SET NO. _____

PROJECT MANUAL

CMAR BID SET

CITY OF IDAHO SPRINGS

WASTEWATER TREATMENT PLANT EXPANSION

PROJECT 1 – PRELIMINARY TREATMENT AND SOLIDS HANDLING

NOVEMBER 2018

PROJECT MANUAL

CMAR BID SET

CITY OF IDAHO SPRINGS

WASTEWATER TREATMENT PLANT EXPANSION

PROJECT 1 – PRELIMINARY TREATMENT AND SOLIDS HANDLING

JVA, Inc.
1319 Spruce Street
Boulder, CO 80302

JVA Job No. 1529.32c

November 2018

PROJECT MANUAL

TABLE OF CONTENTS

CITY OF IDAHO SPRINGS
WASTEWATER TREATMENT PLANT EXPANSION
PROJECT 1 – PRELIMINARY TREATMENT AND SOLIDS HANDLING

Section No.	**Subject**	**# of Pages**
DIVISION 0 – GENERAL CONDITIONS		
00010	Advertisement to Bid	1
00520	Construction Agreement	7
00610	Performance Bond	3
00615	Payment Bond	3
00700	Standard General Conditions of the Construction Contract	63
00800	Supplementary Conditions	12
00800A	State Revolving Fund Required Specifications	34
00800B	Davis Bacon Wage Determination	5
00800C	Davis Bacon Certification Form	1
00800D	Request for Authorization of Additional Class and Rate Form	1
00800E	Labor Standards Interview Form	1
00800F	Certified Payroll Form	2
00800G	American Iron and Steel Certification Form	1
00800H	American Iron and Steel Spreadsheet	1
00940	Work Change Directive	1
00941	Change Order	1
00942	Field Order	1
DIVISION 1 – GENERAL REQUIREMENTS		
01010	Summary of Work	6

01020	Geotechnical Report	1
01020A	Geotechnical Engineering Study	44
01035	Modification Procedures	2
01039	Coordination and Meetings	6
01080	Identification Systems	3
01200	Payment Procedures	5
01340	Shop Drawings, Product Data, and Samples	13
01380	Construction Photographs	3
01400	Quality Control	6
01500	Construction Facilities and Temporary Controls	7
01600	Materials and Equipment	12
01650	Starting of Systems	2
01700	Contract Closeout	7
01730	Operation and Maintenance Data	6

DIVISION 2 – SITE WORK

02220	Demolition	5
02300	Earthwork	25
02370	Erosion and Sedimentation Control	6
02468	Micropiles	7
02616	Site Piping	33
02676	Disinfection of Water Systems	4
02740	Flexible Paving	15
02750	Rigid Paving	12
02950	Seeding	7

DIVISION 3 – CONCRETE

03300	Cast-In-Place Concrete	20
03600	Non-Shrink Grout	3

DIVISION 4 – MASONRY

04220	Unit Masonry Assemblies	12

DIVISION 5 – METALS

05500	Metal Fabrications	9
05400	Cold-Formed Metal Framing	4

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07160	Bituminous Dampproofing	3
07210	Building Insulation	2
07920	Joint Sealants	6

DIVISION 8 – OPENINGS

08100	Steel Doors and Frames	5
08331	Overhead Coiling Doors	5
08700	Door Hardware	5
08800	Glass and Glazing	5

DIVISION 9 – FINISHES

09900	Coatings	11

DIVISION 10 – MISCELLANEOUS SPECIALTIES

10950	Miscellaneous Specialties	3

DIVISION 11 – EQUIPMENT

11229	Coarse Bubble Aeration	18
11310	Non-Clog Centrifugal Pumps	13
11316	Rotary Lobe Sludge Pumps	15
11321	Grit Classifier	10
11322	Mechanically-Induced Vortex Grit Removal Equipment	9

11332	Center Flow Band Screen and Washer Compactor	10
11377	Rotary Lobe Blowers	19
11380	Dewatering System (Installation Only)	4
11635	Automatic Sampler	4

DIVISION 13 – SPECIAL CONSTRUCTION

13122	Pre-Engineered Metal Building	9

DIVISION 14 – CONVEYING SYSTEMS

14620	Manual Hoists	2

DIVISION 15 – MECHANICAL

15010	Basic Mechanical Requirements	7
15050	Basic Mechanical Materials and Methods	2
15060	Pipe and Pipe Fittings	31
15066	Common Motor Requirements for HVAC Equipment	4
15075	Mechanical Identification	2
15090	Supports and Anchors	5
15100	Valves, Cocks and Hydrants	17
15544	Fuel Fired Unit Heaters	2
15810	Ducts	3
15820	Duct Accessories	3
15835	Exhaust Fans	1
15850	Air Outlets and Inlets	2
15950	Testing, Adjusting, and Balancing	11

DIVISION 16 – ELECTRICAL

16050	Basic Electrical Materials and Methods	22
16150	Variable Frequency Drives and Control Equipment	4
16200	Electric Motors	6

16250	Engine Generators: Diesel	10
16280	Automatic Transfer Switch	5
16480	Motor Control Centers and Control Equipment	4
16900	Instrumentation and Controls	16
16950	Programmable Logic Controllers	7
16951	Control Descriptions	5

ADVERTISEMENT TO BID

WASTEWATER TREATMENT PLANT EXPANSION – PROJECT 1
FOR THE
CITY OF IDAHO SPRINGS

The City of Idaho Springs (Owner) is soliciting proposals for a Construction Manager at Risk (CMAR) firm for the Wastewater Treatment Plant Expansion – Project 1. Project 1 includes a new headworks, aerobic digestion tanks, influent equalization, and relocation of the City's dewatering facilities at the City's existing wastewater treatment plant (WWTP). The owner intends to contract with the selected CMAR firm to assist the Owner and Engineer in finalizing design and developing a guaranteed maximum price for the Project (Design Phase). Additional services may be awarded to the selected CMAR firm for construction, construction inspection, and start-up services (Construction Phase). The Design and Construction phase contracts will be awarded separately.

The RFP will be available Friday, October 12th at 8 AM. A mandatory pre-bid meeting will be held on Tuesday October 16th at 3 pm at the existing WWTP (980 County Road 314, Idaho Springs CO 80452). Sealed copies of the proposal will be received until 3:00 pm, local time, Wednesday, October 31st, 2018, at:

City of Idaho Springs
Attn: Andrew Marsh
1711 Miner Street
PO Box 907
Idaho Springs, CO 80452

Proposals received after the date and time indicated and/or proposals which are not prepared and filed in accordance with the terms and conditions of the Requester for Proposal will not be considered for evaluation and will be returned to the Proposer unopened.

For a copy of the Request for Proposals, please contact the Engineer (JVA, Inc) attention Chris Poepping at cpoepping@jvajva.com 303-444-1951.

Published by the authority of the City of Idaho Springs, Andrew Marsh, City Administrator.

Dated October 5, 2018

SUGGESTED FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between City of Idaho Springs ("Owner") and _____ ("Contractor").

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

A. The work will include all necessary labor, supervision, equipment, tools, and materials for the expansion of the existing wastewater treatment facility. This includes (but not limited to) all civil, mechanical, structural, electrical, and controls work for site clearing and grubbing, excavation and backfill, site piping, mechanical, process equipment, electrical and controls, and associated appurtenances for a fully functional treatment facility.

B. Contractor shall furnish and pay for all materials, equipment, supplies, appurtenances; provide all construction equipment and tools; and perform all necessary labor and supervision. Coordinate the progress of the Work including coordination between trades, subcontractors, suppliers, public utilities and subsequent building contractor performing work on site and Owner to insure the progress of Work. It is the intent of this contract that Work proceed in the most expeditious manner possible with scheduled milestones.

ARTICLE 2 – THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

1. Construction of a new headworks building and installation of headworks equipment including but not limited to influent flow measurement equipment, mechanical fine screen and manual bypass, grit removal and grit pumping, grit classification, pre-equalization, associated process piping, electrical, and controls.

2. Construction of new aerobic digestion tanks and equipment buildings and installation of aerobic digestion and solids handling equipment including but not limited to aerobic digestion equipment, digested sludge pumping, associated process piping, electrical, and controls. Relocation of the existing dewatering screw press and all ancillary equipment including but not limited to the cake pump and polymer equipment to the new buildings and the associated process piping, electrical, and controls for the dewatering system.

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ARTICLE 3 – ENGINEER

3.01 The Project has been designed by JVA, Inc. (Engineer), which is to assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.02 *Days to Achieve Substantial Completion and Final Payment*

A. The Work will be substantially completed by (insert date here) as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions by (insert date here).

4.03 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner $500 for each day that expires after the time specified in Paragraph 4.02 above for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $500 for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 – Contract Price

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to Paragraphs 5.01.A, 5.01.B, and 5.01.C below:

A. For all Work other than Unit Price Work, a lump sum of: (insert price here)
(In words:)

B. All specific cash allowances are included in the above price in accordance with Paragraph 11.02 of the General Conditions.

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ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

B. Owner may refuse to make payment of the full amount recommended by Engineer in accordance with Article 14 of the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 1st day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.

a. Ninety-five percent (95%) of Work completed (with the balance being retainage); and

b. Ninety-five percent (95%) of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to no more than ninety-five percent (95%) of the Work completed, if payments have not already reached that amount, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less two hundred percent (200%) of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work by Engineer and Owner in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

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ARTICLE 7 – INTEREST

7.01 All moneys not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of zero percent (0%) per annum.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

8.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:

A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

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ARTICLE 9 – CONTRACT DOCUMENTS

9.01 *Contents*

A. The Contract Documents consist of the following:

1. This Agreement (pages to , inclusive).

2. Performance bond (pages to , inclusive).

3. Payment bond (pages to , inclusive).

4. General Conditions (pages to , inclusive).

5. Supplementary Conditions (pages to , inclusive).

6. Drawings consisting of __ sheets with each sheet bearing the following general title: City of Idaho Springs Wastewater Treatment Plant Expansion Project 1, Idaho Springs, Colorado – Construction Documents

7. Project Manual

8. Exhibits to this Agreement (enumerated as follows):

   a. Contractor's GMP Cost Estimate (pages to , inclusive).

9. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

   a. Notice to Proceed (pages to , inclusive).

   b. Work Change Directives.

   c. Change Orders.

B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

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10.02 *Assignment of Contract*

A. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

A. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

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IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

This Agreement will be effective on _____(which is the Effective Date of the Agreement).

OWNER:

City of Idaho Springs

By: _____

Title: _____

Attest: _____

Title: _____

Address for giving notices:

_____

_____

_____

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

CONTRACTOR

_____

By: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Title: _____

Address for giving notices:

_____

_____

_____

License No.: _____

(Where applicable)

Agent for service of process:

_____

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PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND

Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

_____ *(seal)*
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest:_____
Signature

_____
Title

SURETY

_____ *(seal)*
Surety's Name and Corporate Seal

By:_____
Signature *(attach power of attorney)*

_____
Print Name

_____
Title

Attest:_____
Signature

_____
Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety

refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

_____ *(seal)*
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ *(seal)*
Surety's Name and Corporate Seal

By: _____
Signature *(attach power of attorney)*

_____
Print Name

_____
Title

Attest:_____
Signature

_____
Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

   5.1 Claimants who do not have a direct contract with the Contractor,

      5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

      5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

   5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

   7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

   7.2 Pay or arrange for payment of any undisputed amounts.

   7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

Page

Article 1 – Definitions and Terminology 1
1.01 Defined Terms 1
1.02 Terminology 5

Article 2 – Preliminary Matters 6
2.01 Delivery of Bonds and Evidence of Insurance 6
2.02 Copies of Documents 6
2.03 Commencement of Contract Times; Notice to Proceed 6
2.04 Starting the Work 7
2.05 Before Starting Construction 7
2.06 Preconstruction Conference; Designation of Authorized Representatives 7
2.07 Initial Acceptance of Schedules 7

Article 3 – Contract Documents: Intent, Amending, Reuse 8
3.01 Intent 8
3.02 Reference Standards 8
3.03 Reporting and Resolving Discrepancies 8
3.04 Amending and Supplementing Contract Documents 9
3.05 Reuse of Documents 10
3.06 Electronic Data 10

Article 4 – Availability of Lands; Subsurface and Physical Conditions; Hazardous Environmental Conditions; Reference Points 10
4.01 Availability of Lands 10
4.02 Subsurface and Physical Conditions 11
4.03 Differing Subsurface or Physical Conditions 11
4.04 Underground Facilities 13
4.05 Reference Points 14
4.06 Hazardous Environmental Condition at Site 14

