less than 0.10	Negligible	No special type required	
0.10 to 0.20	Moderate	Type II cement	0.50
0.20 to 2.00	Severe	Type V cement	0.45
Over 2.00	Very Severe	Type V cement plus pozzolan or slag	0.40

<u>The native site soils are considered corrosive to buried metallic elements</u>. Use of high-density polyethylene (HDPE) or polyvinyl chloride (PVC) utility pipes and culverts is recommended in lieu of metallic products. The sulfate testing results indicate the on-site soils have a severe exposure to concrete sulfate attack. Type V cement is recommended for all cast-in-place structural concrete exposed to the native soils.

# **3** ANALYSIS AND RECOMMENDATIONS

# 3.1 Proposed Construction

The proposed Wastewater Treatment Plant facility will consist of a 12-foot by 24-foot screening building, a 20-foot by 24-foot UV disinfection and blower building, two Submerged Attached Growth Reactor (SAGR) cells, and two lined earthen lagoons. Pending progression of design, the two SAGR cells may be replaced with a nitrification reactor instead. The reactor would be positioned in the same location as the SAGR cells.

Pioneer understands the following preliminary design criteria of each structure:

- 1. The two buildings are anticipated to be founded on either a conventional shallow foundation system with footings, or a monolithic mat slab foundation, and will be built close to existing grade.
- 2. The SAGR cells will likely be 8 feet to 10 feet deep and approximately 50 feet by 150 feet in size.







- 3. The two lagoons will be set to balance cut and fill as closely as possible and will each be approximately 190 feet by 260 feet in size.
- 4. The lagoons will be designed with 3 Horizontal to 1 Vertical (3H:1V) or flatter slopes. Lagoons will be lined with geomembrane liner.
- 5. If the nitrification reactor is required in place of the SAGR cells it will be a concrete structure approximately 30 feet by 40 feet in size and 10 feet to 12 feet deep.

## 3.1 Subsurface Materials

The elastic silt was logged from the ground surface to depths of 5.3 feet and 4 feet in BH-01 and BH-02, respectively. This elastic silt has low bearing capacity, is prone to settlement (*in situ* state), and has proven to be difficult to moisture condition and compact. Pioneer recommends the elastic silt be removed from the infrastructure footprints and replaced with structural fill. With proper construction techniques (moisture conditioning and compaction) the elastic silt is suitable for use in lagoon embankment construction.

The sandy lean clay logged at the 13-foot depth can also be problematic for long-term settlement. Pioneer understands the proposed building foundations will be positioned at maximum depth of 10 feet. Pioneer recommends maintaining this maximum 10-foot footing depth to allow the poorly graded gravel (above the sandy lean clay) to function as a uniform bearing surface which can distribute imposed building loads.

### 3.2 Structure Foundations

The proposed screening building, UV disinfection building, and SAGR cells are suitable for construction on spread footings or a mat slab. Pioneer recommends placing structural fill directly under the footings due to encountering elastic silt at anticipated foundation depths.

### 3.2.1 Earthwork

Pioneer recommends the following earthwork sequence to prepare the site for the proposed structures:

- 1. Elastic silts are anticipated at the proposed foundation depths for the UV disinfection building and screening building. Granular soils (sands and gravels) are anticipated at the proposed foundation depths for the SAGR cells.
- 2. Where observed, over-excavate the silt subgrade soils beneath the building footprint to poorly graded gravel with sand and cobbles.
  - a. Elastic silt was measured at a depth of 5.3 feet in BH-01 (screening building) and 4 feet in BH-02 (UV disinfection building).
  - b. The over-excavation should extend horizontally at a minimum 1H:2V projection from the perimeter of the building. For example, a 4-foot over-excavation would require a horizontal extension of 2 feet in each direction around the perimeter.
- 3. Bottom of exterior footings are to be located at least 48 inches below final grade to mitigate frost potential.
- 4. Dewater as warranted. Pioneer recommends contractor have an approved dewatering plan prior to initiating construction.





- 5. Provide an opportunity for the engineer to inspect the bottom of the excavation. Excavate soft spots or unsatisfactory materials that are observed.
- 6. Compact the subgrade soils to a standard relative compaction (ASTM D698) of at least 98 percent. If subgrade soils are saturated, prone to pumping, or have erratic soil types:
  - a. Compact excavation subgrade with a minimum of 4 passes of a sheep's foot roller weighing at least 10,000 pounds. Do not use vibratory compaction.
  - b. Soft spots (if encountered) should be over-excavated and replaced with rockfill meeting the gradation requirements listed in Table 5. Additional dewatering may be required.
  - c. Compacted excavation surface should be proof rolled with heavy equipment. The engineer should be allowed to observe proof-rolling to approve compacted surface. Density testing is not required for rockfill.

SIEVE SIZE	PERCENT PASSING
6 - inch	100
3⁄4 - inch	0 - 10
No. 4	0 - 5

Table 5: Rockfill (MDT Drain Aggregate)

- d. Place geotextile in accordance to manufacture recommendations over top of rockfill. Geotextile should meet or exceed the engineering properties of Geotex 801.
- 7. Place and compact structural fill to design grade. Place structural fill in 8-inch (maximum) loose lifts and compact to a standard relative compaction of at least 98 percent under footing/mat slab locations and 95 percent for slab-on-grade locations. Structural fill should meet the gradation requirements listed in Table 6.

Table 6: Structural Fill(MPW 4-inch Minus Subbase Course)

SIEVE SIZE	PERCENT PASSING
4 - inch	100
No. 4	25 - 60
No. 40	10 - 30
No. 200	2 - 10

- 8. At contractor's option to assist with fine-grading, the top lift of structural fill may be substituted with base course. Base course must meet the gradation requirements listed in Table 7 and be compacted to a standard relative compaction of at least 98 percent.
- 9. Form and construct the footings and slab-on-grade.



SIEVE SIZE	PERCENT PASSING
1.5 - inch	100
No. 4	25 - 60
No. 200	0 - 8

#### Table 7: MPW 1.5-inch Minus Base Course

Ensure there is positive drainage away from the open footing excavations to keep all surface water from draining into the excavations. This also applies to final grading, where positive drainage must be in place around the entire building perimeter.

#### 3.2.2 Spread Footings

With the structures set on structural fill per Section 3.2.1, Pioneer recommends the following spread footing design parameters:

- 1. Allowable soil bearing capacity of 3,000 pounds per square foot (psf).
- 2. The friction coefficient ( $\mu$ ) can be taken as 0.40 for sliding against structural fill/base course.
- 3. Total and differential settlement of foundations designed and placed as recommended is anticipated to be less than 1 inch and ½ inch, respectively.

#### 3.2.3 Mat Slab and/or Slab-on-Grade

With the structures set on structural fill and/or native granular soils per Section 3.2.1, Pioneer recommends the following mat slab parameters:

- 1. Moduli of subgrade reaction (k_s) of 300 pounds per square inch per inch (pci) of deflection for structures set on structural fill and k_s of 200 pci for structures set on native granular soils.
- 2. Moduli of elasticity (E_s) value of 14,000 pounds per square inch (psi) and Poisson's ratio ( $\upsilon$ ) of 0.30 for the structural fill. E_s value of 6,000 psi and  $\upsilon$  of 0.50 for native, wet granular soils.
- 3. Friction coefficient of 0.40 for sliding.
- 4. Allowable bearing capacity of 3,000 psf.
- 5. Pioneer anticipates total settlement of the mat slab designed and placed as recommended will be less than 1 inch.

#### **3.2.4** Foundation Walls

The native soils and/or structural fill are suitable for backfill. Note Type 5 cement should be used for all concrete exposed to native soils. Place backfill in 8-inch (maximum) loose lifts and compact each lift to a standard relative compaction of at least 95 percent. Use hand operated compactors in areas adjacent to structures.

Reinforced concrete wall design can use the lateral pressure coefficients listed in Table 8.







LATERAL EARTH PRESSURE	NATIVE SILT BACKFILL COEFFICIENT (K)	NATIVE GRANULAR SOILS & STRUCTURAL FILL COEFFICIENT (K)
Active	0.41	0.30
Passive	2.46	3.39
At-Rest	0.58	0.46
Seismic (Mononobe-Okabe)	0.57	0.43

#### Table 8: Lateral Earth Coefficients and Pressures – Native Silt Soils

Silt values are based on an assumed strength value for internal angle of friction ( $\phi$ ) equal to 25°, a cohesion value (c) of 0 psf, a moist unit weight of 90 pounds per cubic foot (pcf), level backfill, and an equivalent fluid weight of 37 pcf. Structural fill and native granular soil values are based on an assumed  $\phi$  equal to 33°, a c of 0 psf, a moist unit weight of 135 pcf, level backfill, and an equivalent fluid weight of 40 pcf.

These values can also be used for retaining walls planned for this project, provided similar backfill is used.

## 3.3 Lagoons and Embankment Construction

The native elastic silt soils, native granular soils (underlying silt soils), or imported structural fill are suitable for use as embankment fill. Alternative materials may also be acceptable provided they are approved by the engineer through the submittal process.

Note: the elastic silt soils are suitable for use but can be problematic. The design team and contractor should be aware of the following conditions associated with the silt:

- 1. The elastic silt soils have low engineering strength; hence embankments should be constructed with gentle slopes. The *Design of Small Dams* (USBR, 1987) recommends embankment slopes for elastic silt soils of 3.5H:1V for the upstream slope and 2.5H:1V for the downstream slope. Please note this does not consider the lagoons will be lined.
- 2. The elastic silts are moisture sensitive. *In situ* moisture contents were measured between 36 and 49 percent. Past experience in the area indicates it is challenging to properly moisture condition these soils to an optimum moisture content to facilitate compaction. Pioneer recommends the contractor have an approved work plan for moisture-conditioning the soils if the elastic silts are to be used in embankment construction. A waiver to the optimum moisture content specifications should not be given for the elastic silt soils.

To construct the lagoon embankments, Pioneer recommends the following earthwork sequence:

- 1. Excavate to design grade. Design grade to be established by others. At a minimum strip all topsoil, roots, and organic vegetation from embankment footprint.
- 2. Pending design grades, dewater as warranted.



- 3. Scarify, moisture condition, and compact embankment footprint. Subgrade soils should be moisture conditioned to plus or minus 3 percentage points from optimum moisture content and compacted to a standard relative compaction of at least 95 percent (ASTM D698).
- 4. Proof roll compacted subgrade with loaded dump truck. Provide an opportunity for the engineer to inspect the bottom of the excavation and observe proof rolling. Excavate or recondition and compact soft spots or unsatisfactory materials that are observed.
- 5. Construct the embankment. Moisture condition and compact embankment materials:
  - a. Moisture condition embankment soils to plus or minus 3 percentage points from optimum moisture content (ASTM D698).
  - b. Place in 12-inch (maximum) loose lifts. If contractor's compactor weighs less than 15,000 pounds, the loose lift thickness should be reduced to 8 inches (maximum).
  - c. Compact to a standard relative compaction of at least 95 percent (ASTM D698). A sheep's foot roller is recommended for silt soils. Use hand operated compactors in backfilled areas adjacent to structures.

## 3.4 Seismic Considerations

The project site is within the Northern Rocky Mountains seismic zone (Wong, 2005). Several quaternary faults are located in the area. Liquefaction is not anticipated to occur to the depths explored during the drilling investigation (25 feet) due to the soil plasticity and/or relative density. The seismic coefficients were estimated using 2012 International Building Code and Risk Category II and are presented in Table 9. The seismic coefficients data sheet is included in Appendix D.

IBC 2012 – SEISMIC COEFFICIENTS	
Site Class Definition	D
Mapped Spectral Response Acceleration Parameter, Ss for 0.2 second	0.390g
Mapped Spectral Response Acceleration Parameter, S1 for 1.0 second	0.127g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S _{MS}	0.580g
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S _{M1}	0.291g
Design Spectral Response Acceleration Parameter, SDS	0.387g
Design Spectral Response Acceleration Parameter, Sp1	0.194g

#### Table 9: Seismic Coefficients

## 3.5 Shrink/Swell Characteristics

The volume change potential of the granular subgrade soils, which the infrastructure will be founded upon, is considered low. Regardless, Pioneer recommends the following be incorporated into the design:

1. Roof runoff water is to be collected in a gutter/downspout system and routed away from the foundations.





- 2. Grades (minimum 2 percent) should be designed and constructed to promote positive drainage away from the building perimeter.
- 3. Avoid placing plantings and irrigation systems immediately adjacent to the building.

## 3.6 Underground Utilities and Trench Stability

For utility trench excavations, the trench soils meet the Occupational Safety and Health Administration's (OSHA) 29 CFR Part 1926 requirements for a Type C soil. The steepest unsupported slope within a Type C soil is limited to 1.5H:1V.

Use Type I bedding soils beneath and up to 6 inches above the top of the pipe. Type I bedding soils are ³/₄-inch minus granular soils having a soluble sulfate content less than 0.1 percent and a resistivity greater than 3,000 ohm-centimeters. The on-site soils can be reused as trench backfill above the bedding soils.

Soil compaction in utility trenches deeper than 5 feet should be performed using a remote trench compactor or a Felco-style bucket on an excavator and observed by an inspector. Compaction testing should be performed on each lift from a depth of 5 feet to the top of the trench. The trench soils should be placed in 8-inch (maximum) loose lifts and compacted to a standard relative compaction of at least 95 percent.

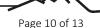
## **4** EARTHWORK TESTING

Pioneer recommends that a qualified inspector perform compaction testing for subgrade, structural fill, base course, and backfill. Table 10 lists the suggested minimum compaction testing frequency.

LOCATION	FREQUENCY
Beneath Strip Footings	1 test per 25 linear feet of footing per lift
Beneath Column Footings	1 test per footing per lift
Beneath Interior Slab-On-Grade / Mat Slab	1 test per 400 square foot per lift
Foundation Wall Backfill	1 test per 50 linear feet per lift
Embankment	1 test per 100 lineal feet per lift

#### **Table 10: Compaction Testing Frequency**

Table 11 summarizes the material compaction specifications. Compaction testing should be performed on subgrade, structural fill, base course, and backfill. Frozen soils, ice particles, and soils with organics, debris, or deleterious materials are not suitable for use as fill. Appropriate winter construction techniques will be used, as warranted, to protect subgrade, fill, and cast concrete from frost. Fill cannot be placed on top of frozen soils. Maximum loose lift thickness is 8 inches.





LOCATION	REQUIRED MINIMUM RELATIVE COMPACTION	STANDARD
Beneath Foundation Footings	98 %	ASTM D698
Beneath Interior Slab-On-Grade	95 %	ASTM D698
Beneath Mat Slab	98 %	ASTM D698
Foundation Wall Backfill	95 %	ASTM D698
Embankment	95 %	ASTM D698

#### Table 11: Required Relative Compaction

Concrete testing frequency should be performed in accordance with Montana Public Works specifications, project specifications, and/or structural engineer requirements.

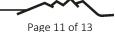
## **5** BASIS OF RECOMMENDATIONS

The analyses and recommendations submitted in this report are based on the boreholes drilled during the subsurface investigation and with general site familiarity. Often, variations occur within the subgrade, the nature and extent of which do not become evident until additional exploration or construction is conducted. Pioneer recommends geotechnical involvement be continued throughout the project to ascertain the recommendations presented herein (Geotechnical Report) have been properly interpreted both during design and construction. These services will reduce potential for misinterpretation of geotechnical design recommendations. Pioneer also recommends a geotechnical engineer be notified during the excavation construction phase to evaluate the foundation soils and verify their resemblance to those encountered during the site investigation.

This report is based on Pioneer's understanding of the preliminary design location associated with the proposed Wastewater Treatment Plant for the Montana State Hospital. If the project location or proposed elevation profile change, please consult Pioneer to verify that these recommendations are still applicable.

This report is for the exclusive use of Anderson-Montgomery Consulting Engineers and their design team. In the absence of Pioneer's written approval, Pioneer makes no representation and assumes no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. Other parties contemplating other structures or purposes should contact Pioneer.

Services performed by Pioneer's personnel for this project have been conducted with the level of care and skill ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is made.





#### **Professional Certification**

I hereby certify that this report was prepared by me and that I am a duly Licensed Professional Engineer under the laws of the State of Montana.



Mike Browne, P.E. Geotechnical Engineer

Ada Feth C

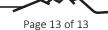
Adam Fetherston, E.I. Staff Geotechnical Engineer





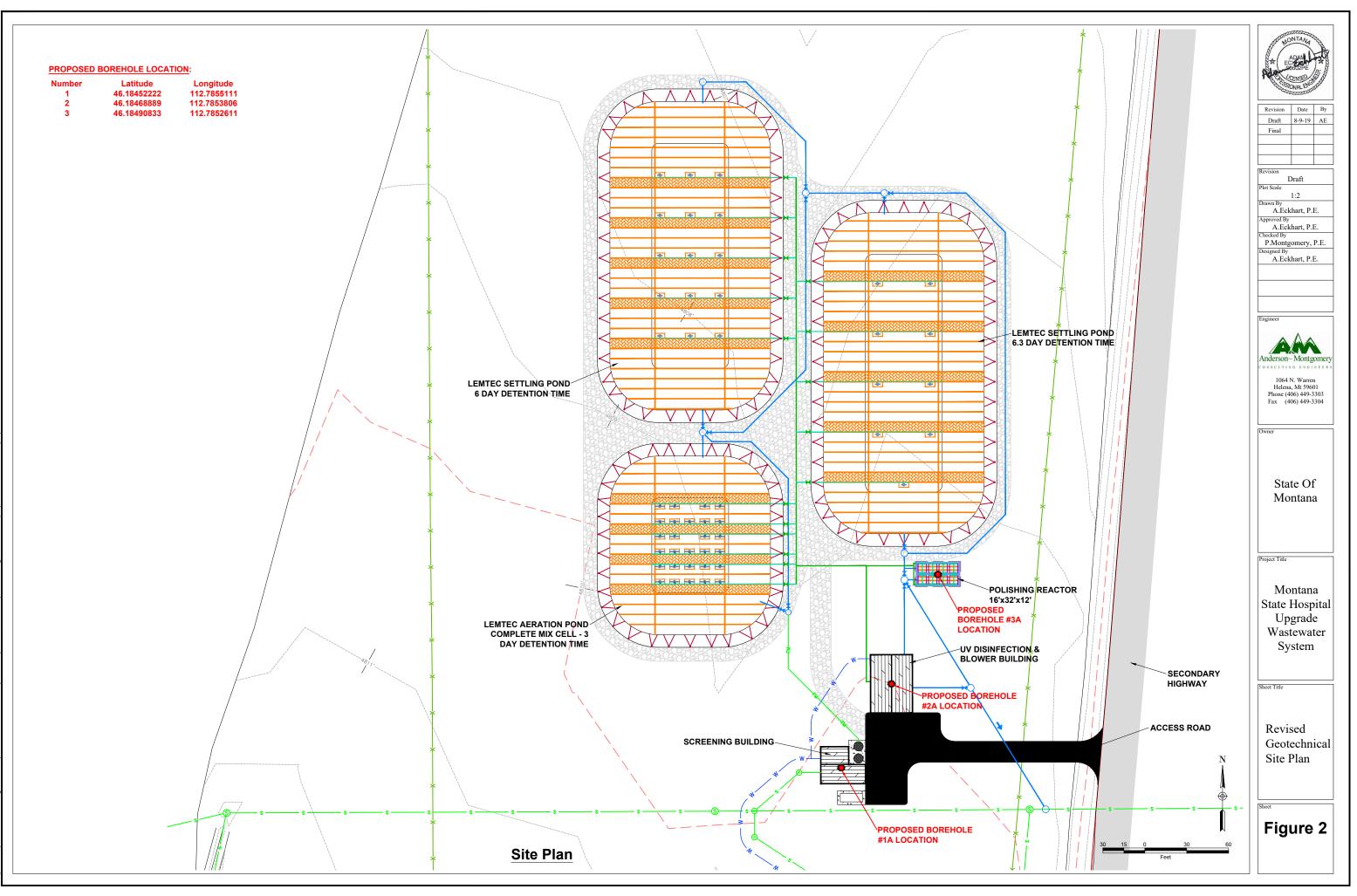
## **6 R**EFERENCES

- Bureau of Reclamation, 1987. Design of Small Dams, Third Edition, United States Department of the Interior Bureau of Reclamation, 1987.
- MBMG, 2004. Geologic Map of the Upper Clark Fork Valley, Southwestern Montana, Open-File Report 506, Montana Bureau of Mines and Geology, Richard B. Berg and Phyllis Hargrave, 2004.
- Montana Bureau of Mines and Geology, Ground-Water Information Center, Accessed August 2019, http://data.mbmg.mtech.edu/mapper/mapper.asp?view=Wells&
- Wong, I., et. al., 2005. Probabilistic Earthquake Hazard Maps for the State of Montana. Prepared for: Montana Department of Natural Resources and Conservation Dam Safety Program, Montana Bureau of Mines and Geology.





BH BOREHOLE LOCATION		DISPLAYED AS:           COORD SYS/ZONE:MSP           DATUM:NAD83           UNITS:INT FEET           SOURCE:PIONEER
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Geotechnical Report, Rev. 2

**APPENDIX A. BOREHOLE LOGS** 

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	17	20 - 14	- 14		Sandy Lean CLAY (CL), fine to coarse grained. Lo	nedium stiff, moist, bro w to medium plasticity.	wn,	12.5	8					Moderate drilling at 12.5 to BOH.
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 _ 20 _ 4790.5 		X	100	)	W	/H - 3 - 3		Sar fine	ndy Lean CLAY (CL), me to coarse grained. Low	dium stiff, moist, brown o medium plastic.	, 17.5						
25 4785.5 		X	100		W	/H - 2 - 3			Boring Depth: 26.5 ft,	Elevation: 4784.0 ft							

Phone: 406 Fax: 442-1			2						BORING 9 BH-03							TEC	HVICAL SERVICES, IN Sheet 1 of
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		100		2 - 3	8 - 5		Lea	an CLAY with sand (CL), wn, medium grained. Lo	medium stiff, moist, w to medium plasticity		15.0	37					Easy to moderate drillin at 15'.
		100		1-2	2 - 4		Cla	iyey SAND (SC), loose to t, brown, fine to coarse g	o medium dense, mois rained. Low plasticity.	it to	21.3						Moderate drilling at 21.3
} } _ 25 _/// 4786.5 		78		6 - 14	- 14						26.5						Hard drilling at 23.5'.
								Boring Depth: 26.5 ft,	Elevation: 4785.0 ft		/						

201 E Broadway Ste C Helena, MT 59601 Phone: 406-457-8252 Fax: 442-1158 Project: MSH WWT Project Number: Date Started: 7/18/19 Driller: N. Farley Logger: A. Fethersto
Project: MSH WWT
Project Number:
Date Started: 7/18/19
Driller: N. Farley
Logger: A. Fethersto

## LOG OF BORING



Boring BH-04

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		X	89		2 - 2 - 3			Elastic SILT (MH), medium st white. Low plasticity.	iff, moist, brown to			40					Easy drilling from surfac to 4.5'.
5 4807.0 		X	94		7 - 8 - 19			Silty GRAVEL with sand (GM dense, moist, brown to gray, subangular to subrounded.	), Cobbles, medium fine to coarse graine	ed, ▽	4.5	10					Moderate drilling at 4.5'
 _ 10 4802.0								Poorly-Graded SAND with sil dense, wet, gray, medium gra		<u> </u>	7.5	24					Hard drilling at 7.5'.
		X	78		13 - 13 - 1			Poorly-Graded GRAVEL with dense, wet, gray, medium gra rounded.	ained, subrounded to	)	10.8 13.5	5					
15 4797.0 		X	89		2 - 2 - 3			Sandy Lean CLAY (CL), med medium grained. Low to med		/n,							Easy to moderate drillir at 13.5'.
 _ 20 4792.0		X	83		5 - 4 - 5			Clayey SAND (SC), loose, m to coarse grained. Low plasti		ne	17.5						Moderate drilling at 17. to BOH.
  _ 25 4787.0								Sandy Lean CLAY (CL), soft, coarse grained. Low to mediu		)	23.0						
		X	100		2 - 4 - 5												
		r \					<u></u>	Boring Depth: 26.5 ft, E	Elevation: 4785.5 ft		<u>√26.5</u>	<u> </u>					·
							-	During		_							
After		Wate	er Le	vel	Observatio	ons	$\underline{\nabla}$	During Drilling: 7.5 ft After		Rem	arks:						
⊥ After ⊥ Drillin	g:						Ţ	Drilling:									