Article 5 – Bonds and Insurance 16
5.01 Performance, Payment, and Other Bonds 16
5.02 Licensed Sureties and Insurers 16
5.03 Certificates of Insurance 16

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5.04 Contractor's Insurance 17
5.05 Owner's Liability Insurance 18
5.06 Property Insurance 18
5.07 Waiver of Rights 20
5.08 Receipt and Application of Insurance Proceeds 21
5.09 Acceptance of Bonds and Insurance; Option to Replace 21
5.10 Partial Utilization, Acknowledgment of Property Insurer 21

Article 6 – Contractor's Responsibilities 22
6.01 Supervision and Superintendence 22
6.02 Labor; Working Hours 22
6.03 Services, Materials, and Equipment 22
6.04 Progress Schedule 23
6.05 Substitutes and "Or-Equals" 23
6.06 Concerning Subcontractors, Suppliers, and Others 25
6.07 Patent Fees and Royalties 27
6.08 Permits 27
6.09 Laws and Regulations 27
6.10 Taxes 28
6.11 Use of Site and Other Areas 28
6.12 Record Documents 29
6.13 Safety and Protection 29
6.14 Safety Representative 30
6.15 Hazard Communication Programs 30
6.16 Emergencies 30
6.17 Shop Drawings and Samples 30
6.18 Continuing the Work 32
6.19 Contractor's General Warranty and Guarantee 32
6.20 Indemnification 33
6.21 Delegation of Professional Design Services 34

Article 7 – Other Work at the Site 35
7.01 Related Work at Site 35
7.02 Coordination 35
7.03 Legal Relationships 36

Article 8 – Owner's Responsibilities 36
8.01 Communications to Contractor 36
8.02 Replacement of Engineer 36
8.03 Furnish Data 36
8.04 Pay When Due 36
8.05 Lands and Easements; Reports and Tests 36
8.06 Insurance 36
8.07 Change Orders 36
8.08 Inspections, Tests, and Approvals 37
8.09 Limitations on Owner's Responsibilities 37
8.10 Undisclosed Hazardous Environmental Condition 37

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8.11 Evidence of Financial Arrangements 37
8.12 Compliance with Safety Program 37

Article 9 – Engineer's Status During Construction 37
9.01 Owner's Representative....37
9.02 Visits to Site....37
9.03 Project Representative 38
9.04 Authorized Variations in Work 38
9.05 Rejecting Defective Work 38
9.06 Shop Drawings, Change Orders and Payments 38
9.07 Determinations for Unit Price Work 39
9.08 Decisions on Requirements of Contract Documents and Acceptability of Work 39
9.09 Limitations on Engineer's Authority and Responsibilities 39
9.10 Compliance with Safety Program 40

Article 10 – Changes in the Work; Claims 40
10.01 Authorized Changes in the Work 40
10.02 Unauthorized Changes in the Work 40
10.03 Execution of Change Orders 41
10.04 Notification to Surety 41
10.05 Claims 41

Article 11 – Cost of the Work; Allowances; Unit Price Work....42
11.01 Cost of the Work 42
11.02 Allowances 45
11.03 Unit Price Work....45

Article 12 – Change of Contract Price; Change of Contract Times 46
12.01 Change of Contract Price....46
12.02 Change of Contract Times....47
12.03 Delays 47

Article 13 – Tests and Inspections; Correction, Removal or Acceptance of Defective Work 48
13.01 Notice of Defects 48
13.02 Access to Work....48
13.03 Tests and Inspections....48
13.04 Uncovering Work 49
13.05 Owner May Stop the Work 50
13.06 Correction or Removal of Defective Work....50
13.07 Correction Period....50
13.08 Acceptance of Defective Work 51
13.09 Owner May Correct Defective Work 51

Article 14 – Payments to Contractor and Completion....52
14.01 Schedule of Values 52
14.02 Progress Payments 52
14.03 Contractor's Warranty of Title 55

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14.04 Substantial Completion 55
14.05 Partial Utilization....56
14.06 Final Inspection 56
14.07 Final Payment 57
14.08 Final Completion Delayed....58
14.09 Waiver of Claims....58

Article 15 – Suspension of Work and Termination....58
15.01 Owner May Suspend Work 58
15.02 Owner May Terminate for Cause....58
15.03 Owner May Terminate For Convenience....60
15.04 Contractor May Stop Work or Terminate 60

Article 16 – Dispute Resolution....61
16.01 Methods and Procedures 61

Article 17 – Miscellaneous 61
17.01 Giving Notice 61
17.02 Computation of Times....61
17.03 Cumulative Remedies....62
17.04 Survival of Obligations....62
17.05 Controlling Law....62
17.06 Headings 62

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

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12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

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27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

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40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

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51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

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c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the

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Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete

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and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the

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performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation , (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

   a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or

   b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

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B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

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ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

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4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

   b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and

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contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data;

b. locating all Underground Facilities shown or indicated in the Contract Documents;

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the

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consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

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C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

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H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also

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meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

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a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

a. Such insurance shall remain in effect for two years after final payment.

b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

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5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

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members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

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B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other

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party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

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6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a

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proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

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a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified, and

b) available engineering, sales, maintenance, repair, and replacement services; and

4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

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G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

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6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

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2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

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1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

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6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

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C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

   a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

   b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

   c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

   d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each

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such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

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6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents,

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Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed 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 Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and

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other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

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8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

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8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

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9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability

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of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

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9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

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10.04 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor

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invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

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4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

   a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

   c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

   d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

   e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

   f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

   g. The cost of utilities, fuel, and sanitary facilities at the Site.

   h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

   i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

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B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances:*

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

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b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the

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Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

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f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

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ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

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E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims,

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costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as

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provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

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2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

    a. the Work has progressed to the point indicated;

    b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and

    c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

    a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

    b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work, or

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

    d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in

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Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

b. the Contract Price has been reduced by Change Orders;

c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

   a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

   b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

   c. there are other items entitling Owner to a set-off against the amount recommended; or

   d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

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14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

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14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

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2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

   d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment

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(for Work fully completed and accepted) and recommendation of 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 to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

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4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

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1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

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B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

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17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SECTION 00800

SUPPLEMENTARY CONDITIONS

TABLE OF CONTENTS

Article 1 – Definitions 2
SC-1.01 Defined Terms 2

Article 2 – Preliminary Matters 3
SC-2.02 Copies of Documents....3

Article 4 – Availability of Lands; Subsurface and Physical Conditions; Reference Points 3
SC-4.02 Subsurface and Physical Conditions....3
SC-4.06 Hazardous Environmental Condition at Site 3

Article 5 – Bonds and Insurance....3
SC-5.01 Performance, Payment and Other Bonds....3
SC-5.02 Licensed Sureties and Insurers 3
SC-5.04 Construction Manager's Insurance....4
SC-5.06 Property Insurance 5
SC-5.07 Waiver of Rights....6
SC-5.09 Acceptance of Bonds and Insurance; Option to Replace....6

Article 6 – Construction Manager's Responsibilities....6
SC-6.06 Concerning Subcontractors, Suppliers, and Others 6
SC-6.10 Taxes....7
SC-6.17 Shop Drawings and Samples 7
SC-6.20 Indemnification....7

Article 10 – Changes In the Work; Claims....8
SC-10.03 Execution of Change Orders....8
SC-10.05 Claims 8

Article 12 – Change of Contract Price; Change of Contract Times 9
SC-12.01 Change of Contract Price....9
SC-12.03 Delays 9

Article 13 – Tests and Inspections; Correction, Removal or Acceptance of Defective Work 10
SC-13.07 Correction Period....10

Article 14 – Payments to Construction Manager and Completion 11
SC-14.02 Payment for Materials....11
SC-14.07 Final Payment 11

Article 16 – Dispute Resolution....12
SC-16.01 Methods and Procedures....12

Article 17 – Miscellaneous 12
SC-17.07 Addresses of Owner, Engineer, Construction Manager 12
SC-17.08 Cross-Referencing 12

SECTION 00800

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC C-700 (2007 Edition). All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 1 – DEFINITIONS

SC-1.01.A.15 Add the following sentence at the end of paragraph 1.01.A.15:

The term “Contractor” as used in all of the Contract Documents shall refer to the “Construction Manager”.

SC-1.01.A.16 Add the following sentence at the end of paragraph 1.01.A.16:

The term “Cost of the Work” as used in all of the Contract Documents shall refer to the “Guaranteed Maximum Price (GMP)”.

SC-1.01A.19 Add the following sentence at the end of Paragraph 1.01.A.19:

The title of Architect as used in the Contract Documents also refers to the Engineer.

SC-1.01.A.29 Add the following sentence at the end of paragraph 1.01.A.29:

The terms “Owner” or “City” as used in all of the Contract Documents shall refer to the City of Idaho Springs.

SC-1.01A.34 Add the following sentence at the end of Paragraph 1.01.A.34:

The Project Manual also includes the bidding requirements, Contract Forms, Conditions of the Contract and Specifications.

SC-1.01A.50 Add the following sentence at the end of Paragraph 1.01.A.50:

Work shall also include the materials and equipment provided by Construction Manager or equipment as provided by Owner for installation by Construction Manager.

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.02A. Delete Paragraph 2.02A in its entirety and insert the following in its place:

Owner shall furnish to Construction Manager two (2) complete sets of the Contract Documents for use in the execution of the Work. Additional copies will be furnished, upon request, at the cost of the reproduction.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

SC-4.02 Add the following new subparagraph immediately after subparagraph 4.02.A.2:

3. Geotechnical reports are included in Section 01020 – Subsurface and Physical Conditions of the Project Manual.

SC-4.06 Delete Paragraphs 4.06.A and 4.06.B in their entirety and insert the following:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

B. Not Used.

ARTICLE 5 – BONDS AND INSURANCE

SC-5.01 Add the following new paragraph immediately after Paragraph 5.01.C:

D. In addition to the performance bond specified in the General Conditions, Construction Manager shall furnish Labor and Material Payment Bonds and Insurance Certificates. Town and Engineer reserve the right to reject surety providing performance and payment bonds or other bonds as specified in the Contract Documents. Contract Agreement will not be executed until surety is acceptable to Town and Engineer.

SC-5.02.A Delete Paragraph 5.02. A in its entirety and insert the following:

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by the Construction Manager shall be obtained from surety or insurance companies that are duly licensed or authorized in the State of Colorado and must be countersigned by an agent who is a resident of the State of Colorado and must be accompanied by a certified copy of the authority to act for the surety and authority to transact business in the State of Colorado.

SC-5.04 Add the following new paragraphs immediately after Paragraph 5.04.B:

C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation and related coverages under Paragraphs 5.04.A.1and A.2 of the General Conditions:

a.	State of Colorado:	Statutory
b.	Applicable Federal:	Statutory
c.	Employer's Liability:	$100,000 each accident $500,000 disease, policy limit $100,000 disease, each employee

2. Construction Manager's General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Construction Manager:

a.	General Aggregate:	$1,000,000
b.	Products Completed Operations Aggregate	$1,000,000
c.	Personal and Advertising Injury	$500,000
d.	Each Occurrence (Bodily Injury and Property Damage)	$500,000

e. Property Damage liability insurance will provide Explosion, Collapse, and Under-ground coverages where applicable.

f. Excess or Umbrella Liability

Bodily Injury and Property Damage	$2,000,000
Retention	$10,000

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:

a. Combined Single Limit of $2,000,000

SC-5.06.A Delete Paragraph 5.06.A in its entirety and insert the following in its place:

A. Construction Manager shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Construction Manager shall be responsible for any deductible or self-insured retention. This insurance shall:

1. include the interests of Owner, Construction Manager, Subcontractors, Engineer, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, false work, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by these Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup;

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Construction Manager, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and

8. comply with the requirements of Paragraph 5.06.C of the General Conditions.

SC-5.06.B Delete Paragraph 5.06.B and replace with the following:

B. Construction Manager shall purchase and maintain equipment breakdown insurance and any other additional property insurance required by Laws and Regulations, which insurance will include the interest of Owner, Construction Manager, Subcontractors, and Engineer, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

SC-5.07.B.1 Delete subparagraph 5.07.B.1 in its entirety and insert the following in its place:

1. loss due to business interruption, loss of use or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner, but the foregoing shall not apply to liquidated damages Owner may claim as provided in the Agreement; and

SC-5.09.A Delete Paragraph 5.09.A in its entirety and insert the following in its place:

A. If the Owner has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the Construction Manager in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the Owner shall so notify the Construction Manager in writing within 10 days after receipt of the certificates (or other evidence requested) required by paragraph 2.01.B. Construction Manager shall provide to the Owner such additional information in respect of insurance. If Construction Manager does not purchase or maintain all of the Bonds and insurance required of Construction Manager by the Contract Documents, Construction Manager shall notify the Owner in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the Owner may elect to obtain equivalent Bonds or insurance to protect the Owner's interests at the expense of the Construction Manager and a Change Order shall be issued to adjust the Contract Price accordingly.

ARTICLE 6 – CONSTRUCTION MANAGER'S RESPONSIBILITIES

SC-6.06 Add the following new paragraph immediately after Paragraph 6.06.G:

H. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Construction Manager on

account of Work performed for Construction Manager by a particular Subcontractor of Supplier.

SC-6.10.A Delete Paragraph 6.10.A in its entirety and insert the following in its place:

A. Owner is exempt from Colorado State Sales and Use Taxes on materials and equipment to be incorporated in the Work (said taxes shall not be included in the Contract Price or modifications to the Contract Price). Prior to purchase of any materials to be incorporated in the Work, the Construction Manager and any Subcontractor shall apply to the Colorado Department of Revenue for an exemption to be used for all materials and work done under this Contract (Form DR-0172 (09/21/06)). All purchases for the Work shall use the exemption from Sales and Use Taxes.

SC-6.10 Add the following new paragraph immediately after Paragraph 6.10.A:

B. Owner's exemption does not apply to construction tools, machinery, equipment, or other property purchased by or leased by Construction Manager, or to supplies or materials not incorporated into the Work.

SC-6.17 Delete paragraphs 6.17.A, B, C, D, and E in their entirety and replace with the following:

A. Construction Manager shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, Samples, or other items requiring approval and Construction Manager shall reimburse Owner for Engineer's charges for such time.

B. In the event that Construction Manager requests a change of a previously approved item, Construction Manager shall reimburse Owner for Engineer's charges for its review time unless the need for such change is beyond the control of Construction Manager.

SC-6.20.A Delete Paragraph 6.20.A in its entirety and replace with the following:

A. The Construction Manager agrees to indemnify and hold harmless Owner, its officers, employees, insurers, and self-insurance pool, from and against all liability, claims, and demands, on account of injury, loss, or damage, including without limitation claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage, or any other loss of any kind whatsoever, which arise out of or are in any manner connected with this contract, if such injury, loss, or damage is caused in whole or in part by, or is claimed to be caused in whole or in part by, the act, omission, error, professional error, mistake, negligence, or other fault of the Construction Manager, any subcontractor of the Construction

Manager, or any officer, employee, representative, or agent of the Construction Manager or of any subcontractor of the Construction Manager, or which arise out of any workmen's compensation claim of any employee of the Construction Manager or of any employee of any subcontractor of the Construction Manager. The Construction Manager agrees to investigate, handle, respond to, and to provide defense for and defend against, any such liability, claims, or demands at the sole expense of the Construction Manager. The Construction Manager also agrees to bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not any such liability, claims, or demands alleged are groundless, false, or fraudulent.

SC-6.20 Add the following new paragraph immediately after Paragraph 6.20.C:

D. Governmental Immunities Act. The Owner is relying on, and does not waive or intend to waive by any provision of this Agreement, the monetary limitations or any rights, immunities and protection provided by the Colorado Governmental Immunities Act (C.R.S. § 24-10-101 et seq.) as from time to time amended, or otherwise available to the Town, its officers, agents, employees, attorneys, engineers, planners, indemnifiers and insurers.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

SC-10.03.A.4. Add the following new paragraph immediately after Paragraph 10.03.A.3:

4. At the time of execution of a Change Order or Written Agreement, Owner and Construction Manager expressly acknowledge that said Change Order or Written Agreement provides for a fair and equitable adjustment in Contract Price and/or Contract Time for the additions, deletions, or revisions in the Work as authorized by said Change Order or Written Agreement. Owner and Construction Manager further expressly acknowledge that later claims for adjustments to the Contract Price and/or Contract Time associated with said Change Order or Written Agreement are not valid.

SC-10.05.G Add the following new paragraphs immediately after Paragraph 10.05.F:

G. Should Construction Manager cause damage to the Work or property of any separate contractor or subcontractor at the site, or should any claim arising out of Construction Manager's performance of the Work at the site be made by any separate contractor against the Construction Manager, Owner, or Engineer, the Construction Manager shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by arbitration.

Construction Manager shall to the fullest extent permitted by Laws and Regulations, indemnify and hold Owner or Engineer harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any separate contractor against Owner or Engineer.

ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

SC-12.01.A Add the following language at the end of the last sentence of Paragraph 12.01A:

Changes in the Contract Price or Contract Time, which are agreed to by the parties by an appropriate, duly executed Change Order or Written Amendment shall constitute a full and final change or amendment to the Contract for any and all changes of which the Construction Manager is, or should have been, aware as of the date of the executed Change Order.

Accordingly, execution of a Change Order or Written Amendment by the Construction Manager shall constitute a waiver on the part of the Construction Manager of any further claims for changes in the Contract Price or Contract Time, which occurred or may have occurred up through the date of any executed Change Order, whether such changes were expressly set forth in the executed change Order or not.

SC-12.03 Add the following new paragraph immediately after Paragraph 12.03.E:

F. Any and all claims for delay damages pursuant to this Article shall be made based on written notice submitted by party making the claim to the Engineer and the other party to the Contract in accordance with provisions of Article 10. Such claims shall be made as such delays are affecting Work and shall not be deemed "cumulative." Failure to raise any such claims on a timely basis shall be construed as a waiver of such claims, individually.

SC-12.03 Add the following new paragraph immediately after Paragraph 12.03.G:

H. The Owner and Construction Manager are both aware that a portion of the construction may be conducted during winter weather conditions, and that extremely variable and severe weather conditions are typical for the site of the Work. The Construction Manager expressly agrees that the Contract Price is based on completion of the Work within the times specified in the Agreement and under weather conditions typically encountered during the contemplated construction period at the site of the Work. For purposes of evaluating requests for extensions of time due to unusually severe weather

conditions, the following conditions, and no others, will be considered unusually severe:

1. Precipitation exceeding the historical mean for the months of the construction period by more than one standard deviation;

2. For winter construction, average temperature less than the historical mean for the months of the construction period by more than one standard deviation;

3. For winter construction, number of days below freezing exceeding the historical mean for the months of the construction period by more than one standard deviation;

4. Isolated abnormal weather occurrences of a severely destructive nature, which in fact, cause such destruction at the site of the Work.

5. For the purpose of determining mean conditions, all available data contained in the records of the National Weather Service for reporting from, as well as data available from the State Climatologist for the same areas. The Construction Manager further agrees that should a request for time extension due to unusually severe weather conditions be made, the Construction Manager shall submit all necessary historical and detailed daily data during the construction period to support the claim.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC-13.07 Add the following new paragraph immediately after Paragraph 13.07.E:

F. Nothing in the General Conditions concerning the correction period shall establish a period of limitation with respect to any other obligation, which Construction Manager has under the Contract Documents. The establishment of a time period relates only to the specific obligations of the Construction Manager to correct the Work, and has no relationship to the time within which his obligations under the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish his liability with respect to his obligations other than to specifically correct the Work.

SC-13.07 Delete Paragraph 13.07.A in its entirety and replace with the following:

A. If within two years after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable

special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Construction Manager's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Construction Manager shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. Repair such defective land or areas; or
2. correct such defective Work; or
3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

ARTICLE 14 - PAYMENTS TO CONSTRUCTION MANAGER AND COMPLETION

SC-14.02.A.1 Add the following as the last sentence of subparagraph 14.02.A.1:

Payment for materials and equipment not incorporated in the Work, but delivered and suitably stored, shall be based only upon the actual cost of such materials to Construction Manager, and shall not include any overhead or profit to Construction Manager. For Pre-Selected Equipment only, Construction Manager will be able to submit Application for Payment to meet the terms of the Pre-Selected Equipment Supplier in accordance with SECTION 00315.

SC-14.02.C.1 Delete Paragraph 14.02.C.1 in its entirety and replace with the following:

1. Thirty (30) days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Construction Manager.

SC-14.02.D.3 Delete subparagraph 14.02.D.3 in its entirety and replace with the following:

3. Upon a subsequent determination that the Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1, as amended, and subject to 3% interest from the date of said determination, to the date of payment.

SC-14.07.C.1 Delete subparagraph 14.07.C.1 in its entirety.

SC-14.09 Delete paragraph 14.09 in its entirety.

ARTICLE 16 – DISPUTE RESOLUTION

SC-16.01 Delete Paragraph 16.01 A, B and C in their entirety.

ARTICLE 17 – MISCELLANEOUS

SC-17.07 Add the following new paragraphs immediately after Paragraph 17.06:

A. Owner is the City of Idaho Springs and their duly authorized agents. All notices, letters and communication directed to Owner shall be addressed and delivered to JVA Incorporated, who is designated representative (below), with a copy to the City of Idaho Springs.

JVA, Incorporated	City of Idaho Springs
Attn: Michael Katalinich, P.E.	Attn: Andrew Marsh
1319 Spruce Street	1711 Miner Street
Boulder, CO 80302	Idaho Springs, CO 80452

B. All duties and responsibilities assigned to Engineer in the Contract Documents, with the corresponding rights and authority will be assumed by JVA, Incorporated and their duly authorized agents. All notices, letters and communication directed to Engineer shall be addressed and delivered to JVA, Inc. 1319 Spruce Street, Boulder, CO 80302, Attention: Michael Katalinich, P.E., mkatalinich@jvajva.com with a copy to Owner.

C The business addresses of Construction Manager given in contract for the work and Construction Manager's office at the site of the Work are hereby designated as the places to which all notices, letters, and other communication to Construction Manager will be delivered.

E. Either Owner, Subcontractor, or Engineer may change his address at any time by an instrument in writing delivered to the other parties.

SC-17.08 Add the following new paragraph immediately after Paragraph 17.07:

The cross-referencing or specification sections under the heading "Related Sections" and elsewhere within each specification section is intended as an aid to the Construction Manager and shall not relieve the Construction Manager from his responsibility to coordinate the Work under the Contract Documents. Listings of cross-references are not intended to be comprehensive. The omission of a cross-reference to an additional or related requirement shall not relieve the Construction Manager of his obligation to provide a complete Project.

END OF SECTION

COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

State Revolving Fund Required Specifications

Revised September 28, 2016

The following State Revolving Fund Required Specifications are designed for the subrecipient to cut and paste in their entirety and insert into the construction documents for bid and for construction. There is one exception to these specifications and that is the Disadvantaged Business Enterprise (DBE) section. Please refer to your loan agreement or contact the grants and loans unit project manager or compliance specialist for applicability of this requirement to your project. For more detailed information on the federal requirements of the SRF program please refer to the Navigating State Revolving Fund Requirements Handbook for Borrowers.

If you have any questions regarding the information contained in this document, please contact your CDPHE Water Quality Control Division Grants and Loans Unit project manager or the compliance specialist.

Name	Title	Phone	Email
Michael Beck	Section Manager	303-692-3374	michael.s.beck@state.co.us
Corrina Quintana	Unit Manager	303-691-4025	corrina.quintana@state.co.us
Randi Johnson-Hufford	Project Manager	303-692-2203	randi.johnson-hufford@state.co.us
Bradley Monson	Project Manager	303-692-2286	bradley.monson@state.co.us
Margaret Pauls	Project Manager	303-692-3290	margaret.pauls@state.co.us
Matthew Stearns	Compliance Specialist	303-691-4064	matthew.stearns@state.co.us
Paul Young	Project Manager	303-692-3606	paul.young@state.co.us
Erick Worker	Project Manager	303-692-3594	erick.worker@state.co.us

State Revolving Fund Required Specifications

Section 1

Davis Bacon Prevailing Wage Requirements

This contract is governed by the Davis Bacon and related Acts and is subject to General Decision Number_____dated_____CO_____.
A copy of this General Decision Number is included as Exhibit_____of this document.

The SRF Program is subject to "Davis Bacon and Related Acts" or DBRA, which extends the requirements of the Davis-Bacon Act. Compliance with the Davis Bacon Act is required for any project funded by the Drinking Water Revolving Fund (DWRF) or Water Pollution Control Revolving Fund programs. Non-Compliance with the Davis Bacon Act may result in debarment and suspension from working on future projects funded with federal dollars for up to three years and/or loss of funding for the current project.