Phone: 406 Fax: 442-11		_							BORING 9 BH-05							<i>TEC</i>	HNICAL SERVICES, INC. Sheet 1 of 1
Project: N	1SH	W١	NTP	)				Rig: Geoprobe Hammer: Auto	Boring Location Coordinates:	E	1,137,0			t		Stat Offs	tion: set:
Project Number:					UPN	:		Boring Diameter: 3"	System: MT S. Datum: Warm	•		tica	l D	atur	n	Top Ele	o of Boring vation: 4810.49 ft
Date Started:	7/18/	/19		Date Finishe	ed: 7/1	8/19		Drilling Fluid: None	Location	dheld	GPS	Un	cori	ect			vation Irce: Surveyed
Driller: N Logger: A	. Fa	rley						Abandonment	ntonite		Town: and S	shi	рR	ang	е		N 18
Depth (ft) Depth	Sample Type	Recovery (%)	RQD (%)	Blow Count		Lithology		Material De			Depth (ft)	(%)			(%)		Remarks and Other Tests
(ft)	Sa	_	Ľ					astic SILT with sand (MH)		)		<b>9</b> 36	<b>-</b>	<b>占</b> 37	<b>60</b> 79	8	Easy drilling from surface
		50 100		1 - 2 30 - 50			hig Silf dry	ite, fine grained. Organic hly plastic. ty GRAVEL with sand (G to moist, brown to gray, bangular to subrounded.	N), Cobbles, very der fine to coarse grained		4.0	6		07	, ,		to 4'. Very hard drilling at 4' to 7.5'.
  10 4800.5				40.5						Ţ		12					Moderate to hard drilling 7.5'.
{/// {/// ////		89		18 - 7	(-2		me	an CLAY (CL), stiff, moisi adium plasticity. ndy Lean CLAY (CL), me			10.8 12.5	41					Easy drilling at 10.8'. Moderate drilling at 12.5'
		100		2 - 3	- 4		me Po	edium grained. Low plasti orly-Graded SAND with s e to coarse grained.	city.		17.0		29	20	54		
20 4790.5 }} 		100		2 - 1	- 3		Sa coa	ndy Lean CLAY (CL), so arse grained. Low plastic	t, moist, brown, fine to ty.	0	20.3						
>>> >>> _ 25 _>>> _ 4785.5 		100		5 - 2	- 1		fine	orly-Graded SAND with s e to coarse grained. an CLAY with sand (CL), coarse grained. Low place	soft, moist, brown, fin ticity.	Л	24.5 25.5 <u>26.5</u>						Hard drilling at 24.5'.
								Boring Depth: 26.5 ft,	Elevation: 4784.0 ft								

⁻ ax: 442-11									g BH-06		700						Sheet 1 of 1
Project: N	/ISH	W١	NTP					Rig: Geoprobe Hammer: Auto	Boring Locat Coordinates:	E	1,136,9			ť		Sta Off	tion: set:
Project Number:					UPN	:		Boring Diameter: 3"	System: MT S Datum: Warn			tica	al D	atu	m	Top Ele	o of Boring vation: 4812.7 ft
Date Started:	7/17	/19		Date Finish	ned: 7/	17/19	)	Drilling Fluid: None	Location	ndheld	GPS	Un	cori	rect	ted		vation Jrce: Surveyed
Driller: N Logger: A	. Fa	rley						Abandonment			Town	shi	рR	ang	ge		
					+			Method: Be	ntonite		and S				5	<u>N 9</u>	<u>N 18</u>
Depth (ft) <i>Elev.</i> (ft)	Sample Type	Recovery (%)	RQD (%)	;	Blow Count	Lithology		Material De	escription		Depth (ft)	MC (%)	E	Ч	-200 (%)	00	Remarks and Other Tests
-		17		1-	1 - 1		fin	andy Elastic SILT (MH), s le grained. Organics/roots asticity.		y,	0.5	39					Very easy drilling from surface to 5.5'.
							br	ayey GRAVEL with sand own, fine grained, subang asticity.	(GC), dense, moist, gular to subrounded.	Low	2.5						
4807.7 		89		3 - 1	2 - 25		de	lty GRAVEL with sand (G ense to dense, moist, brow ained, subangular to subl	wn to gray, fine to co		5.5	8					Hard drilling at 5.5'.
10 4802.7		56		18 - 1	16 - 11					Ā		9					
							Si	andy Lean CLAY (CL), ma	oist brown medium	Ţ	13.0						Easy drilling at 13' to 14
15								ained. Low to medium pla									Moderate drilling at 14.5
4797.7 \\\\ -\\\\ -\\\\		100		2 - 1	7 - 14	******		oorly-Graded SAND (SP), own, fine to coarse grain		.,	16.0	26	5				
2020								ayey SAND (SC), mediur coarse grained. Low plas		, fine	18.0						
4792.7 	$\mathbb{X}$	100		12 -	13 - 9		***										Hard drilling at 21' to BC
25 4787.7		78		6 -	4 - 3			an CLAY with sand (CL),	medium stiff moist		25.5						
1	$\mathbb{V}$							own, medium grained. Lo Boring Depth: 26.5 ft,	w to medium plastic	ity. 🖌	<u>26.5</u>						

ax: 44										MW-02								Sheet 1 o
Projec	t: M	SH	WV	VTP	)				Rig: Geoprobe Hammer: Auto	Boring Locatio Coordinates:	E 1	,136,9			t		Stat Offs	tion: set:
Projec Numb						UPN:			Boring Diameter: 2"	System: MT S.I Datum: Warm S	. ,		tica	l Da	atur	n	Top Elev	of Boring vation: 4812.1 f
Date Starte	d: 7	/18/	19		Date Finish	ed: 7/18	3/19		Drilling Fluid: None	Location Source: Hand	lheld	GPS.	Und	corr	ect			vation Irce: Surveyed
Driller Logge			•		ı				Abandonment Method: N/A			Town: and S	ship	o Ra	ang	le		V 18
Depth		e	(%			-												
(ft) Elev. (ft)	Operation	Sample Type	Recovery (%)	RQD (%)			Lithology		Material De	scription		Depth (ft)	MC (%)	F	Ъ	-200 (%)	QQ	Remarks and Other Tests
-								fine	ndy Elastic SILT (MH), m grained. Organics/roots		ite,							Very easy drilling fro surface to 4.5'.
-			44					Clay to c	sticity. yey GRAVEL with sand oarse grained, subangu sticity.			2.0						
5_								-	GRAVEL with sand (G	VI). Cobbles. moist to		4.5						Hard drilling at 4.5'.
307.1 - -			58					wet	, brown to gray, fine to c angular to subrounded.									
-	<u>}</u>										$\overline{\nabla}$							
- 10 302.1			23								<u> </u>							
-																		
-									ndy Lean CLAY (CL), mo v to medium plasticity.	ist, brown, fine grained	d.	12.3						
- 15 7 <b>9</b> 7.1			44				<b>6</b> 86666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 88666 886666 886666 88666 88666 88666 88666 88666 88666 88666 88666 88666 8	Poc to g	orly-Graded SAND with or ray, fine to coarse grain	lay (SP-SC), wet, brov ed. Low plasticity.	wn	13.8						
-									ndy Lean CLAY (CL), mo ined. Low to medium pla		rse	16.5						
- - 20 792.1			58					Clay coa	yey SAND (SC), moist to rse grained. Low plastic	o wet, brown, fine to ty.		18.0						
-			88						n CLAY with sand (CL), dium grained. Low to me			20.8						
-	<u> </u>	i j							Boring Depth: 24.0 ft,	Elevation: 4788.1 ft		24.0						

R	
20	201 E Broadway Ste C Helena, MT 59601 Phone: 406-457-8252 Fax: 442-1158
ឧ	Helena, MT 59601
Ē	Phone: 406-457-8252
≩	Fax: 442-1158
Ŀ	

# LOG OF BORING



									g BH-01A								Sheet 1 of 1
-		lont	ana	Sta	ate Hosp	oital W	WTF	Rig: Mobile B61 Hammer: Auto	Boring Locati Coordinates:	E	1,136,9			t		Stat	ion: set:
Projec Numbe	t ər:					UPN:		Boring Diameter: 8"	System: MT S	•	Ξ)					Top Elev	of Boring vation: 4810.5 ft
Date Started	<b>d:</b> 7	/30/	/20		Date Finishe	<b>d:</b> 7/30	)/20	Drilling Fluid: None	Location Source: Sca	led fro	<u>om Plar</u>	าร					<b>rce:</b> Plans
Driller: Logge								Abandonment Method: Ba	ackfilled with Cutti	ings	Town: and S	shij ecti	o Ra ion:	ang		<u>v 9v</u>	V 18
Depth (ft) <i>Elev.</i> (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count		Lithology	Material [	Description		Depth (ft)	MC (%)	Ľ	PL	-200 (%)	DO	Remarks and Other Tests
			50		3-3			Elastic SILT (MH), mediur Medium to highly plastic. Clayey SAND with gravel light brown, medium grain	(SC), very dense, mois	st,	3.5						
5 4805.5  			78		7 - 25 - 5	υ/υ.3π		Poorly-Graded GRAVEL v dense, moist, brown, fine subrounded to subangula	obbles. vith sand (GP), Cobble to coarse grained,	es, ⊻	6.0						
10 4800.5 			83		16 - 25	- 24											
 _ 15 _ _ 4795.5 		X	0		2 - 2	- 3		Sandy Lean CLAY (CL), I wet, brown. Medium plast	/lica flakes, medium sti ic.	iff,	13.0						No recovery in SS
 _ 20 _ 4790.5 		X	100		3 - 4	- 6											
 25 4785.5			100		2 - 9 -	- 23		Silty SAND (SM), dense, grained. Low to medium p Boring Depth: 25.5 f	noist, brown, medium lastic. t, <i>Elevation: 4785.0 ft</i>	]	25.0 25.5						
								J									
⊈ After ⊈ Drilling		Wate	er L	.evel	Observa	ations		∑ During ∑ Drilling: 6.5 ft		Rem	arks: Mo	onito	orinę	g po	oint	was	ground surface.
								▼ After Drilling:		1							

201 E Br Helena, I Phone: 4 Fax: 442	oadv MT 5 06-4 -115	way 5960 157-1 8	Ste )1 825:	C 2					LOG OF Boring	BORINO BH-02A	G					_	DIECI	IONEER ENICAL SERVICES, INC. Sheet 1 of 1
Project	: M	onta	ana	Sta	te Hosp	oital W	'WTP	,	Rig: Mobile B61 Hammer: Auto	Boring Loc Coordinate		722,81			t		Stat Offs	tion:
Project Numbe						UPN:			Boring Diameter: 8"	System: M Datum: Lo	T S.P. (				-		Тор	of Boring vation: 4810 ft
Date Started		201	20		Date Finishe		0/20		Drilling	Location		D					Elev	vation
Driller:	Ste	eve			1 1113110	<b>u.</b> 775	0/20		Fluid: None Abandonment	Source: S		Town	shij	p R	ang	ge		Irce: Plans
Logger						,			Method: Bad	kfilled with Cu	uttings	and S		on		5	<u>N 9</u> V	V 18
Depth (ft) <i>Elev.</i> (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count		Lithology		Material De	scription		Depth (ft)	MC (%)	LL	Ч	-200 (%)	DD	Remarks and Other Tests
Project Project Numbe Date Started Driller: Logger Depth (ft) Elev. (ft) 		X	100 67 72		6 - 10 11 - 14			Mec Poo den	stic SILT (MH), medium lium to highly plastic. rly-Graded GRAVEL wi se, moist, brown, fine to rounded to subangular.	h sand (GP), Cob		- 3.5						2" gravels present in cuttings.
 15 4795.0  		X	100		3 - 4	- 5		San wet,	dy Lean CLAY (CL), Mi brown. Medium plastic	ca flakes, medium	n stiff,	13.0						
20 4790.0 		X	100		3 - 2	- 3												
		$\overline{\langle}$	100		4 - 8	- 10												
4785.0		Nate	r 1	evel	Observ	ations	<u></u>			Elevation: 4784.5		25.5		orin			Was	Occasional gravels.
⊈ After ⊈ Drilling		Nate	r L	.evel	Observa	ations	7	<u>⊻</u> Dril ∎ Aft	ling: 7.7 ft		Rem	arks: M	onito	oring	g po	oint	was	ground surface.

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20	201 E Broadway Ste C
8	Helena, MT 59601
E	Phone: 406-457-8252
₹	Fax: 442-1158
AL/	
,⋖.	