Preamble

With respect to the Clean Water and Safe Drinking Water State Revolving Funds, EPA provides capitalization grants to each State which in turn provides sub grants or loans to eligible entities within the State. Typically, the subrecipients are municipal or other local governmental entities that manage the funds. For these types of recipients, the provisions set forth under Roman numeral I, below, shall apply. Although EPA and the State remain responsible for ensuring subrecipients' compliance with the wage rate requirements set forth herein, those subrecipients shall have the primary responsibility to maintain payroll records as described in Section 3(ii)(A), below and for compliance as described in Section I -5.

Attachment 1

Wage Rate Requirements under:

- **The Consolidated Appropriations Act, 2016 (P.L 114-133), or**
- **The Water Resources Reform and Redevelopment Act of 2014 (WRRDA):**

I. For Subrecipients that Are Governmental Entities:

The following terms and conditions specify how recipients will assist EPA in meeting its Davis - Bacon (DB) responsibilities when DB applies to EPA awards of financial assistance under The 2014 Act with respect to State recipients and subrecipients that are governmental entities. If a subrecipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient. If a State recipient needs guidance, the recipient may contact Brian Friel at friel.brian@epa.gov or at 303-312-6277 of EPA, Region 8 for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at www.dol.gov/whd/

1. Applicability of the Davis-Bacon (DB) prevailing wage requirements.

Under The Consolidate Appropriations Act, 2016, or The Water Resources Reform and Redevelopment Act of 2014, DB prevailing wage requirements apply to the construction,

alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(1) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(2) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient , at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the

contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of $2,000 which is entered into for the actual construction , alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or The 2014 Act, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof , regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period , are deemed to be constructively made or incurred during such weekly period . Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov

(ii) (A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor , or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract . In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis- Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable , that the plan or program is financially responsible , and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii) (A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week . The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls . Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at www.dol.gov/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for

submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection , copying, or transcription by authorized representatives of the State , EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program , who is not individually registered in the program , but who has been certified by the Office of Apprenticeship Training , Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed . In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable

apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval , evidenced by formal certification by the U .S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate , and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a

subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U .S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of $100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages

shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor , or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act , which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics , including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicated that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of non compliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments there under by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at: www.dol.gov/whd/index.htm

Section 2

American Iron and Steel

The State Revolving Fund Program is subject to, and requires compliance with, the American Iron and Steel requirement. American Iron and Steel requires Water Pollution Control State Revolving Fund (WPCRF) and Drinking Water State Revolving Fund (DWSRF) assistance recipients use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works if the project is funded through an assistance agreement executed on or after January 17, 2014.

In providing bids, proposals, or services, the Contractor represents and warrants to and for the benefit of the borrower and the State that:

a. The Contractor has reviewed and understands the American Iron and Steel requirement.

b. All of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved.

c. The Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the borrower or the State.

Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the borrower or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the borrower or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the borrower). While the Contractor has no direct contractual privity with the State, as a lender to the borrower for the funding of its project, the borrower and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of the Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

For purposes of the WPCRF and DWSRF projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the public water system or treatment works:

- Lined or unlined pipes or fittings;
- Manhole Covers;
- Municipal Castings (defined in more detail below);
- Hydrants;
- Tanks;
- Flanges;
- Pipe clamps and restraints;
- Valves;
- Structural steel (defined in more detail below);

- Reinforced precast concrete; and
- Construction materials

If the subrecipient can justify a claim made under one of the categories below, a waiver may be granted. Until a waiver is granted by the EPA, the AIS requirement must be adhered to as described in the act.

A waiver may be provided if EPA determines that:

1. Applying these requirements would be inconsistent with the public interest.
2. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
3. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

All waiver requests must be routed through the Grants and Loans unit project manager or c ompliance specialist.

EPA's guidance on AIS requirements, available at http://water.epa.gov/grants_funding/aisrequirement.cfm, inc ludes specific instructions for communities interested in applying for a waiver. After receiving a completed application for a waiver from the grants and loans unit, EPA will publish the waiver request and all material submitted with the application on this website for 15 days. During that period, the public will have the opportunity to review the request and provide informal comment to the EPA.

Approved National Waivers available for borrowers and contractors include:

- April 15, 2014 Plans and Specifications Waiver:

  "The EPA is hereby granting a nationwide waiver of the American Iron and Steel requirement pursuant to Section 436(b)(1) (public interest waiver), of the Consolidated Appropriations Act (CAA), 2014 for eligible projects that had engineering plans and specifications submitted to an appropriate state agency prior to and including January 17, 2014, the date of the enactment of the CAA, and approved between and including January 17, 2014, and the date of this waiver, where the state agency that approved such plans and specifications did so under the normal course of business for that agency.

  "If a project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the plans and specifications approval date for purposes of this national waiver."

- April 15, 2014 De Minimis Waiver:

  "The EPA is hereby granting a nationwide waiver pursuant to the American Iron and Steel requirements of P.L. 113-76 CAA 2014 (Act), section 436 under the authority of Section 436(b)(1) (public interest waiver) for de minimis incidental components of eligible water infrastructure projects. This action permits the use of products when they occur in de minimis incidental components of such projects funded by the Act that may otherwise be prohibited under section 436(a). Funds used for such de minimis incidental components cumulatively

may comprise no more than a total of 5 percent of the total cost of the material used in and incorporated into a project; the cost of an individual item may not exceed 1 percent of the total cost of materials used in and incorporated into a project."

For more information on approved waivers visit the following website:
http://water.epa.gov/grants_funding/aisrequirement.cfm

Section 3

National Term on Suspension and Debarment

Under Executive Order 12549, an individual or organization debarred or excluded from participation in Federal assistance or benefit programs may not receive any assistance award under a Federal program, or a subagreement thereunder for $25,000 or more.

The status of prospective individuals or organizations can be checked at http://www.sam.gov. It is the prime contractor's responsibility to verify that subcontractors, vendors, suppliers and manufacturers are not on the excluded parties list.

Section 4

Disadvantaged Business Enterprise (DBE) – SRF Program Grant Agreement Information and Requirements

(NOTE: This section may not be required, please refer to your loan agreement or contact the grants and loans unit compliance specialist for applicability of this requirement to your project.)

1. OVERVIEW OF DISADVANTAGED BUSINESS ENTERPRISE (DBE) UTILIZATION

The Environmental Protection Agency's (EPA) new Disadvantaged Business Enterprise (DBE) rule became effective on May 27, 2008. The new DBE rule sets forth an EPA program that serves the compelling government interest of remedying past and current racial discrimination through agency-wide procurement objectives. The new DBE rule revises and replaces EPA's Minority and Women Business Enterprise (MBE/WBE) Program for funding received after May 27, 2008.

Note that the loan recipient is not a passive conduit of the contractor's DBE information. By submitting the proposed contractor's DBE documentation to the SRF Loan Program for review, the loan recipient is asserting that it has found the proposed contractor's documentation of good faith efforts adequate.

In order to be counted as a MBE/WBE under the new EPA DBE rule, MBE/WBEs must be certified by a federal agency (e.g., EPA, Small Business Administration, Department of Transportation) or by a State, locality, Indian Tribe, or independent private organization that meets the certification requirements of the new EPA DBE rule. Under the new EPA DBE rule an individual claiming economic disadvantaged status must have an initial and continued personal net worth of less than $750,000.

Locating potential DBE sub-contractors is the responsibility of the bidder/contractor. The Colorado Department of Transportation does maintain a listing of some certified DBE'S on its website at http://coloradodbe.org/

Applications for certification by EPA can be found on EPA's Small Business Programs website at http://www.epa.gov/osbp/dbe_fair.htm under Certification Forms.

1. Each procurement contract signed by a loan participant must include the following term and condition:

> *"The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract." (Appendix A to Part 33—Term and Condition)*

GUIDANCE FOR UTILIZATION OF DISADVANTAGED BUSINESS ENTERPRISES REQUIREMENTS OF 40 CFR PART 33

A. REQUIREMENTS

1. Each procurement contract signed by a loan recipient must include the following term and

condition:

The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

2. The recipient and prime contractor will create and maintain a bidders list if the recipient of the loan is subject to, or chooses to follow, competitive bidding requirements. The purpose of a bidders list is to provide the recipient and entities receiving identified loans who conduct competitive bidding with as accurate a database as possible about the universe of MBE/WBE and non-MBE/WBE prime and subcontractors. The list must include all firms that bid or quote on prime contracts, or bid or quote subcontracts on EPA assisted projects, including both MBE/WBEs and non-MBE/WBEs. The bidders list must only be kept until the project period for the identified loan has ended. The following information must be obtained from all prime and subcontractors:
    a. Entity's name with point of contact;
    b. Entity's mailing address, telephone number, and e-mail address;
    c. The procurement on which the entity bid or quoted, and when; and
    d. Entity's status as an MBE/WBE or non-MBE/WBE.

3. The recipient and prime contractor will exercise good faith efforts to attract and utilize small, minority, and women's business enterprises primarily through outreach, recruitment, and race/gender neutral activities; at a minimum, fulfillment of the six affirmative steps set forth below:
    a. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.
    b. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
    c. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

d. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

e. Use the services of the SBA and the Minority Business Development Agency of the Department of Commerce.

f. If the prime contractor awards subcontract, require the prime contractor to take steps in paragraphs (a) through (e) of this section

4. The prime contractor must pay its subcontractors for satisfactory performance no more than 30 days from the prime contractor's receipt of payment from the owner.

5. The prime contractor must notify the owner in writing prior to any termination of a DBE subcontractor for convenience.

6. If a DBE subcontractor fails to complete work under the subcontract for any reason, the prime contractor must employ the good faith efforts if soliciting a replacement subcontractor, even if the fair share objectives have already been achieved.

B. Fair Share Objectives

1. The Colorado SRF project goals are:

SRF Project	%MBE	%WBE
Construction	6.1%	6.6%

C. DEFINITIONS

1. Disadvantaged Business Enterprise (DBE) is a business concern which meets the qualifications of a Minority Business Enterprise (MBE), Women's Business Enterprise (WBE)

2. Minority Business Enterprise (MBE) is a business concern which is:

a. Certified as socially and economically disadvantaged by the Small Business Administration;

i. Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities.

ii. Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system is impaired due to diminished capital and credit opportunities, as compared to others in the same business area who are not socially disadvantaged. In determining the degree of diminished credit and capital opportunities, the Small Business Administration shall consider, but not be limited to, the assets and net worth of such socially disadvantaged individuals. Individuals who certify that they are members of named groups (Black Americans, Hispanic Americans, Native

Americans, Asian-Pacific Americans, Asian-Indian Americans), are to be considered socially and economically disadvantaged. Economically and socially disadvantaged individuals are deemed to include women.

b. Certified as a minority business enterprise by a State or Federal agency; and

c. An independent business concern which is at least 51 percent owned and controlled by minority group member(s).

   i. A minority group member is an individual who is a citizen of the United States and one of the following:

      1. Black American;

      2. Hispanic American (with origins from Puerto Rico, Mexico, Cuba, South or Central America)

      3. Native American (American Indian, Eskimo, Aleut, native Hawaiian); or

      4. Asian-Pacific American (with origins from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, Taiwan or the Indian subcontinent).

   ii. In order to satisfy this third criteria of the MBE definition, the minority ownership's interest must be real, substantial and continuing. Such interest is characterized by:

      1. Risk of loss/share of profit commensurate with the proportional ownership; and

      2. Receipt of the customary incidents of ownership, such as compensation (i.e., salary and other personnel compensation).

   iii. A minority owner must have and exercise control of the business decisions. Characteristics of control include, but are not limited to:

      1. Authority to sign bids and contracts;

      2. Decisions in price negotiations;

      3. Incurring liabilities for the firm;

      4. Final staffing decisions;

      5. Policy-making; and

      6. General company management decisions.

   iv. Only those firms performing a useful business function according to custom

and practice in the industry, are qualified as MBEs. Acting merely as a passive conduit of funds to some other firm where such activity is unnecessary to accomplish the project does not constitute a "useful business function according to custom and practice in the industry." The purpose of this approach is to discourage the use of MBE "fronts" and limit the creation of an artificial supplier and broker marketplace.

3. Women's Business Enterprise (WBE) is a business which is certified as such by a State or Federal agency, or which meets the following definition:

   "A women's business enterprise is an independent business concern which is at least 51 percent owned by a woman or women, who also control and operate it. Determination of whether a business is at least 51 percent owned by a woman or otherwise qualified WBE which is 51 percent owned by a married woman in a community property State will not be disqualified because her husband has a 50 percent interest in her share. Similarly, a business which is 51 percent owned by a married man and 49 percent owned by an unmarried woman will not become a qualified WBE by virtue of his wife's 50 percent interest in his share of the business."

   As in the case of a MBE, only United States citizens will be deemed to be WBEs. Similar to the MBE criteria, WBE should meet the criteria cited in subparagraphs B.1.c.(2), (3), and (4).

4. Fair Share or Fair Share Objective A fair share or a fair share objective is an amount of funds reasonably commensurate with the total project funding and the availability of qualified MBEs and WBEs, taking into account experience on EPA-funded projects and other comparable projects in the area. A fair share objective does not constitute an absolute requirement, but a commitment on the part of the bidder to exercise good faith efforts as defined in this section to use MBEs and WBEs to achieve the fair share objective.

5. Recipient A party receiving SRF financial assistance.

6. Project The scope of work for which an SRF loan is awarded.

7. Bidder A party seeking to obtain a contract with a recipient through a competitive, advertised, sealed bid process.

8. Offeror A party seeking to obtain a contract with a recipient through a negotiative procurement process.

9. Prime Contractor A party that has obtained a contract with a recipient through a competitive, advertised, sealed bid process.

10. Good Faith Efforts Good faith efforts by a recipient, prime contractor, and/or bidder/offeror means efforts to attract and utilize DBEs primarily through outreach, recruitment, and race/gender neutral activities. The following are examples of activities to assist recipients, prime contractors and/or bidders/offerors to comply with good faith efforts.

    a. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State

and Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.

i. Maintain and update a listing of qualified MBE/WBEs that can be solicited for construction, equipment, services and/or supplies.

ii. Provide listings to all interested parties who request copies of the bidding or proposing documents.

iii. Contact appropriate sources within your geographic area and state to identify qualified MBE/WBE for placement on your MBE/WBE business listings.

iv. Utilize other MBE/WBE listings such as those of the state's minority business office, the Small Business administration, Minority Business Development Agency (MBDA) of the Department of Commerce, EPA OSDBU, and DOT.

v. have state environment agency personnel review solicitation lists.

b. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

i. Develop realistic delivery schedules which may provide for greater MBE/WBE participation.

ii. Advertise through the minority media in order to facilitate MBE/WBE utilization. Such advertisements may include, but are not limited to, contracting and subcontracting opportunities, hiring and employment, or any other matter related to the project.

iii. Advertise in general circulation publications, trade publications, state agency publications and minority and women's business focused media concerning contracting opportunities on your projects. Maintain a list of minority and/or women's business-focused publications that may be utilized to solicit MBE/WBEs.

c. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

i. Perform an analysis to identify portions of work that can be divided and performed by qualified MBE/WBEs.

ii. Scrutinize the elements of the total project to develop economical units of work that are within the bonding range of MBE/WBEs.

iii. Conduct meetings, conferences, and follow-ups with MBE/WBE associations and minority media to inform these groups of opportunities to provide construction, equipment, services ad supplies.

d. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

   i. Notify MBE/WBEs of future procurement opportunities so they may establish bidding solicitations and procurement plans.

   ii. Provide MBE/WBE trade organizations with succinct summaries of solicitations.

   iii. Provide interested MBE/WBEs with adequate information about plans, specifications, timing and other requirements of the proposed projects.

e. Use the services of the SBA and the Minority Business Development Agency of the Department of Commerce.

   i. Use the services of outreach programs sponsored by the MBDA and/or the SBA to recruit bona fide firms for placement on DBE bidders lists to assist these firms in the development of bid packaging.

   ii. Seek out Minority Business Development Centers (MBDCs) to assist recipients and prime contractors in identifying MBE/WBEs for potential work opportunities on projects.

f. If the prime contract awards subcontracts, require the prime contractor to take steps in Paragraphs (a) through (e) of this section.

D. REPORTING

1. The recipient must submit "DBE Utilization Under Federal Grants, Cooperative Agreements, and Interagency Agreements," to the Project Administrator beginning with the Federal Fiscal year quarter the bid is awarded and continuing until the project is completed. These reports must be submitted within 5 days of the end of the Federal fiscal quarter or by January 5, April 5, July 5, and October 5. Please e- mail reports to:

   Cdphe_grantsandloans@state.co.us

2. Bidders/offerors shall demonstrate compliance with good faith efforts in order to be deemed responsible.

3. The prime contractor must distribute DBE Program Subcontractor Participation Form (EPA Form 6100-2) to all of its DBE subcontractors. The subcontractors can submit completed forms to the State of Colorado, Water Quality Control Division, Grants and Loans Unit.

4. The prime contractor must have its DBE subcontractors complete DBE Program Subcontractor Performance Form (EPA Form 6100-3) and should include completed forms in its bid or proposal package.

5. The prime contractor must complete DBE Program Subcontractor Utilization Form (EPA Form 6100-4) which should be submitted as part of its bid or proposal package.

6. Form 6100-3 and Form 6100-4 must be submitted by the apparent low-bidder within ten calendar days of the bid opening. Failure to submit this information will be viewed as a non-responsive bid.

Section 5

Equal Employment Opportunity and Affirmative Action Requirements on Federally Assisted Construction Contracts

A. NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

This notice shall be included in, and shall be a part of, all solicitations for offers and bids on all federal and federally assisted construction contracts or subcontracts.

(1) The Offerer's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

(2) The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Minority Participation In Each Trade	Female Participation In Each Trade
27.5% (Pueblo County)	**6.9%** (National)

These goals are applicable to all the contractor's construction work (whether or not it is Federal or Federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non- federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from contractor to contractor or from project to project for the sole purpose of meeting the contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

(3) The contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under

the contract resulting from this solicitation. The notification shall list the name, address and telephone number for the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed (See Form C).

(4) As used in this Notice, and in the contract resulting from this solicitation, the covered area is ___Pueblo___County.

B. EQUAL OPPORTUNITY CLAUSES

(1) The Equal Opportunity Clause published at 41 CFR Part 60-1.4(b) is required to be included in, and is part of, all nonexempt federally assisted construction contracts and subcontracts. By operation of the order, the equal opportunity clause shall be considered to be a part of every contract and subcontract required by the order and the regulations in this part to include such a clause whether or not it is physically incorporated.

(2) In addition to the clauses described above, all federal contracting officers, all applicants, and all non-construction contractors, as applicable, shall include the specifications set forth in this section in all federal and federally assisted construction contracts in excess of $10,000 to be performed in geographical areas designated by the Director pursuant to 41 CFR 60-4.6 of this part and in construction subcontracts in excess of $10,000 necessary in whole or in part to the performance of nonconstruction Federal contracts and subcontracts covered under the Executive Order.

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY CONSTRUCTION CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)

A. DEFINITIONS AS USED IN SPECIFICATIONS

(1) "Covered Area" means the geographical area described in solicitation from which this contract resulted;

(2) "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

(3) "Employer identification number" means the Federal Social Security number used on the employer's quarterly Federal Tax Return, U.S. Treasury Department Form 941.

(4) "Minority" includes:

(a) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(b) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

(c) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asian, the Indian Subcontinent, or the

Pacific Islands);

(d) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North American and maintaining identifiable tribal affiliations through membership and participation or community identification).

B. DETAILED SPECIFICATIONS

(1) Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $25,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

(2) If the contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area, (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved Plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

(3) The contractor shall implement the specific affirmative action standards provided in paragraphs (6)(a) through (p) of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the contractor should reasonably by able to achieve in each construction trade in which it has employees in the covered area. The contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

(4) Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

(5) In order for the non-working training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the contractor during the training period, and the contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(6) The contractor shall take specific affirmative action to ensure equal employment

opportunity. The evaluation of the contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the contractor's employees are assigned to work. The contractor, where possible, will assign two or more women to each construction project. The contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the contractor's obligation to maintain such a working environment, with specific

b. Attention to minority or female individuals working at such sites or in such facilities.

c. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations where the contractor or its unions have employment opportunities available, and maintain a record of the organization's responses.

d. Maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the contractor by the union or, if referred, not employed by the contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the contractor may have taken.

e. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

f. Develop on-the-job training opportunities and/or participate in training programs for the areas which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the contractor's employment needs, especially those programs funded or approved by the Department of Labor. The contractor shall provide notice of these programs to the sources compiled under (7)(b) above.

g. Disseminate the contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

h. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as superintendents, general foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

i. Disseminate the contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the contractor's EEO policy with other contractors and subcontractors with whom the contractor does or anticipates doing business.

j. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations servicing the contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

k. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a contractor's workforce.

l. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

m. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

n. Ensure that seniority practices, job classification, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the contractor's obligations are followed.

o. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

p. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

q. Conduct a review, at least annually, of all supervisor's adherence to and performance under the contractor's EEO policies and affirmative action obligations.

(7) Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (6)(a) through (p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under (6)(a) through (p) of the specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the contractor. The obligation to comply, however, is the contractor's and failure of such a group to fulfill an obligation shall not be a defense for the contractor's noncompliance.

(8) A single goal for minorities and a separate single goal for women have been established. The contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the contractor has achieved its goals for women generally, the contractor may be in violation of the order if a specific minority group of women is under-utilized).

(9) The contractor shall not use the goals and timetables of affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(10) The contractor shall not enter into any subcontract with any person or firm debarred from government contracts pursuant to Executive Order 11246.

(11) The contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

(12) The contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph (6) of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.3.

(13) The contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

(14) Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

Section 6

Williams Steiger Occupational Safety and Health Act of 1970

A. Authority

(1) The contractor is subject to the provisions of the Williams-Steiger Occupational Safety and Health Act of 1970.

(2) These construction documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the Federal law(s), including but not limited to the latest amendment of the following:

a. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 94-596;

b. Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations;

c. Part 1926 - Safety and Health Regulations for Construction, Chapter XVII of Title 29, Code of Federal Regulations.

B. Safety and Health Program Requirements

(1) This project, its prime contractor and its subcontractors, shall at all times be governed by Chapter XVII of Title 29, Code of Federal Regulations, Part 1926 - Safety and Health Regulations for Construction (29 CFR 22801), as amended to date.

(2) To implement the program and to provide safe and healthful working conditions for all persons, general project safety meetings will be conducted at the site at least once each month during the course of construction, by the construction superintendent or his/her designated safety officer. Notice of such meeting shall be issued not less than three (3) days prior, stating the exact time, location, and agenda to be included. Attendance by the owner, architect, general foreman, shop steward(s), and trades, or their designated representatives, witnessed in writing as such, shall be mandatory.

(3) To further implement the program, each trade shall conduct a short gang meeting, not less than once a week, to review project safety requirements mandatory for all persons during the coming week. The gang foreman shall report the agenda and specific items covered to the project superintendent, who shall incorporate these items in his/her daily log or report.

(4) The prime contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the owner and architect, or their designated representatives, in writing. This shall not obviate any mandatory reporting under the provisions of the Occupational Safety and Health Act of 1970.

(5) This program shall become a part of the contract documents and the contract between the owner and prime contractor, prime contractor and all subcontractors, as though fully written therein.

Section 7

Discovery of Archaeological and Other Historical Items

A. Construction Procedures

(1) In the event of an archaeological or more recent historical find (e.g., artifacts, housing sites) during any phase of construction, the following procedure should be followed:

(2) Construction shall be halted, with as little disruption to the archaeological site possible.

(3) The Contractor shall notify the Owner who shall contact the State Historical Preservation Officer.

(4) The State Historical Preservation Officer may decide to have an archaeologist inspect the site and make recommendations about the steps needed to protect the site, before construction is resumed.

(5) The entire event should be handled as expediently as possible in order to hold the loss in construction time to a minimum while still protecting archaeological finds.

B. National Register Status

In the event archaeological/historical data are evaluated to meet National Register criteria, the Advisory Council on Historic Preservation may be notified and asked to comment by the Water Quality Control Division.