# LOG OF BORING

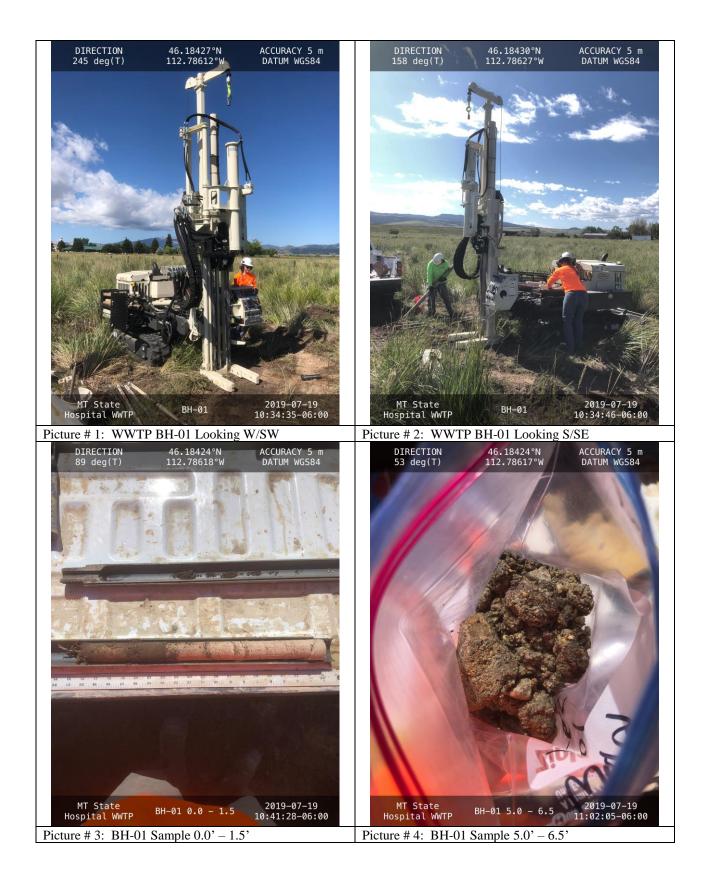


									g BH-03A								Sheet 1 of 1
Projec	:t: №	lonta	ana	Sta	te Hosp	ital W	WTF	Rig: Mobile B61 Hammer: Auto	Boring Locati Coordinates:		722,89 <u>1,137,0</u>					Stat	tion: set:
Projec Numbe						UPN:		Boring Diameter: 8"	System: MT : Datum: Loca	•	Ξ)					Top Elev	of Boring vation: 4809.5 ft
Date Started	<b>d:</b> 7	/30/	20		Date Finishe	<b>d:</b> 7/30	)/20	Drilling Fluid: None	Location Source: Sca	led fro	om Plar	าร					vation Irce: Plans
Driller: Logge	A		in					Abandonment	ckfilled with Cutt		Towns and S	ship			je		V 18
Depth (ft) <i>Elev.</i> (ft)	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count		Lithology	Material D	escription		Depth (ft)	MC (%)	LL		-200 (%)	DO	Remarks and Other Tests
Logge Depth (ft) Elev. (ft)                                                                                                 			83 72		2 - 5 - 25 - 50/			Elastic SILT (MH), medium Medium to highly plastic. Clayey SAND with gravel ( coarse grained, subrounde have low plasticity. Poorly-Graded GRAVEL w dense, moist, brown, fine t subrounded to subangular	SC), moist, brown, fin ed to subangular. Fine ith sand (GP), Cobble o coarse grained,	es ∫	3.0 4.0						
 10 4799.5  			94		11 - 27	- 23					14.0						
15 4794.5  		X	63 100		9 - 16 ·	- 21		Clayey SAND (SC), dense coarse grained. Fines have		)							Shelby tube achieved 7 penetration.
20 4789.5 			94		4 - 5 ·	- 6		Sandy Lean CLAY (CL), M wet, brown. Medium plastic		iff,	19.5						
25 4784.5			100		5 - 12 -	- 11		Boring Depth: 25.5 ft.	Elevation: 4784.0 ft		<u>25.5</u>						
		Wate	r Le	vel	Observa	tions		∠ During Drilling: 6.7 ft		Rem	arks: Mo	onito	oring	g po	oint	was	ground surface.
⊥ After Drilling								After Drilling:									



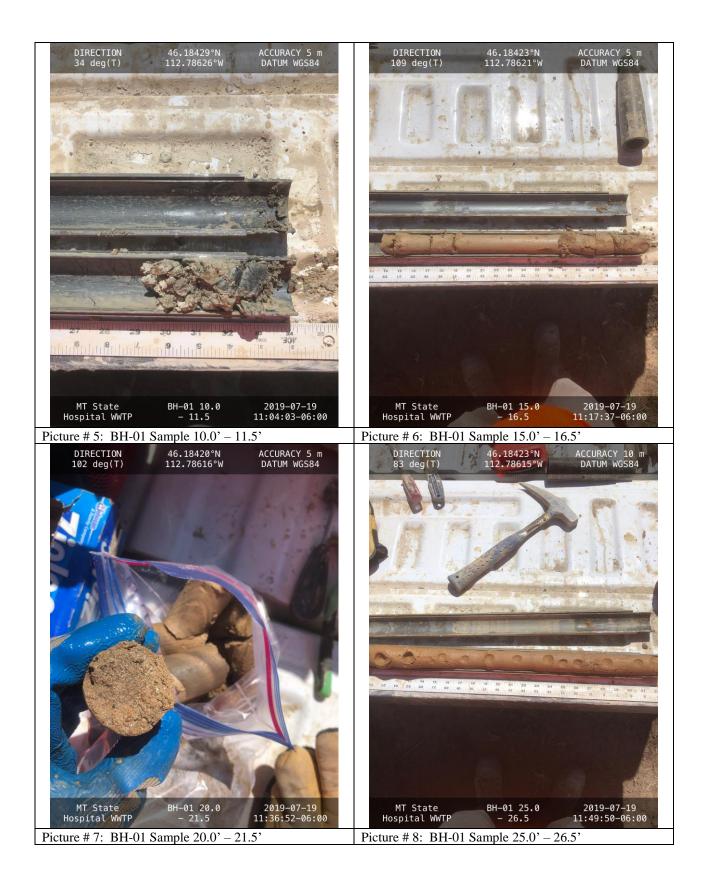
Geotechnical Report, Rev. 2

**APPENDIX B. PHOTOGRAPH LOG** 





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MT State Hospital WWTP Geotechnical Investigation Page 2 of 15







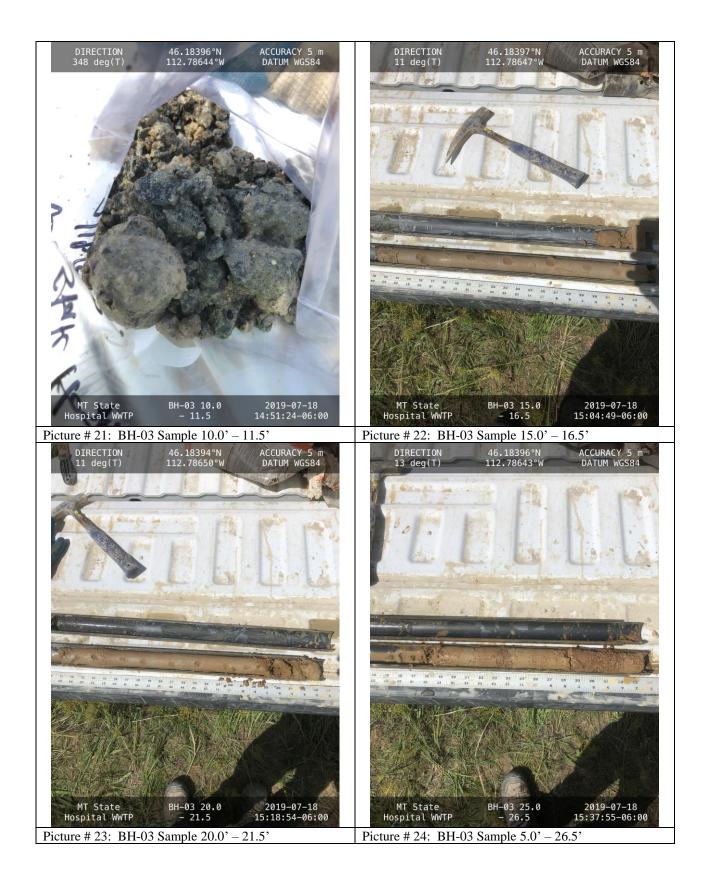


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MT State Hospital WWTP Geotechnical Investigation Page 7 of 15





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MT State Hospital WWTP Geotechnical Investigation Page **12** of **15** 













MT State Hospital WWTP Geotechnical Investigation Page **15** of **15** 



Geotechnical Report, Rev. 2

APPENDIX C. LABORATORY DATA



201 East Broadway, Suite C Helena, Montana 59601

Phone (406)457-8252 Fax (406)442-1158 www.pioneer-technical.com

Project Number:

1901031

#### Moisture Analysis - AASHTO T265; ASTM D2216

Project Name: MT State Hospital - WWTP

Lab No:	22792	22793	22794	22795	22796	22799	22800	22801	22802	22806
BH or Loc:			BH-01	BH-01	BH-01	BH-02			BH-02	BH-03
Depth:		5-5.3	5.3-6.5	10-11.5	15-16.5	0-1.5	5-6.5	10-11.5	15-16.5	5-6.5
Date Tested:										
L							1		1	
Pan No:										
Wet Wt, & Pan (g):	229.1	177	285.7	312.9	235	188.4	304	274	185.54	226.09
Dry Wt, & Pan (g):	184.9	161.14	274.61	296.73	193.91	152.91	291.47	252.7	155.28	218.07
Loss of Moisture	44.2	15.86	11.09	16.17	41.09	35.49	12.53	21.3	30.26	8.02
Wt. of Pan (g):	83.5	82.82	83.3	81.7	82	80.7	82.9	82.3	83.24	
Wt. of Dry Soil (g):	101.4	78.32	191.31	215.03	111.91	72.21	208.57	170.4	72.04	136.18
M. Content (%):	43.6	20.3	5.8	7.5	36.7	49.1	6.0	12.5	42.0	5.9
										•
Lab No:	22807	22808	22812	22813	22814	22815	22819	22820	22821	22822
BH or Loc:	BH-03	BH-03	BH-04	BH-04	BH-04	BH-04	BH-05	BH-05	BH-05	BH-05
BH or Loc: Depth:		BH-03	BH-04			BH-04				
BH or Loc:	BH-03	BH-03	BH-04	BH-04	BH-04	BH-04	BH-05	BH-05	BH-05	BH-05
BH or Loc: Depth: Date Tested:	BH-03	BH-03	BH-04	BH-04	BH-04	BH-04	BH-05	BH-05	BH-05	BH-05
BH or Loc: Depth: Date Tested: Pan No:	BH-03 10-11.5	BH-03 15-16.5	BH-04 0-1.5	BH-04 5-6.5	BH-04 10-10.8	BH-04 10.8-11.5	BH-05 0-1.5	BH-05 5-6.5	BH-05 10-10.8	BH-05 10.8-11.5
BH or Loc: Depth: Date Tested: Pan No: Wet Wt, & Pan (g):	BH-03 10-11.5 260.01	BH-03 15-16.5 230.48	BH-04 0-1.5 244.56	BH-04 5-6.5 277.21	BH-04 10-10.8 225.24	BH-04 10.8-11.5 	BH-05 0-1.5 147.88	BH-05 5-6.5 257.77	BH-05 10-10.8 275.16	BH-05 10.8-11.5 234.82
BH or Loc: Depth: Date Tested: Pan No: Wet Wt, & Pan (g): Dry Wt, & Pan (g):	BH-03 10-11.5 260.01 246.43	BH-03 15-16.5 230.48 190.21	BH-04 0-1.5 244.56 198.6	BH-04 5-6.5 277.21 259.3	BH-04 10-10.8 225.24 197.57	BH-04 10.8-11.5 383.2 368.91	BH-05 0-1.5 147.88 130.54	BH-05 5-6.5 257.77 247.13	BH-05 10-10.8 275.16 255.19	BH-05 10.8-11.5 234.82 190.73
BH or Loc: Depth: Date Tested: Pan No: Wet Wt, & Pan (g): Dry Wt, & Pan (g): Loss of Moisture	BH-03 10-11.5 260.01 246.43 13.58	BH-03 15-16.5 230.48 190.21 40.27	BH-04 0-1.5 244.56 198.6 45.96	BH-04 5-6.5 277.21 259.3 17.91	BH-04 10-10.8 225.24 197.57 27.67	BH-04 10.8-11.5 383.2 368.91 14.29	BH-05 0-1.5 147.88 130.54 17.34	BH-05 5-6.5 257.77 247.13 10.64	BH-05 10-10.8 275.16 255.19 19.97	BH-05 10.8-11.5 234.82 190.73 44.09
BH or Loc: Depth: Date Tested: Pan No: Wet Wt, & Pan (g): Dry Wt, & Pan (g): Loss of Moisture Wt. of Pan (g):	BH-03 10-11.5 260.01 246.43 13.58 81.56	BH-03 15-16.5 230.48 190.21 40.27 81.24	BH-04 0-1.5 244.56 198.6 45.96 82.17	BH-04 5-6.5 277.21 259.3 17.91 81.16	BH-04 10-10.8 225.24 197.57 27.67 83.61	BH-04 10.8-11.5 383.2 368.91 14.29 82.29	BH-05 0-1.5 147.88 130.54 17.34 81.92	BH-05 5-6.5 257.77 247.13 10.64 81.5	BH-05 10-10.8 275.16 255.19 19.97 80.98	BH-05 10.8-11.5 234.82 190.73 44.09 82.2
BH or Loc: Depth: Date Tested: Pan No: Wet Wt, & Pan (g): Dry Wt, & Pan (g): Loss of Moisture	BH-03 10-11.5 260.01 246.43 13.58	BH-03 15-16.5 230.48 190.21 40.27	BH-04 0-1.5 244.56 198.6 45.96 82.17 116.43	BH-04 5-6.5 277.21 259.3 17.91	BH-04 10-10.8 225.24 197.57 27.67 83.61	BH-04 10.8-11.5 383.2 368.91 14.29 82.29 286.62	BH-05 0-1.5 147.88 130.54 17.34 81.92 48.62	BH-05 5-6.5 257.77 247.13 10.64 81.5	BH-05 10-10.8 275.16 255.19 19.97	BH-05 10.8-11.5 234.82 190.73 44.09 82.2 108.53