Forms by Section

SRF forms can be found on this webpage: https://www.colorado.gov/pacific/cdphe/water-quality-srf-forms

Section 1 - Davis Bacon Prevailing Wages

- Davis Bacon Certification Form (SRF form)
- WH – 347 - Contractors Payroll Form
- Standard Form 1444 - Request for Authorization of Additional Classification and Rate
- Standard Form 1445 – Labor Standards Interview Form

Section 2 - American Iron and Steel

- American Iron and Steel Certification Form (SRF Form)
- American Iron and Steel Product Spreadsheet (SRF Form)
- American Iron and Steel Waiver Request Form

Section 3 –National Term on Suspension and Debarment

- No applicable forms

Section 4 - Disadvantaged Business Enterprise (DBE)

- EPA Form 6100-2 provided by prime contractor completed by DBE subcontractor and submitted to EPA at R8grants@epa.gov
- EPA Form 6100-3 provided by prime contractor completed by DBE subcontractor and submitted to EPA at R8grants@epa.gov
- EPA Form 6100-4 provided by subrecipient completed by prime contractor as part of bid package
- Form B provided by subrecipient completed by prime contractor submitted to SRF program at Cdphe_grantsandloans@state.co.us

Section 5 – Equal Employment Opportunity and Affirmative Action Requirements

- No applicable forms

Section 6 - Williams Steiger Occupational Safety and Health Act of 1970

- No applicable forms

Section 7 – Discovery of Archaeological and Other Historical Items

- No applicable forms

General Decision Number: CO180013 10/12/2018 CO13

Superseded General Decision Number: CO20170013

State: Colorado

Construction Type: Heavy

Counties: Alamosa, Archuleta, Baca, Bent, Chaffee, Cheyenne, Clear Creek, Conejos, Costilla, Crowley, Custer, Delta, Dolores, Eagle, Elbert, Fremont, Garfield, Gilpin, Grand, Gunnison, Hinsdale, Huerfano, Jackson, Kiowa, Kit Carson, La Plata, Lake, Las Animas, Lincoln, Logan, Mineral, Moffat, Montezuma, Montrose, Morgan, Otero, Ouray, Park, Phillips, Pitkin, Prowers, Rio Blanco, Rio Grande, Routt, Saguache, San Juan, San Miguel, Sedgwick, Summit, Teller, Washington and Yuma Counties in Colorado.

HEAVY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2018
1	01/12/2018
2	01/19/2018
3	02/02/2018
4	07/13/2018
5	10/12/2018

* ELEC0012-002 09/01/2018

ALAMOSA, ARCHULETA, BACA, BENT, CHAFFEE, CONEJOS, COSTILLA, CROWLEY, CUSTER, FREMONT, HUERFANO, KIOWA, LAS ANIMAS, MINERAL, OTERO, PROWERS, RIO GRANDE AND SAGUACHE COUNTIES

	Rates	Fringes
Electricians:		
Electrical contract over $1,000,000	$ 27.70	12.30+3%
Electrical contract under $1,000,000	$ 24.85	12.30+3%

ELEC0068-011 06/01/2018

CLEAR CREEK, EAGLE, GILPIN, GRAND, JACKSON, LAKE, LOGAN, MORGAN, PHILLIPS, SEDGWICK, SUMMIT, WASHINGTON AND YUMA COUNTIES

	Rates	Fringes
ELECTRICIAN	$ 35.80	15.45

ELEC0111-002 09/01/2017

	Rates	Fringes
Line Construction:		
Groundmen	$ 25.68	25.25%+$5.75
Line Equipment Operator	$ 31.35	25.25%+$5.75

Lineman and Welder.....$ 44.92 25.25%+$5.75

ELEC0113-004 06/01/2018

CHEYENNE, ELBERT, KIT CARSON, LINCOLN, PARK AND TELLER COUNTIES

	Rates	Fringes
ELECTRICIAN.....	$ 31.80	15.90

ELEC0969-003 06/01/2015

DOLORES, GARFIELD, GUNNISON, HINSDALE, LA PLATA, MOFFAT, MONTEZUMA, RIO BLANCO, AND ROUTT COUNTIES

	Rates	Fringes
ELECTRICIAN.....	$ 24.00	7.92

ELEC0969-006 01/01/2018

OURAY, PITKIN, SAN JUAN AND SAN MIGUEL COUNTIES

	Rates	Fringes
ELECTRICIAN.....	$ 31.00	10.13

ELEC0969-010 06/01/2015

DELTA AND MONTROSE COUNTIES

	Rates	Fringes
ELECTRICIAN.....	$ 24.00	7.92

ENGI0009-004 05/01/2017

	Rates	Fringes
Power equipment operators:		
Mechanic.....	$ 28.08	10.10
Motor Grader: Blade-finish..	$ 27.92	10.10
Motor Grader: Blade-rough...	$ 27.60	10.10
Roller: self-propelled, all types over 5 tons.....	$ 27.60	10.10
Roller: self-propelled, rubber tires under 5 tons...	$ 27.22	10.10
Trackhoe.....	$ 27.75	10.10

PLUM0003-003 06/01/2017

CLEAR CREEK, GILPIN, GRAND, JACKSON, LAKE, LOGAN, MORGAN, PHILLIPS, SEDGWICK, SUMMIT, WASHINGTON, AND YUMA. PARTS OF ELBERT, EAGLE, KIT CARSON, LINCOLN, AND PARK COUNTIES

	Rates	Fringes
PLUMBER.....	$ 39.08	16.44

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* PLUM0058-010 07/01/2018

ALAMOSA, BACA, BENT, CHAFFEE, CHEYENNE, CONEJOS, COSTILLA, CROWLEY, CUSTER, ELBERT (Southern portion including towns of Elbert, Matherson and Simla), FREMONT, HUERFANO, KIOWA, KIT CARSON (Including towns of Dfalgler, Siebert, Vona, Stratton and Bethune), LAS ANIMAS, LINCOLN (Including towns of Geona and Arriba in the southern portion of the county), MINERAL, OTERO, PARK (Including towns of Fauplay, Hartsel and Lake George), PROWERS, PUEBLO, RIO GRANDE, AND SAGUACHE COUNTIES

	Rates	Fringes
PLUMBER.....	$ 32.75	14.85

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* PLUM0058-012 07/01/2018

TELLER COUNTY

	Rates	Fringes
PLUMBER		
Includes HVAC Work.....	$ 32.75	14.85

PLUM0145-004 08/01/2016

ARCHULETA, DELTA, DOLORES, EAGLE (Eagle County is divided from where Pitkin and Lake Counties join on the north, and in a straight line to and including the town of Edwards and northerly to the south east corner of Routt County), GARFIELD, GUNNISON, HINSDALE, LA PLATA, MOFFAT, MONTEZUMA, MONTROSE, OURAY, PITKIN, RIO BLANCO, ROUTT, SAN JUAN AND SAN MIGUEL COUNTIES

	Rates	Fringes
PLUMBER.....	$ 26.18	11.52

SUCO2001-005 12/20/2001

	Rates	Fringes
Carpenters:		
Form Building and Setting...	$ 16.16	.82
All Other Work.....	$ 15.72	
Cement Mason/Concrete Finisher...	$ 14.76	2.28
Laborer, common.....	$ 11.11	3.80
PIPEFITTER.....	$ 18.13	1.84
Power equipment operators:		
Backhoe.....	$ 15.93	3.58
Bobcat/Skid Loader.....	$ 20.22	4.41
Bulldozer.....	$ 15.08	4.44
Excavator.....	$ 15.39	
Front End Loader.....	$ 15.86	3.59

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate

(weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

Project Name: _____

Period From: _____**To:**_____

Davis-Bacon Act CERTIFICATION

I certify to the best of my knowledge and belief that the above referenced project:

Complies with Davis-Bacon and Related Acts and that all laborers and mechanics employed by contractors and subcontractors during the above referenced period were paid wages at rates not less than those listed on the prevailing wage rate contained in the contract documents and that all applicable provisions of the Davis-Bacon and Related Acts have been met.

_____ _____
Name of Loan Recipient Date

_____
Signature of Authorized Official

_____
Print Name and Title of Authorized Official

REQUEST FOR AUTHORIZATION OF ADDITIONAL CLASSIFICATION AND RATE

CHECK APPROPRIATE BOX
☐ SERVICE CONTRACT
☐ CONSTRUCTION CONTRACT

OMB Control Number: 9000-0089
Expiration Date: 10/31/2019

PAPERWORK REDUCTION ACT STATEMENT: Public reporting burden for this collection of information is estimated to average .5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspects of this collection of information, including suggestions for reducing this burden, to U.S. General Services Administration, Regulatory Secretariat (MVCB)/IC 9000-0089, Office of Governmentwide Acquisition Policy, 1800 F Street, NW, Washington, DC 20405.

INSTRUCTIONS: THE CONTRACTOR SHALL COMPLETE ITEMS 3 THROUGH 16, KEEP A PENDING COPY, AND SUBMIT THE REQUEST, IN QUADRUPLICATE, TO THE CONTRACTING OFFICER.

1. **TO:**
ADMINISTRATOR,
WAGE AND HOUR DIVISION
U.S. DEPARTMENT OF LABOR
WASHINGTON, DC 20210

2. **FROM:** *(REPORTING OFFICE)*

3. CONTRACTOR

4. DATE OF REQUEST

5. CONTRACT NUMBER	6. DATE BID OPENED *(SEALED BIDDING)*	7. DATE OF AWARD	8. DATE CONTRACT WORK STARTED	9. DATE OPTION EXERCISED (If *APPLICABLE) (SERVICE CONTRACT ONLY)*

10. SUBCONTRACTOR *(IF ANY)*

11. PROJECT AND DESCRIPTION OF WORK *(ATTACH ADDITIONAL SHEET IF NEEDED)*

12. LOCATION (*CITY, COUNTY AND STATE)*

13. IN ORDER TO COMPLETE THE WORK PROVIDED FOR UNDER THE ABOVE CONTRACT, IT IS NECESSARY TO ESTABLISH THE FOLLOWING RATE(S) FOR THE INDICATED CLASSIFICATION(S) NOT INCLUDED IN THE DEPARTMENT OF LABOR DETERMINATION

NUMBER: _____ DATED: _____

a. LIST IN ORDER: PROPOSED CLASSIFICATION TITLE(S); JOB DESCRIPTION(S); DUTIES; AND RATIONALE FOR PROPOSED CLASSIFICATIONS *(Service contracts only)*	b. WAGE RATE(S)	c. FRINGE BENEFITS PAYMENTS
(Use reverse or attach additional sheets, if necessary)		

14. SIGNATURE AND TITLE OF SUBCONTRACTOR REPRESENTATIVE *(IF ANY)*

15. SIGNATURE AND TITLE OF PRIME CONTRACTOR REPRESENTATIVE

16. SIGNATURE OF EMPLOYEE OR REPRESENTATIVE

TITLE

CHECK APPROPRIATE BOX-REFERENCING BLOCK 13.
☐ **AGREE** ☐ **DISAGREE**

TO BE COMPLETED BY CONTRACTING OFFICER *(CHECK AS APPROPRIATE - SEE FAR 22.1019 (SERVICE CONTRACT LABOR STANDARDS) OR FAR 22.406-3 (CONSTRUCTION WAGE RATE REQUIREMENTS))*

☐ THE INTERESTED PARTIES AGREE AND THE CONTRACTING OFFICER RECOMMENDS APPROVAL BY THE WAGE AND HOUR DIVISION. AVAILABLE INFORMATION AND RECOMMENDATIONS ARE ATTACHED.

☐ THE INTERESTED PARTIES CANNOT AGREE ON THE PROPOSED CLASSIFICATION AND WAGE RATE. A DETERMINATION OF THE QUESTION BY THE WAGE AND HOUR DIVISION IS THEREFORE REQUESTED. AVAILABLE INFORMATION AND RECOMMENDATIONS ARE ATTACHED.

(Send 3 copies to the Department of Labor)

SIGNATURE OF CONTRACTING OFFICER OR REPRESENTATIVE	TITLE AND COMMERCIAL TELEPHONE NUMBER	DATE SUBMITTED

LABOR STANDARDS INTERVIEW

CONTRACT NUMBER	EMPLOYEE INFORMATION		
	LAST NAME	FIRST NAME	MI
NAME OF PRIME CONTRACTOR	STREET ADDRESS		
NAME OF EMPLOYER	CITY	STATE	ZIP CODE
SUPERVISOR'S NAME			
LAST NAME / FIRST NAME / MI	WORK CLASSIFICATION	WAGE RATE	

ACTION	CHECK BELOW YES	NO
Do you work over 8 hours per day?	☐	☐
Do you work over 40 hours per week?	☐	☐
Are you paid at least time and a half for overtime hours?	☐	☐
Are you receiving any cash payments for fringe benefits required by the posted wage determination decision?	☐	☐

WHAT DEDUCTIONS OTHER THAN TAXES AND SOCIAL SECURITY ARE MADE FROM YOUR PAY?