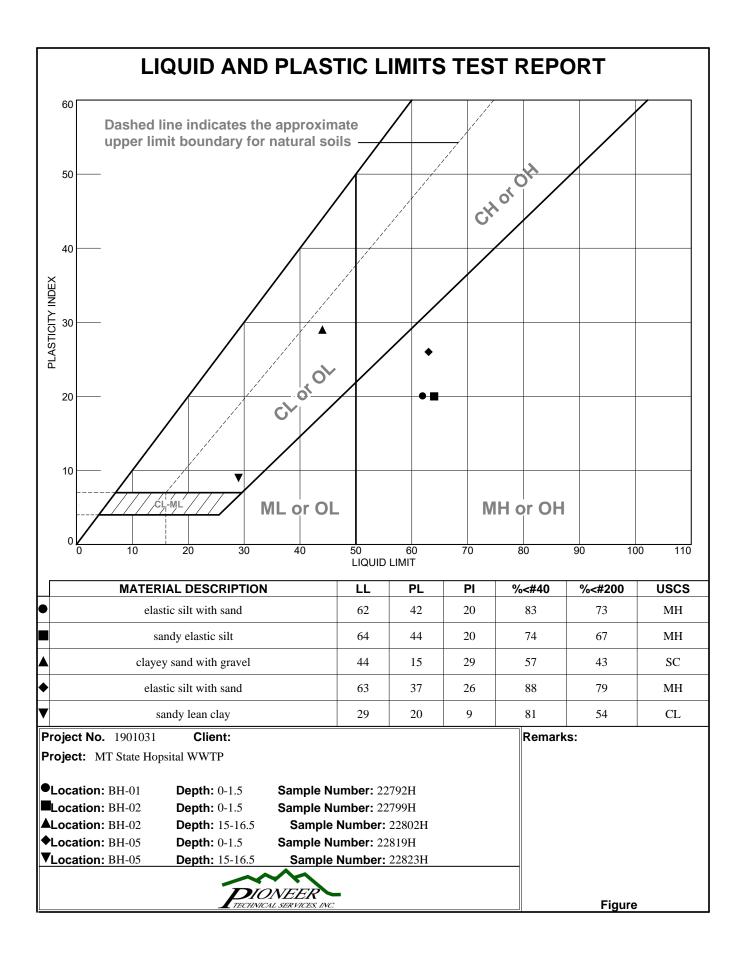
#### Project Name: MT State Hospital - WWTP

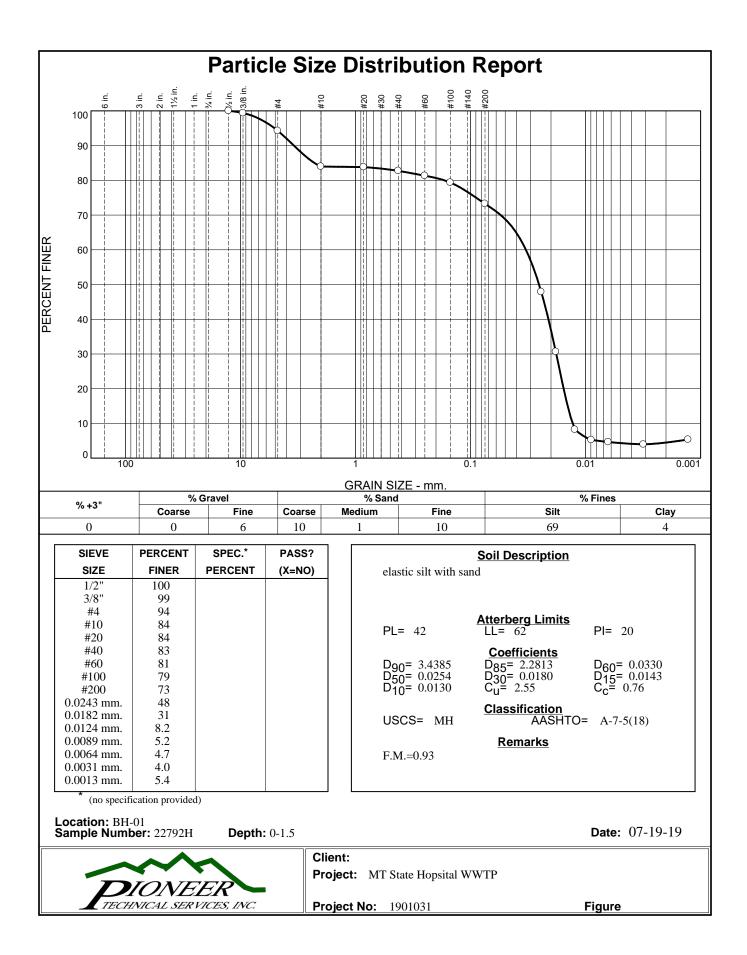
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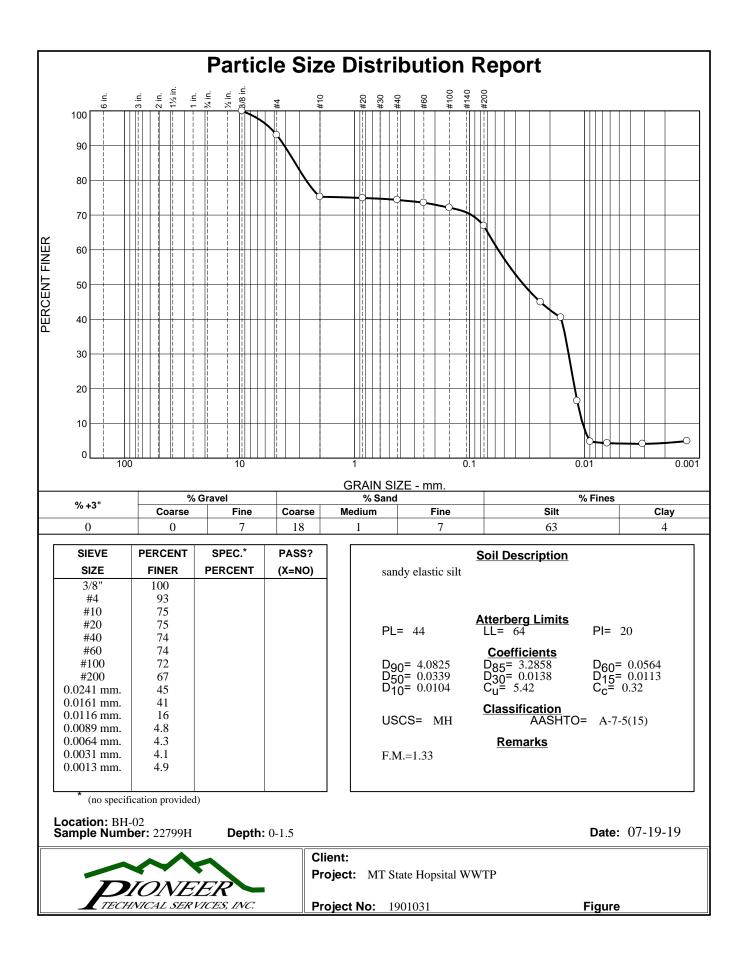
Project Number: 1901031

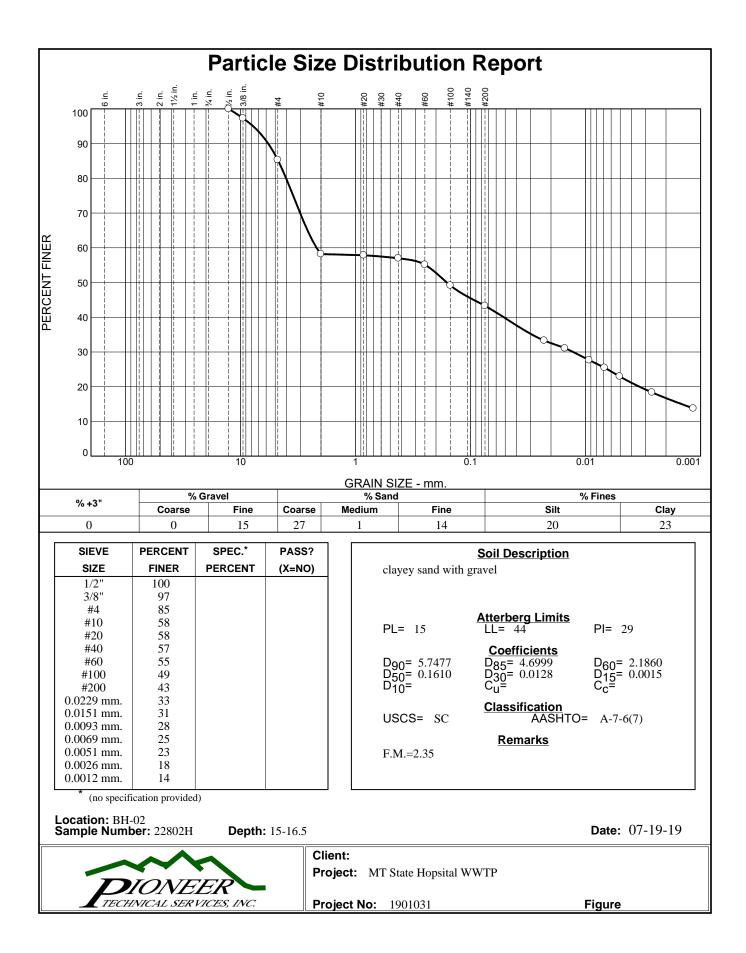
Lab No:	22828	22829	22830	22831			
BH or Loc:	BH-06	BH-06	BH-06	BH-06			
Depth:	0-1.5	5-6.5	10-11.5	15-16			
Date Tested:							
Pan No:							
Wet Wt, & Pan (g):	206.61	366.38					
Dry Wt, & Pan (g):				271.48			
Loss of Moisture							
Wt. of Pan (g):	81.12		82.25				
Wt. of Dry Soil (g):	90.43		263.65	190.33			
M. Content (%):	38.8	8.4	8.7	26.2			
Lab No:							
BH or Loc:							
Depth:							
Date Tested:							
				<b>I</b>		 	 
Pan No:							
Wet Wt, & Pan (g):							
Dry Wt, & Pan (g):							
Loss of Moisture							
Wt. of Pan (g):							
Wt. of Dry Soil (g):					 	 	
M. Content (%):							

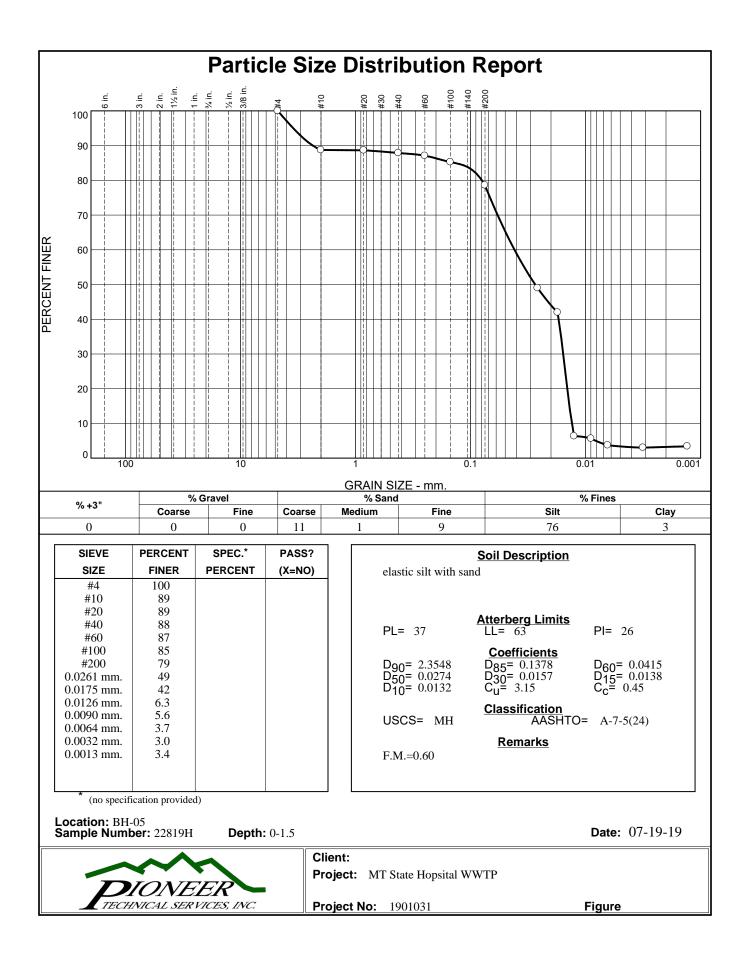
Revised 10-16-15

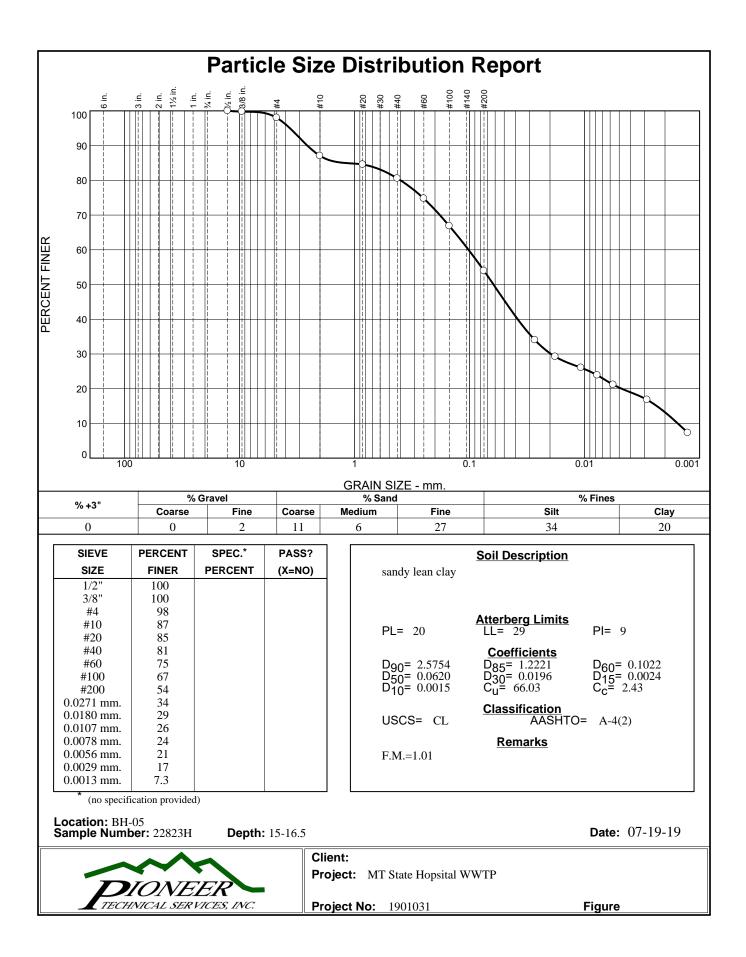














### **Case Narrative**

On August 21, 2019, two soil samples were received by our laboratory for analysis. The chain of custody indicated the that samples were to be analyzed for soluble sulfate and pH. The samples were received cool, intact, and hand delivered.

Results are summarized on the following page. Quality control data are available upon request.

Should you have any questions regarding this analysis feel free to give us a call at 449-6282.

We appreciate the fact that you have chosen us as your analytical lab.

Sincerely yours,

EC

Chris Erickson Laboratory Manager



Client: Pic	oneer Tec	hnical S	Services
-------------	-----------	----------	----------

Date Reported: 22-Aug-19

Sample ID: BH-02 5-6.5' Project ID: MT State Hospital WWTP Site ID: None Given

Chain of Custody #: 28796

Laboratory ID: 26F140 Sample Matrix: Soil Date / Time Sampled:None GivenDate / Time Received:21-Aug-19 @ 15:53

			Analyz	ed	Method
Parameter	Result	PQL	Date/Time	Ву	Reference
Soluble Sulfate, %	0.2786	0.00005	22-Aug-19 @ 12:07	CE	EPA 300.0
pH, s.u.	7.8	0.01	22-Aug-19 @ 10:00	CE	MT 232-04

#### **Comments:**

PQL - Practical Quantitation Limit

#### **References:**

*Methods for Chemical Analysis of Water and Wastes,* US EPA, 600/4-79-020 Method of Sampling and Testing MT232-04, *Soil Corrosion Test* (Montana Method).

Reviewed by: CE



Client: Pic	oneer Tec	hnical S	Services
-------------	-----------	----------	----------

Date Reported: 22-Aug-19

Sample ID: BH-04 0-1.5' Project ID: MT State Hospital WWTP Site ID: None Given

Chain of Custody #: 28796

Laboratory ID: 26J300 Sample Matrix: Soil Date / Time Sampled:None GivenDate / Time Received:21-Aug-19 @ 15:53

			Analyz	ed	Method
Parameter	Result	PQL	Date/Time	Ву	Reference
Soluble Sulfate, %	1.5669	0.00005	22-Aug-19 @ 13:38	CE	EPA 300.0
pH, s.u.	8.3	0.01	22-Aug-19 @ 10:00	CE	MT 232-04

#### **Comments:**

PQL - Practical Quantitation Limit

#### **References:**

*Methods for Chemical Analysis of Water and Wastes,* US EPA, 600/4-79-020 Method of Sampling and Testing MT232-04, *Soil Corrosion Test* (Montana Method).

Reviewed by: CE



#### QUALITY CONTROL DATA

Date Reported: 22-Aug-19

|--|

Parameter	Analytical Result	Duplicate Result	% Difference
Soluble Sulfate, %	0.2786	0.2932	-5.2%
pH, s.u.	8.3	8.3	0.0%

#### Comments:

NA - Not Applicable

#### **References:**

*Methods for Chemical Analysis of Water and Wastes,* US EPA, 600/4-79-020 Method of Sampling and Testing MT232-04, *Soil Corrosion Test* (Montana Method).

Reviewed by: <u>CE</u>

		Purchase Order:	S ATTACHED Construction SH Tumaround SH Tumaround	SE Material Description 20	20822	22812					Received by: Received by: 2(19) 2(2) 100 2(2) 100 2(2) 100 100 100 100 100 100 100 10
Hospital WWTP	one, Fax, Email: 3 om	: 77 .com	nple Type therg Limits tation tor (STD, MOD) & Marble PH & Marble PH mductivity uble Sulfates	Atte Grad Proc Proc PHG	£						Shipped by:
Project Name:	Project Contact Name, Phone, Fax, Email: Kevin Mock, (406) 443-6053 Fax: (406) 443-8584 kmock@pioneer-technical.com	Invoice Contact and Phone: Dana Bunney, (406) 782-5177 Fax: (406) 782-5866 dbunney@pioneer-technical.com		Collection Collection Date Time	247						Date/Time: S- 21 - 19 APS 5 3 P.M
Company Name: Pioneer Technical Services	Report Mail Address: 1309 Cole Ave. Helena, MT 59601	Invoice Address: 1101 S. Montana St. Butte, MT 59701		Client ID Sample Identification (Name, Location, Interval, etc.)	245299 BH-02 5-6.5'	265300 2 BH-64 Q-1.51	6	4	S	6	Custody Relinquished by:



Geotechnical Report, Rev. 2

**APPENDIX D. SEISMIC DATA** 

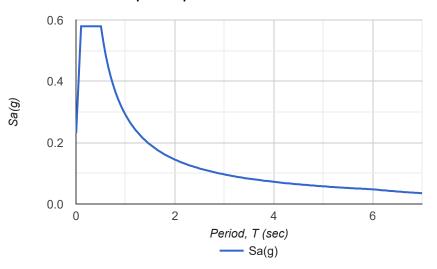


# OSHPD

### **Montana State Hospital**

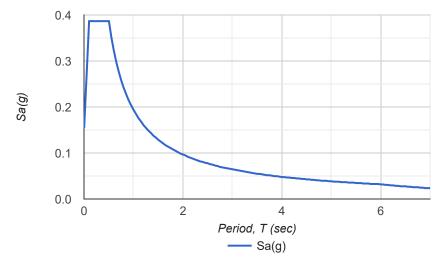
#### Latitude, Longitude: 46.18104861, -112.78606207

Goo	Corr	men's rectional Center	Map data ©2019
Date		8/8/2019, 10:00:08 AM	
		nce Document IBC-2012	
Risk Cate		ll D - Stiff Soil	
	Value	Description	
Type S _S	0.39	MCE _R ground motion. (for 0.2 second period)	
S ₁	0.127		
s _{MS}	0.58	Site-modified spectral acceleration value	
S _{M1}	0.291	Site-modified spectral acceleration value	
S _{DS}	0.387		
S _{D1}	0.194		
Type SDC	Value C	Description Seismic design category	
F _a	1.488	Site amplification factor at 0.2 second	
F _v	2.293	Site amplification factor at 1.0 second	
PGA	0.151	MCE _G peak ground acceleration	
F _{PGA}	1.499	Site amplification factor at PGA	
PGA PGA _M	0.226	Site modified peak ground acceleration	
T _L	6	Long-period transition period in seconds	
'L SsRT	0.39	Probabilistic risk-targeted ground motion. (0.2 second)	
SsUH	0.39	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration	
SsD	1.5	Factored deterministic acceleration value. (0.2 second)	
S1RT	0.127	Probabilistic risk-targeted ground motion. (1.0 second)	
S1UH	0.126	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.	
S1D	0.6	Factored deterministic acceleration value. (1.0 second)	
PGAd	0.6	Factored deterministic acceleration value. (Peak Ground Acceleration)	
C _{RS}	0.963	Mapped value of the risk coefficient at short periods	
C _{R1}	1.01	Mapped value of the risk coefficient at a period of 1 s	



**MCER Response Spectrum** 





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≜ 201 E Broadway Ste C ≥ Helena, MT 59601
$\geq$ 201 E Broadway Ste C
≤ Helena, MT 59601
- Dhamay 406 457 9252
≓ Phone: 406-457-8252
₹ Phone: 406-457-8252 Fax: 442-1158
5