	TOOLS YOU USE	
HOW MANY HOURS DID YOU WORK ON YOUR LAST WORK DAY BEFORE THIS INTERVIEW?		
DATE OF LAST WORK DAY BEFORE INTERVIEW *(YYMMDD)*		
DATE YOU BEGAN WORK ON THIS PROJECT *(YYMMDD)*		

THE ABOVE IS CORRECT TO THE BEST OF MY KNOWLEDGE

EMPLOYEE'S SIGNATURE			DATE *(YYMMDD)*
INTERVIEWER	SIGNATURE	TYPED OR PRINTED NAME	DATE *(YYMMDD)*

INTERVIEWER'S COMMENTS

WORK EMPLOYEE WAS DOING WHEN INTERVIEWED	ACTION *(If explanation is needed, use comments section)*	YES	NO
	IS EMPLOYEE PROPERLY CLASSIFIED AND PAID?	☐	☐
	ARE WAGE RATES AND POSTERS DISPLAYED?	☐	☐

FOR USE BY PAYROLL CHECKER

IS ABOVE INFORMATION IN AGREEMENT WITH PAYROLL DATA?

☐ YES ☐ NO

COMMENTS

CHECKER

LAST NAME	FIRST NAME	MI	JOB TITLE
SIGNATURE			DATE *(YYMMDD)*

U.S. Department of Labor
Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions at www.dol.gov/whd/forms/wh347instr.htm)

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

U.S. Wage and Hour Division

Rev. Dec. 2008

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐	ADDRESS	OMB No.: 1235-0008 Expires: 01/31/2015

PAYROLL NO.	FOR WEEK ENDING	PROJECT AND LOCATION	PROJECT OR CONTRACT NO.

(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g., LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT. OR ST.	(4) DAY AND DATE / HOURS WORKED EACH DAY							(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS FICA	WITH-HOLDING TAX			OTHER	TOTAL DEDUCTIONS	(9) NET WAGES PAID FOR WEEK
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that is will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

(over)

Date _____

I, _____ _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)

_____; that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,

all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

_____

_____

_____

_____

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.

American Iron and Steel Certification

Project Name: _____

Period From: _____ **To:**_____

Section 436 of the Consolidated Appropriations Act, 2014 states that:

None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

To meet this requirement, the undersigned hereby certifies that all iron and steel products which are to be incorporated into the (Name of Construction Contract), has been manufactured and/or fabricated using domestic iron and steel as defined by the above referenced section 436 of P.L. 113-76 and EPA's Guidance Memorandum dated March 20, 2014 for Implementation of American Iron & Steel unless an appropriate waiver has been granted by the Administrator of the Environmental Protection Agency.

_____ _____
Name of Loan Recipient Date

_____
Signature of Authorized Official

_____
Print Name and Title of Authorized Official

NOTE: A current completed copy of the American Iron and Steel Products tracking spreadsheet MUST accompany this document.

COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

American Iron and Steel Certification

Borrower Name: _____

Contractor: _____

Project Number: _____ Date: _____

Procurement Date	Product Description	Quantity	Cost	*Type of Certification Used ~Manufacturer/Fabricating Shipment Wavier (Pick One)	New or Existing Certification

* used to verify chain of custody control for product
~ includes melting, bonding, coating, galvanizing, cutting, etc.

Work Change Directive

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

THIS IS NOT A CHANGE ORDER. Contractor is directed to submit an itemized proposal for changes in the Contract Sum/Time for the proposed modification to the Contract Documents described herein. Submit proposal within seven (7) days, or notify the Engineer in writing of the date on which you anticipate submitting your proposal.

Attachments (list documents supporting change):

The work described above will affect the project as summarized below. Include all costs of labor, materials, taxes, overhead, profit, time impact and all other changes and/or charges involved as required by the Contract Documents.

Estimated change in Contract Price and Contract Times:

Contract Price $_____ (increase/decrease) Contract Time _____ (increase/decrease) days

Contractor's Signature	Date
Recommended for Approval by Engineer:	Date
Authorized for Owner by:	Date
Received by Funding Agency (if applicable):	Date:

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

The Contract Documents are modified as follows upon execution of this Change Order:

Description:

Attachments (list documents supporting change):

CHANGE IN CONTRACT PRICE:	**CHANGE IN CONTRACT TIMES:**
Original Contract Price: $_____	Original Contract Times: ☐ Working days ☐ Calendar days Substantial completion (days or date): _____ Ready for final payment (days or date): _____
[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____: $_____	[Increase] [Decrease] from previously approved Change Orders No. _____ to No. _____: Substantial completion (days): _____ Ready for final payment (days): _____
Contract Price prior to this Change Order: $_____	Contract Times prior to this Change Order: Substantial completion (days or date): _____ Ready for final payment (days or date): _____
[Increase] [Decrease] of this Change Order: $_____	[Increase] [Decrease] of this Change Order: Substantial completion (days or date): _____ Ready for final payment (days or date): _____
Contract Price incorporating this Change Order: $_____	Contract Times with all approved Change Orders: Substantial completion (days or date): _____ Ready for final payment (days or date): _____

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (Authorized Signature)	By: _____ Owner (Authorized Signature)	By: _____ Contractor (Authorized Signature)
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable):

_____ Date: _____

Field Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

Attention:
You are hereby directed to promptly execute this Field Order issued in accordance with General Conditions Paragraph 9.04.A, for minor changes in the Work without changes in Contract Price or Contract Times. If you consider that a change in Contract Price or Contract Times is required, please notify the Engineer immediately and before proceeding with this Work.

Reference: _____ _____
(Specification Section(s)) (Drawing(s) / Detail(s))

Description: _____

_____

_____

_____

_____

_____

_____

Attachments: _____

_____

_____

Recommended for Approval by Engineer:	Date

Receipt Acknowledged by Contractor:	Date

Copy to Owner

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Work covered by contract documents

B. Work by others

C. Contractor use of site and premises

D. Work sequence

E. Easements and right-of-way

F. Protection of public and private property

G. Maintenance of traffic

H. Barricades and lights

I. Lines and grades

J. Regulatory requirements

K. Cutting and patching

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of this Contract consists all work performed will be in accordance with the bid documents. All necessary labor, supervision, equipment, tools, and materials related to the:
   1. Construction of a new headworks building and installation of headworks equipment including but not limited to influent flow measurement equipment, mechanical fine screen and manual bypass, grit removal and grit pumping, grit classification, pre-equalization, associated process piping, site work, demolition, electrical, and controls.
   2. Construction of new aerobic digestion tanks and solids handling buildings and installation of aerobic digestion and dewatering equipment including but not limited to aerobic digestion equipment, pumping, associated process piping, electrical, and controls. Relocation of the existing dewatering screw press and all ancillary equipment including but not limited to the polymer equipment, polymer conditioning tank, screw press, dewatered cake pump, and the associated process piping, site work, demolition, electrical, and controls for the dewatering system.
   3. Installation of the influent feed pumps and ancillary equipment in existing facilities and rehabilitation of existing digester area as a preliminary equalization basin.

B. Furnish and pay for all materials, equipment, supplies, appurtenances; provide all construction equipment and tools; and perform all necessary labor and supervision

C. Coordinate the progress of the Work including coordination between trades, subcontractors, suppliers, public utilities and subsequent building contractor performing work on site and Owner to insure the progress of Work

D. It is the intent of this contract that Work proceed in the most expeditious manner possible.

E. Construct the Work under contract indicated in the Bid Form

1.3 WORK BY OTHERS

A. City manned plant operating times
   1. 8.5 hours per day (7 am – 3:30 pm), 7 days per week

1.4 CONTRACTOR USE OF SITE AND PREMISES

A. Contractor shall limit use of the premises for Work and will use the designated staging area for field offices, equipment, and material storage. Areas have been designated for contractor's use.

B. Coordinate use of premises under direction of Engineer and/or Owner

C. Assume full responsibility for the protection and safekeeping of equipment and products stored on site under this Contract

D. Contractor may use only those areas indicated on the Drawings for storage and such additional areas as Engineer may designate

E. Contractor should plan for normal work days, Monday through Friday, within the hours of 7:00 am to 6:00 pm. Other work hours and days may be allowed by City and Engineer upon 48 hours written notice.

1.5 WORK SEQUENCE

A. Coordinate construction schedule with the Owner

B. Contractor to submit his intended sequence of construction with schedule

C. The Owner's WWTP is a fully functioning wastewater treatment plant and remain in full operation throughout the course of the project

D. The dewatering equipment is currently operational. Dewatering equipment shall be moved to limit interruption to current WWTP operation after all ancillary equipment is installed and functional. Contractor shall coordinate with Owner and Engineer at least 14 days in advance of moving any critical dewatering equipment. Contractor shall

coordinate with Owner and Engineer for any transfer of equipment not critical to dewatering operation

E. New equipment and processes will be tied into existing treatment train only after new equipment and processes have been verified fully functional and operational by Engineer and Owner. Tie-in shall be coordinated with Owner and Engineer at least 30 days prior to scheduled tie-in date

F. Provide open access for Owner to property at all times during construction. Maintain minimum width clearance for access of City and Contractor personnel and emergency vehicles at all times

G. Sequences other than those specified will be considered by Engineer, provided they afford equivalent continuity of operations

H. All shutdowns shall be submitted in a written plan for review and acceptance by City and Engineer at least 14 days in advance of planned shut down. Any process or electrical shut downs should not exceed 4 hours without prior approval from City and Engineer.

1.6 EASEMENTS AND RIGHT-OF-WAY

A. Work will be performed within City property and/or easements

B. Confine construction operations to the immediate vicinity of the location indicated on drawings and use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies, so as to cause the least possible damage to property

C. On Private Property
   1. Do not enter for material delivery or occupy for any purpose with personnel, tools, equipment, construction materials, or excavated materials, any private property outside the designated construction easement without written permission of the City

D. Within Street Right-of-Way
   1. Perform all work and conduct all operations of Contractor, his employees, and his subcontractors in accordance with the requirements of the City of Idaho Springs

E. Care shall be taken for work in existing cell tower easement

1.7 PROTECTION OF WORK AND FACILITIES

A. Contractor shall be solely responsible for the protection of Work until final acceptance

B. Contractor shall protect all and any previously performed Work, work in progress or completed by others, and existing facilities from damage during the performance of Work in the area

1.8 PROTECTION OF PUBLIC AND PRIVATE PROPERTY

A. Protect, shore, brace, support, and maintain underground conduits, drains, and other underground construction uncovered or otherwise affected by construction operations

B. Contractor shall be responsible for all damage to streets, roads, highways, shoulders, street lighting and/or signage, embankments, culverts, location or character, which may be caused by transporting equipment, materials, or personnel to or from the Work or any part or site thereof, whether by him or his subcontractors

C. Make satisfactory and acceptable arrangements with the Owner of, or the agency or authority having jurisdiction over, any damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage

1.9 MAINTENANCE OF TRAFFIC

A. Conduct Work to interfere as little as possible with City and public travel, whether vehicular or pedestrian
   1. Whenever it is necessary to cross, close, or obstruct private roads, driveways and walks, provide and maintain suitable and safe detours, or other temporary expedients for accommodation of private travel

1.10 BARRICADES AND LIGHTS

A. Protect streets, roads, highways, and other public thorough fares which are closed to traffic by effective barricades with acceptable warning and directional signs

B. Locate barricades at the street intersecting public thoroughfare on each side of the blocked section

C. Provide suitable barriers, signs, and lights to the extent required to adequately protect the public

D. Provide similar warning signs and lights at obstructions such as material piles and equipment

E. Illuminate barricades and obstructions with warning lights from sunset to sunrise

F. Store materials and conduct work to cause the minimum obstruction to the other contracts

1.11 LINES, GRADES AND SURVEY

A. Construct all Work to the lines, grades, and elevations indicated on the Drawings
   1. Contractor is responsible for correcting all incorrect grades or grades not meeting specified tolerances

B. Engineer has established basic horizontal and vertical control points in the Drawings
   1. Use these points as datum for the Work

2. Provide such competent personnel and tool, stakes, and other materials as Engineer may require in establishing or designating control points, in establishing construction easement boundaries, or in checking layout survey, and measurement work performed by Contractor

C. Provide all additional survey, layout, and measurement work required
   1. Work performed by a qualified professional engineer or registered land surveyor acceptable to Engineer
   2. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction
      a. Make no changes or relocations without prior written notice to Engineer
      b. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations
      c. Require surveyor to replace Project control points which may be lost or destroyed
      d. Establish replacements based on original survey control
   3. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means
      a. Temporary project benchmark
      b. Stakes for grading, fill and topsoil placement
      c. Utility slopes and invert elevations
   4. From time to time, verify layouts by the same methods
   5. Maintain a complete, accurate log of all control and survey work as it progresses
   6. On request of Engineer, submit documentation to verify accuracy or field engineering work

1.12 REGULATORY REQUIREMENTS

A. Comply with all federal, state, and local laws, regulations, codes, and ordinances applicable to the Work

B. References in the Contract Document to local codes shall mean the codes in effect in the City of Idaho Springs, Clear Creek County, Colorado

C. Other standards and codes which apply to the Work are designated in the specific technical specifications

1.13 CUTTING AND PATCHING

A. Contractor shall be responsible for all cutting, and patching, including attendant excavation and backfill, required to complete the Work or to
   1. Uncover portions of the Work to provide for installation of ill-timed work
   2. Remove and replace defective work
   3. Remove and replace work not conforming to requirements of Contract Documents
   4. Remove samples of installed work as specified for testing

B. Provide products as specified or as required to complete cutting and patching operations

C. Inspection

1. Inspect existing conditions of the Project, including elements subject to damage or to movement during cutting and patching
2. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work
3. Report unsatisfactory or questionable conditions to the Engineer in writing; do not proceed with the work until the Engineer has provided further instructions

D. Preparation
1. Provide devices and methods to protect other portions of the Project from damage
2. Provide protection from the elements for that portion of the Project which may be exposed by cutting and patching work, and maintain excavations free from water
3. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes
4. Restore work which has been cut or removed; install new products to provide completed Work in accord with requirements of Contract Documents

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01020

GEOTECHNICAL REPORT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Reports of explorations and tests of subsurface conditions at the project site.