### LOG OF BORING

								g BH-01							Sheet 1 of	
Projec	t: M	lont	ana	Sta	ate Hospital \	NWTF	Rig: Mobile B61 Hammer: Auto	Boring Location Coordinates:	N 722,75 E 1,136,9			t		Stat Offs	tion: set:	
Projec Numbe					UPN	l:	Boring Diameter: 8"	System: MT S.P. Datum: Local						Top of Boring Elevation: 4810.5 ft		
Date         Date           Started:         7/30/20         Finished: 7/30/20           Driller:         Steve						30/20	Drilling Fluid: None	Location Source: Scaled	from Plar	าร					vation ırce: Plans	
Driller: Logge							Abandonment Method: Bad	kfilled with Cuttings	Town and S					N 9V	N 18	
Depth (ft) <i>Elev.</i> <i>(ft)</i>	Operation	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material De	scription	Depth (ft) <i>Elev.</i> (ft)	MC (%)	LL	PL	-200 (%)	DD	Remarks and Other Tests	
- - - 4805.5 - -			50 78		3 - 3 - 4 7 - 25 - 50/0.3f		Elastic SILT (MH), medium Medium to highly plastic. 3.4 Clayey SAND with gravel (S light brown, medium grained subangular. Occasional cot Poorly-Graded GRAVEL with dense, moist, brown, fine to subrounded to subangular.	5 ft thick. GC), very dense, moist, d, subrounded to bles. 2.5 ft thick. th sand (GP), Cobbles, coarse grained,	3.5 4807.0 ▼ 6.0 4804.5							
 #800.5 			83		16 - 25 - 24				13.0							
- 15 1795.5 - -		X	0		2-2-3		Sandy Lean CLAY (CL), Mi wet, brown. Medium plastic.		4797.5						No recovery in SS	
- 20 790.5 - -		X	100		3 - 4 - 6											
 25 785.5			100		2 - 9 - 23		Silty SAND (SM), dense, mo grained. Low to medium pla Boring Depth: 25.5 ft,	stic. 0.5 ft thick.	25.0 4785.5 25.5 4785.9							
		Wate	er L	evel	Observations		During Drilling: 6.5 ft <i>(4804.0 ft)</i>	R	emarks: Me	onit	orinț	g po	oint	was	ground surface.	
After	q: ()						≚ Drilling: 6.5 ft (4804.0 ft) After - Drilling: ()									

Fax: 442-1	6-457- 158	Ste 01 8252	2				BORING							<b>D</b> TECH	ONEER ENICAL SERVICES, INC. Sheet 1 of 1
	Mant		Cto			Rig: Mobile B61	Boring Locati	on N	722,81	2.5	ft				ion:
Project: Project	wont	ana	Sia	te Hospital W	WIP	Hammer: Auto Boring	Coordinates: System: MT S	S.P. (E	<u>1,136,9</u> E)	987	.5 ft			<u>Offs</u> Top	of Boring
Number:				UPN: Date		Diameter: 8"	Datum: Loca	l							vation: 4810 ft
Started:	7/30/	/20		Finished: 7/3	0/20	Drilling         Location           Fluid:         None         Source:         Scaled from Plans								rce: Plans	
Logger:	A. Kle	ein				Abandonment Method: Ba	ackfilled with Cutti	ings	Township Range and Section: 5N 9W 18					V 18	
Depth (ft) <i>Elev.</i> (ft)	Sample Type	Recovery (%)	RQD (%)	Blow Count	Lithology	Material C	escription		Depth (ft) <i>Elev.</i> (ft)	MC (%)	F	PL 200 (iii)	(%) NNZ-	DD	Remarks and Other Tests
Phone: 400 Phone: 400 Fax: 442-1 Project: Project: Project: Date Started: Date Started: Date Started: Date Started: Date 10 4800.0 - - - - - - - - - - - - -		100 67 72 100		6 - 10 - 18 11 - 14 - 15 3 - 4 - 5 3 - 2 - 3 4 - 8 - 10		Elastic SILT (MH), mediur Medium to highly plastic. 3 Poorly-Graded GRAVEL v dense, moist, brown, fine subrounded to subangular Sandy Lean CLAY (CL), M wet, brown. Medium plastic Boring Depth: 25.5 ft	5.5 ft thick. ith sand (GP), Cobble o coarse grained, 2.9.5 ft thick.	Ā	3.5 4806.5						2" gravels present in cuttings.
After	Wate	er L	evel	Observations		∠ During ∠ Drilling: 7.7 ft <i>(4802.3 ft)</i> After Drilling: <i>()</i>		Rem	arks: Mo	onite	oring	j poi	nt v	was	ground surface.

												Boring Rig: Mobile B61	g BH-03 Boring Loca	tion N	700 00	1 2	ft			C4-	Sheet 1 of
Project		onta	ana	Sta	ate	Hos	spita	al W	/W	ΓP		Hammer: Auto	Coordinates	: E	1,137,0			t		Sta Off:	tion: set:
Project Numbe							U	PN:				Boring System: MT S.P. (E Diameter: 8" Datum: Local			E)					Top Ele	o of Boring vation: 4809.5 ft
Project Number:UPN:Date Started:Date Finished:Started:7/30/20Driller:Steve Logger:Logger:A. KleinDepth (ft) $\underbrace{0}_{0}$ $\underbrace{0}_{0}$ $\underbrace{0}_{0}$ (ft) $\underbrace{0}_{0}$ $\underbrace{0}_{0}$ $\underbrace{0}_{0}$ (ft) $\underbrace{0}_{0}$ $\underbrace{0}_{0}$ $\underbrace{0}_{1}$ $\underbrace{0}_{0}$ $\underbrace{0}_{1}$ $\underbrace{0}_{1}$ $\underbrace{0}_{1}$ 					Drilling Location						Elevation										
Started:7/30/20Finished:7/30/20Driller:Steve				0		Fluid: None Abandonment	<b>Source:</b> Sc	aled In	Town		p R	ang		501	<b>Irce:</b> Plans						
Logger	:A.	Kle	-									Method: Bad	kfilled with Cut	tings	and S	ect	ion	:	5	N 9\	<u>V 18</u>
Depth (ft) <i>Elev.</i> (ft)	Operation	Sample Type	Recovery (%)	RQD (%)		i	Blow Count		Litholoav	3		Material De	scription		Depth (ft) <i>Elev.</i> (ft)	MC (%)	F	PL	-200 (%)	DD	Remarks and Other Tests
·		X	83			2 - {	5 - 13	}			Meo	stic SILT (MH), medium dium to highly plastic. 3. yey SAND with gravel (\$ rse grained, subrounder	) ft thick. SC), moist, brown, fi	ine to	3.0 4806.5 4.0						
5 4804.5 			72		2	25 - 5	50/0.4	lft			hav Poc den	re low plasticity. 1.0 ft thi orly-Graded GRAVEL wi ise, moist, brown, fine to rounded to subangular.	ck. h sand (GP), Cobb coarse grained,		4805.5						
			94			11 - 2	27 - 2	3													
15		X	63 100			9 - 1	6 - 2	1			Clar coa	yey SAND (SC), dense, rse grained. Fines have	moist, brown, fine t low plasticity. 5.5 ft	o thick.	14.0 4795.5						Shelby tube achieved 1 penetration.
		X	94			4 -	5 - 6			848 IIIIIIII	Sar wet	ndy Lean CLAY (CL), Mi , brown. Medium plastic	ca flakes, medium s 6.0 ft thick.	stiff,	19.5 4790.0						
25 4784.5		X	100			5 - 1	2 - 1	1				Boring Depth: 25.5 ft,	Elevation: 4784.0 f	ft	25.5 4784.d						

## **APPENDIX D**

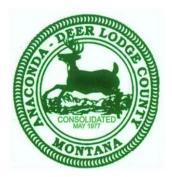
## **Aanconda-Deer Lodge County Permits**

CONSOLIDATED CONSOLIDATED WATIST	ANACONDA-DEER ADMINISTRATIVE DEVELOPM (Please Fill Out Ent <mark>ABSOLUTELY DO NOT BEGIN PROJECT UN PHYSICAL PERMIT HA</mark>	IENT APPLICATION (ADP) ire Application) <mark>IL ALL PAPERWORK IS FINALIZED ANL</mark>
Date of Application:	Admin. Develop	ment Permit #:
Permit Received By:	Date of Receipt:	
	PROPERTY OWNER CONTACT INFORMATION	DN
Property Owner:		
Mailing Address:	City:	State: Zip:
Phone/Mobile #:	E-Mail:	
Physical Address of Project Propert	ty:	
CONTRACTOR MUST DOES CON	DEVELOPER/PERSON DOING THE WORK CON THAVE AN ACTIVE BUSINESS LICENSES IN ANACOI TRACTOR HAVE A BUSINESS LICENSE IN ADLC: Yes TLicense Last Renewed: License #:	IDA-DEER LODGE COUNTY : No:
Contractor:		Self:
Mailing Address:	City:	State: Zip:
Phone/Mobile #:	E-Mail:	
	E-Mail:	
	Disturbed: Yes No	
General Project Description:  More Than One (1) Cu Yd. of Soil D More than Five (5) Cu Yds of Soil D	Disturbed: Yes No	
General Project Description: More Than One (1) Cu Yd. of Soil D More than Five (5) Cu Yds of Soil D Anticipated Start Date: I do hereby acknowledge that all information development permitted will be conducted federal laws. The activity or development that the permit and conditions imposed site.	Disturbed: Yes No Disturbed: Yes No	e and correct, and that the activity or er Lodge County, as well as all state and nposed on the approval of this permit and

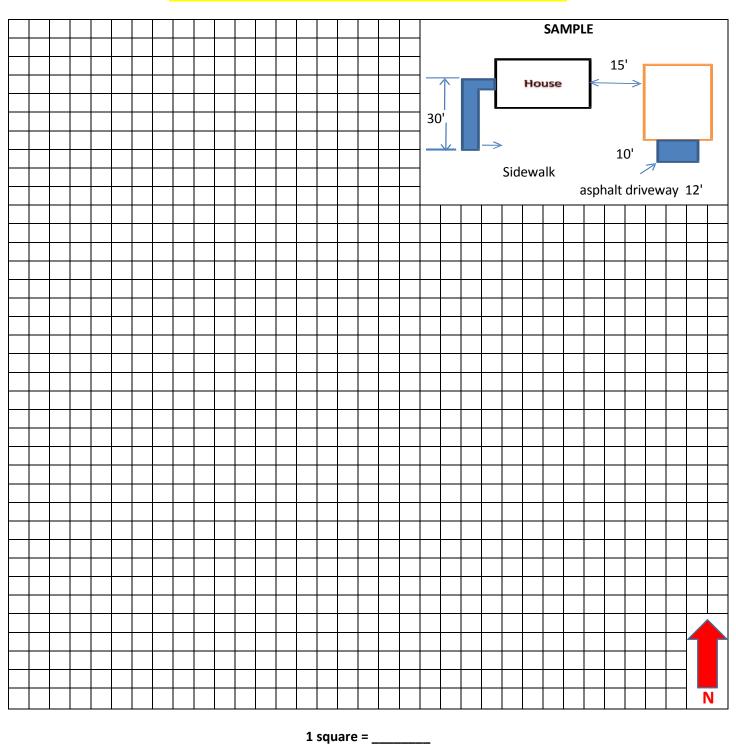


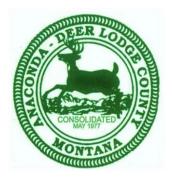
#### **PROJECT DESCRIPTION CHECKLIST**

DESCRIPTION	YES	NO	ADDITIONAL COMMENTS/REMARKS
Demolition			
Buildings			
Infrastructure (Driveways, Sidewalks, Etc.)			
Trees/Shrubs			
Excavation			
Footings			
Foundation			
Posts/Poles			
Install/Repair Water Line			
Install/Repair Well			
Install/Repair Sewer			
Install/Repair Septic System			
Install/Repair Electric Service			
Install/Repair Gas Line			
Install/Repair Telephone Line (Land Line)			
Other:	_		
Grading			
Access Road			
Driveway			
Sidewalks			
Parking Lot			
Landscaping			
Revegetation			
Sod			
Trees/Shrubs			
Garden for Food			
Irrigation System			
Fencing			
Removed/Installed/Both			
Ground Signs			
Removed/Installed/Both			
Soils			
Will Soil Be Removed From Site?			
If So, Where Will This Be Discarded?			
How Much Soil Will Be Removed?			
Will Soil Be Brought To Site?			
If So, Where Will This Be Obtained?			
How Much Soil Will Be Brought In?			
Additional Comments:			



#### SITE PLAN DRAWING DIMENSIONS MUST BE PROVIDED IF BUILDING PERMIT IS NEEDED, ENGINEERED DRAWINGS WOULD BE ACCEPTED





#### CONSENT FOR ACCESS TO PROPERTY FOR THE PURPOSE OF ENVIRONMENTAL SAMPLING

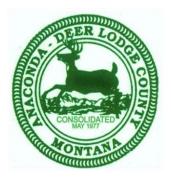
In support of Anaconda-Deer Lodge County's (ADLC) Interim Institutional Controls Program, ADLC would like your consent to collect samples on your property. Pease fill out the information below and return with your Administrative Permit Application.

, (printed name), property owner of the property located at	
, Anaconda, MT 59711, give my consent for employ	/ees
ind/or representatives of ADLC to access my property for the purpose of collection of soil samples. I understan	id that
hese actions are undertaken by EPA pursuant to its responsibilities under the Comprehensive Environmental	l

Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601 et seq (also known as Superfund).

**Property Owner** 

<mark>Date</mark>



ADMINISTRATIVE REVIEW (Staff Use Only)
Legal Description of Property:
Geocode:
Assessor:
This permit will also require:
Building Permit:
Demo Permit:
Driveway Approach Permit:
Well Permit:
Septic Permit:
Fee Paid:        Receipt and/or Check #:       Payment Taken By:



#### ANACONDA-DEER LODGE COUNTY SMELTER SUPERFUND SITE INSTITUTIONAL CONTROLS/COMMUNITY PROTECTIVE MEASURES PROGRAM For Your Information

#### **Incidental Mine Waste Notice**

Residents and property owners in Anaconda-Deer Lodge County need to be aware that the area includes many historic mining districts that may contain hazardous waste. These sites include the Anaconda Smelter Superfund and Georgetown Railroad Superfund sites as well as many other abandoned mined areas in the county. If during excavation and development activities you locate potential mine waste or suspicious materials, ADLC recommends you do the following:

- Cease all activities which might expose yourself, others, or your animals to potential waste until an investigation by a qualified professional is conducted and the site is determined to be safe.
- Contact the ADLC Superfund Department at (406) 563-7476 or the ADLC Planning Department at (406-563-4010). In the event, ALDC does not have jurisdiction of the site, you will be directed to the appropriate agency.
- Common smelting waste includes black slag and cinders, pale yellow and orange tailings, white/gray powdery ash material, and rocks with a scaly green deposit on the surface.

If you require further assistance, please contact the ADLC Planning Department at (406) 563-4010. ADLC's Superfund experts as well as other county staff will do their best to either assist you or direct you to the appropriate party for assistance.

#### **Superfund Soil Repository**

Some projects in Anaconda-Deer Lodge County may involve contaminated soil that may need to be placed in the Superfund Soil Repository. After reviewing your application, the county and Superfund will determine if special soils handling is required and you will be given written instructions by Superfund on how to handle the soils and they will guide you through the process.

Placement of soil in the repository must be part of an approved Administrative Development Permit and Institutional Controls Work Plan. The Superfund Coordinator (406) 563-7476, must be contacted at least 24 hours in advance of beginning excavation. The repository is generally open Monday through Friday, 7 a.m. to 4 p.m. and some seasonal hours may apply.

Only Superfund-related contaminated soil, mining millings, or smelting waste material may be placed in the repository.

A pre-entry briefing is required prior to placing soil and the Superfund Coordinator must be notified at the beginning and the end of each day's hauling activities.

Personal safety equipment is required for all drivers and passengers.



## MEMORANDUM

Attached, please find you Building Permit Application.

Please be advised for new residential construction, that an Administrative Development Permit (ADP), as well as a Septic and/or Well Permit and a Driveway Approach Permit (depending on each individual construction site) is required before a Building Permit Application can be approved. The Office of Environmental Health handles all well and septic permits, and they can be reached at (406) 563-4035. All other permit applications can be obtained in the Planning Office at (406) 563-4010.

The Building Permit and the Administrative Development Permit require a full set of plans from a Registered Design Professional or Engineer before a review of this application can take place. <u>The Building/Planning Department requires</u> <u>a minimum of two (2) weeks from the receipt of completed application and plans for review.</u>

Please be advised that construction must begin within six (6) months of Building Permit approval. Building Permits expire six (6) months from the date of being issued if construction has not been started. After construction begins, the construction should be completed within six (6) months, however extensions may be requested prior to expiration, not less than one (1) month prior. If an extension request is not received before the expiration date, the Building Permit will be null and void and the process will need to be restarted. Extensions may be requested due to weather conditions and/or financial difficulties.

If you have any further questions, please feel free to call the office at (406) 563-4010.

## Note: Twenty-Four (24) hour notice is required for all inspections, including concrete

CONSCILICATED	ANACONDA-DEER LODGE COUNTY BUILDING PERMIT APPLICATION (Please Fill Out Entire Application) ABSOLUTELY DO NOT BEGIN PROJECT UNTIL ALL PAPERWORK IS FINALIZED AND PHYSICAL PERMIT HAS BEEN OBTAINED
Date of Application:	Building Permit #:
Permit Received By:	Date of Receipt:

The applicant must fill out Page 2 and sign Page 4. Your permit will not be processed if you do not fill out the required information. Please read all conditions on this application before signing. The property owner and/or licensed contractor must sign and date the application. Each permit requires a separate check processing.

SECTION 1: Property Owner	SECTION 2: Property Information			
Name:	Location:			
Street Address:	Project Address:			
City, State, Zip:	City, State, Zip:			
Phone/Mobile #:	Legal Description:			
E-Mail:	Section: Township: Range:			
Contractor: SELF: 🗌	Block:Lot: COS/Tract#:			
Contractor/Business Name:	17-Digit Geocode:			
Street Address:	Total Area (Square Footage):			
City, State, Zip:	Lot/Property Size: sq. ft.			
Phone/Mobile #:	Proposed Structure: sq. ft.			
E-Mail:	Existing Structure (if applicable):sq. ft.			
County License #:	Building or Structure Use (please check only one):			
	Residential			
SECTION 3: SANITARIAN APPROVAL (if applicable)Septic:ApprovedDeniedN/AWell:ApprovedDeniedN/A	<ul> <li>Single Family</li> <li>Duplex</li> <li>Townhouse</li> <li>Multi-Family</li> <li>Units</li> <li>Storage Building</li> <li>Detached Garage</li> <li>Other</li> </ul>			
SECTION 4: HISTORICAL PRESERVATION APPROVAL (if applicable) Is this property in a Historical District? Yes No Approved Denied N/A	Commercial/Non-Residential Previous Use: Proposed Use: Business Name:			
SECTION 5: PROPOSED WORK  New Construction Foundation Work Remodel Addition Change of Use Repair Roof Structures Emergency Repair Fire Suppression Moving Building Project Description:				



#### ANACONDA-DEER LODGE COUNTY BUILDING PERMIT APPLICATION

(Please Fill Out Entire Application)

ABSOLUTELY DO NOT BEGIN PROJECT UNTIL ALL PAPERWORK IS FINALIZED AND PHYSICAL PERMIT HAS BEEN OBTAINED

I do hereby acknowledge that all information on this application and on the attached plans is true and correct, and that the activity or development permitted will be conducted in full compliance with all ordinances of Anaconda-Deer Lodge County, as well as all state and federal laws. The activity or development will be in full compliance with any and all conditions imposed on the approval of this permit and that the permit and conditions imposed are binding on future owners of the subject property and on future building permits issued for this site.

X			
	Property Owner	Date	

ADLC 

Building Permit Application

Revised January 2020

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#### ANACONDA-DEER LODGE COUNTY BUILDING PERMIT APPLICATION (Please Fill Out Entire Application)

ABSOLUTELY DO NOT BEGIN PROJECT UNTIL ALL PAPERWORK IS FINALIZED AND PHYSICAL PERMIT HAS BEEN OBTAINED

#### **BUILDING PERMIT/PLAN REVIEW FEES**

Total VALUATION	Building Permit Fee
\$1 to \$500	\$23.50
\$501 to \$2000	\$23.50 for first \$500 plus \$3.05 for each additional \$100 or fraction thereof, to and including \$2,000
\$2001 to \$25,000	\$69.25 for first \$2000 plus \$14 for each additional \$1,000 or fraction thereof, to and including \$25,000
\$25,001 to \$50,000	\$391.25 for first \$25,000 plus \$10.10 for each additional \$1,000 or fraction thereof, to and including \$50,000
\$50,001to\$100,000	\$643.75 for first \$50,000 plus \$7 for each additional \$1,000 or fraction thereof, to and including \$100,000
\$100,001to \$500,000	\$993.75 for first \$100,000 plus \$5.60 for each additional \$1,000 or fraction thereof, to and including \$500,000
\$500,001 to\$1,000,000	\$3,233.75 for first \$500,000 plus \$4.75 for each additional \$1,000 or fraction thereof, to and including \$1,000,000
\$1,000,001to UP	\$5,608.75 for first \$1,000,000 plus \$3 15 for each additional \$1,000 or fraction thereof, up and over \$1,000, 001

Other inspections and fee;

- Inspections outside of normal business hours (minimum charge: 2 hours) \$75/hr.
- Inspections for which no fee is specifically indicated (min charge: 2 hours) \$75/hr.
- Plan Review Fee
  - When submittal documents are required, a plan review fee must be paid in addition to the building permit fee. The plan review fee is 35 percent of the building permit fee.
  - Additional plan review required by changes, additions, or revisions to plans (min charge: 1 hour) \$75/hr.
  - Actual cost includes administrative and overhead cost.

Estimated	Project	T FEE (PLANNING USE ONL t Cost: \$ ee (see above table) \$		Plus Plan Review Fee (35	% BP Fee)	\$
TOTAL DU	E:\$		Received by	: Check	/Receipt #	
ADLC	•	Building Permit Application	ion •	Revised January 2020	•	Page   4

CONTRACTOR	ANACONDA-DEER LODGE COUNTY DEMOLITION PERMIT APPLICATION (Please Fill Out Entire Application)
CONSOLIDATED	ABSOLUTELY DO NOT BEGIN PROJECT UNTIL ALL PAPERWORK IS FINALIZED AND PHYSICAL PERMIT HAS BEEN OBTAINED
MONTAN A TUR	
Date of Application:	Demolition Permit #:
Permit Received By:	Date of Receipt:

The applicant must fill out Page 1 and sign Page 2. Your permit will not be processed if you do not fill out the required information. Please read all conditions on this application before signing. The property owner and/or licensed contractor must sign and date the application. Each permit requires a separate check processing.

SECTION 1: Property Owner	SECTION 2: Property Information				
Name:	Location:				
Street Address:	Project Address:				
City, State, Zip:	City, State, Zip:				
Phone/Mobile #:	Legal Description:				
E-Mail:	Section: Township: Range:				
Contractor: SELF:	Block:Lot: COS/Tract#:				
Contractor/Business Name:	17-Digit Geocode:				
Street Address:	Total Area (Square Footage):				
City, State, Zip:	Proposed Structure for Demolition:				
Phone/Mobile #:	sq ft				
E-Mail:	Building or Structure Use (please check only one):				
County License #:	Residential				
	🔲 Single Family 🔲 Duplex 🔲 Townhouse				
SECTION 3: UTILITY APPROVAL AND DISCONNECT	Multi-Family Units				
COMPLETE	Storage Building Detached Garage				
ADLC Water/Septic: Disconnected: 🔲	Other				
Northwestern Energy Electrical: Disconnected: 🗔	Commercial/Non-Residential				
Northwestern Energy Gas: Disconnected: 🔲	Previous Use:				
Other: Disconnected: 🔲	Proposed Use:				
	Business Name:				
SECTION 4: HISTORICAL PRESERVATION APPROVAL					
(if applicable)					
Is this property in a Historical District? 🔲 Yes 🔲 No					
Historic Preservation Officer's initials:					
SECTION 5: JOB DESCRIPTION					
Project Description:					

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#### ANACONDA-DEER LODGE COUNTY DEMOLITION PERMIT APPLICATION



(Please Fill Out Entire Application)

 ABSOLUTELY DO NOT BEGIN PROJECT UNTIL ALL PAPERWORK IS FINALIZED AND

PHYSICAL PERMIT HAS BEEN OBTAINED

By executing this application, the applicant acknowledges and agrees that:

- The information supplied is true and correct
- The proposed project may be subject to other laws and regulations including, but not limited to, local development standards and flood plain requirements.
- Issuance of a demolition permit is provisional. That is, such permit is conditional on the plan and specifications submitted and approved and does not extend to any changes without the express consent of the Planning Director.
- Demolition of the proposed structure may not be started by any person until a demolition permit is issued.

#### A COUNTY BUSINESS LICENSE IS REQUIRED FOR ANY CONTRACTOR DOING BUSINESS IN ANACONDA-DEER LODGE COUNTY AND ABSOLULTY NO BUILDING PERMIT WILL BE ISSUED WITHOUT AN ACTIVE BUSINESS LICENSE

Х		 		
	Signature of Property Owner		Date	

DEMO PERMIT FEE (\$25.00) (PLANNING USE ONLY)

TOTAL RECEIVED \$	Received by:	Check/Receipt #
	<i>,</i>	