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 02300 – Earthwork

1.3 INVESTIGATION

A. Soil and subsurface investigations were conducted at the site, the results of which are to be found in the report issued by Terracon Consultants, Inc., "Geotechnical Engineering Report – Proposed Idaho Springs Wastewater Treatment Plant Expansion," 10/03/2018.

B. A reference copy of the report is included herein, Supplement A (01020)

C. Bidders are expected to examine soils investigation data and to make their own investigation of the site on or prior to the bid date.

1.4 INTERPRETATION

A. Soil investigation data is provided only for information and the convenience of bidders. Owner and Engineer disclaim any responsibility for the accuracy, true location, and extent of the soils investigation that has been prepared by others. They further disclaim responsibility for interpretations of that data by bidders, as in projecting soil-bearing values, rock profiles, soil stability and the presence, and level and extent of underground water.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

Geotechnical Engineering Report

Proposed Idaho Springs Wastewater Treatment Plant Expansion

980 County Road 314

Idaho Springs, Colorado

October 3, 2018

Terracon Project No. 25185147

Prepared for:

JVA, Incorporated
Denver, Colorado

Prepared by:

Terracon Consultants, Inc.
Wheat Ridge, Colorado

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

October 3, 2018

JVA, Incorporated
1319 Spruce Street
Boulder, Colorado 80302

Attn: Mr. Michael Katalinich, P.E.
E: mkatalinich@jvajva.com
O: 303.565.4952

Re: Geotechnical Engineering Report
Proposed Idaho Springs Wastewater Treatment Plant Expansion
980 County Road 314
Idaho Springs, Colorado
Terracon Project No. 25185147

Mr. Katalinich:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering exploration for the above referenced project. This study was performed in general accordance with our proposal number P25185147, dated May 18, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of the proposed improvements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

COLORADO REGISTERED
WILLIAM D. RETHAMEL
36508
10/3/18
PROFESSIONAL ENGINEER

William D. Rethamel, P.E.
Senior Project Engineer

Scott B. Myers, P.E.
Geotechnical Department Manager

Enclosures
cc: Addressee (PDF)
1 - File

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
1.0 INTRODUCTION 1
2.0 PROJECT INFORMATION 2
2.1 Project Description 2
2.2 Site Location and Description 2
2.3 Previous Study 3
3.0 SUBSURFACE CONDITIONS 3
3.1 Typical Profile 3
3.2 Groundwater 4
4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION 5
4.1 Geotechnical Considerations 5
4.1.1 Existing Fill Materials 5
4.1.2 Dewatering 6
4.1.3 Loose Soils 6
4.1.4 Existing Structures 6
4.1.5 Shoring 7
4.1.6 Deep Backfill Zones 7
4.1.7 Difficult Excavation 7
4.2 Earthwork 7
4.2.1 Site Preparation 8
4.2.2 Material Types 8
4.2.3 Compaction Requirements 9
4.2.4 Excavation and Trench Construction 10
4.2.5 Grading and Drainage 10
4.2.6 Earthwork Construction Considerations 11
4.2.7 Corrosion Test Results 11
4.3 Foundation Recommendations 12
4.3.1 Footing/Mat Foundation Recommendations 12
4.3.2 Buoyancy 15
4.4 Thrust Block Recommendations 15
4.5 Seismic Considerations 16
4.6 Interior Floors 16
4.6.1 Interior Floor Recommendations 16
4.7 Exterior Flatwork 17
4.7.1 Exterior Flatwork Recommendations 17
4.8 Lateral Earth Pressures 18
5.0 GENERAL COMMENTS 20

TABLE OF CONTENTS, CONTINUED

APPENDIX A – FIELD EXPLORATION

Exhibit A-1	Field Exploration Description
Exhibit A-2	Site Location
Exhibit A-3	Aerial Image Exploration Plan
Exhibit A-4	Boring Location Plan
Exhibits A-5 to A-8	Boring Logs

APPENDIX B – LABORATORY TESTING

Exhibit B-1	Laboratory Testing Description
Exhibits B-2 to 3	Grain Size Distribution
Exhibit B-4	Summary of Laboratory Test Results

APPENDIX C – SUPPORTING DOCUMENTS

Exhibit C-1	General Notes
Exhibit C-2	Unified Soil Classification

EXECUTIVE SUMMARY

A geotechnical engineering exploration has been prepared for the proposed Idaho Springs Wastewater Treatment Plant (WWTP) Expansion at 980 County Road 314 in Idaho Springs, Colorado. Based on the information obtained from our subsurface exploration and the laboratory testing completed, the site appears suitable for the proposed construction; however, the following geotechnical conditions will need to be considered:

- Up to about 12 feet of fill was encountered on the subject site. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer. It is our opinion the existing fill should not be used to support foundations, interior slabs, or exterior slabs-on-grade without complete removal and modification. If a higher risk of movement can be tolerated, support of exterior slabs and non-building improvements on the existing fill materials can be considered, provided a portion of the existing fill materials are overexcavated, processed, moisture conditioned and recompacted. We anticipate that the existing fill materials can be reused for support of shallow foundations and slabs-on-grade, provided any deleterious fill materials are removed.

- Groundwater was encountered at depths of 14.1 to 19 feet during the field exploration. We understand improvements extending 15 feet or more below grade are planned. Construction of below-grade tanks or improvements will require dewatering during construction and for the life of the structures. If permanent dewatering is not provided around below-grade tanks or below-grade elements, the tanks and/or below-grade elements must be designed to resist buoyancy forces.

- Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, it is our opinion the proposed building and improvements may be constructed on spread footing foundation systems constructed on native soils or new engineered fill, provided all existing fill materials are removed to native soils, moisture conditioned and placed as new fill, and provided the owner is willing to accept the risk of movement. Non-building improvements that are more tolerant of movement may be constructed on spread footings on a zone of modified existing fill, provided the owner can tolerate higher amounts of movement. Alternatively, if the owner is not willing to accept the risk of movement associated with shallow foundation systems, the proposed building and improvements may be constructed on micropile foundation systems.

- Slabs-on-grade may be utilized for the interior floor systems provided slabs are constructed on native soils or new engineered fill, all existing fill is removed to native soils and/or modified, and provided some slab movement can be tolerated. If higher amounts of slab movement can be tolerated, consideration could be given to modifying a portion of the existing fill.

- Based on the proximity to existing structures and infrastructure, if the existing fill is to be removed and replaced with new engineered fill, excavation slopes may not be able to be safely excavated in accordance with Occupational Health and Safety Administration (OHSA) recommendations and temporary shoring may be required if full-depth removal is desired.

- Loose soils may be encountered on the site. Prior to placing fill or constructing the foundation on soft/loose subgrade soils, it may be necessary to stabilize these soils with several passes of relatively heavy construction equipment along the bottom of the excavation to densify these materials.

- Based on the 2015 International Building Code, Section 1613.3.2, the seismic site classification for this site is D.

- Existing fill materials will generally be encountered beneath exterior flatwork. To reduce distress and maintenance of the associated flatwork and enhance performance, where existing fill is encountered, we recommend a portion of the fill be modified by overexcavation, processing, moisture conditioning and recompacting prior to construction.

- The amount of movement associated with foundations will be related to the wetting of the underlying soils. Therefore, it is imperative the recommendations outlined in the **Grading and Drainage** section of this report be followed to reduce potential movement. Moisture conditioning and/or replacement of the native soils should follow the recommendations outlined in the **Earthwork** section of this report.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED IDAHO SPRINGS WASTEWATER TREATMENT PLANT EXPANSION
980 COUNTY ROAD 314
IDAHO SPRINGS, COLORADO

Terracon Project No. 25185147
October 3, 2018

1.0 INTRODUCTION

A geotechnical engineering report has been prepared for the proposed expansion to the existing Idaho Springs wastewater treatment plant located at 980 County Road 314 in Idaho Springs, Colorado.

As part of our subsurface exploration, four borings (designated as Boring Nos. 1 to 4) were drilled at the site to depths of about 30 to 40 feet below existing site grade. Boring Logs along with a Boring Location Plan is included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater levels
- Earthwork
- Drainage
- Lateral earth pressures
- Seismic site classification
- Foundation design and construction
- Floor slab design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Proposed construction	We understand the proposed project will consist of the design and construction of a new wastewater treatment building and process tank. Structures will include a new headworks consisting of an open channel structure about 10 to 15 feet below grade, with new digester tanks that could be 23 feet deep, extending about 8 to 10 feet below grade. A treatment building will be constructed above or adjacent to the tank. We assume the headworks and tanks will be constructed using cast-in-place reinforced concrete. We understand the treatment building will be a pre-engineered metal building.
Anticipated foundation systems	Spread footing or mat foundation
Below grade areas	The headworks will extend about 10 to 15 feet below grade, and the digester tanks will extend about 8 to 10 feet below grade.
Maximum loads	Columns: 10 to 20 kips (assumed) Walls: 1 to 3 klf (assumed) Slabs: 100 to 200 psf (assumed)
Grading	Cut and fill, about 3 feet (+/-) max (assumed)
Excavation depth	We anticipate that excavations of up to 12 to 17 feet may be required for the tanks and headworks structure, respectively.
Free-standing retaining walls	None anticipated
Infrastructure	Installation of underground utilities within about 5 to 8 feet of finished site grades.

2.2 Site Location and Description

Item	Description
Location	The existing Idaho Springs Wastewater Treatment Plant is located at 980 County Road 314 in Idaho Springs, Colorado. The general location of the proposed project is 39.7437° N 105.4770° W.

Item	Description
Existing improvements	The subject site consists of an existing wastewater treatment plant (WWTP), with a recently annexed property to the west. We understand the WWTP was constructed in 1984. The WWTP consists of a single-story building with a below grade digester tank. Plans indicate the tank extends to the south of the existing single-story portion of the building, to a depth of about 18 feet below existing grade. The western annexed property contains some concrete-walled storage bins, three above-grade fuel or natural gas tanks, and a two to three story industrial building. We are not aware of any below-grade areas within the existing structure.
Current ground cover	Ground cover in the area of the proposed project consists of an aggregate-surfaced access road and storage yard.
Existing topography	The site is generally level with a slight slope down towards the east with an elevation difference of about 5 feet or less.

2.3 Previous Study

Terracon Consultants, Inc. performed a geotechnical report for improvements to the existing wastewater treatment plant in a report dated March 3, 2017 (Terracon Project No. 25175027). Pertinent data from our previous study was reviewed and considered during preparation of this report.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the borings, subsurface conditions on the site can be generalized as follows:

Material Description	Approximate Depth to Bottom of Stratum below Existing Site Grade	Consistency/ Relative Density/ Hardness
Asphalt	About 4 inches, Boring No. 3 only	N/A
Apparent aggregate base course	About 1 to 2 inches, None in Boring No. 3	N/A
Existing fill consisting of sand with varying amounts of clay, silt and gravel	About 7 to 12 feet	Variable
Native soils consisting of sand with varying amounts of clay, silt, gravel and cobble, or gravel with varying amounts of silt, sand, cobbles and boulders	About 23 to 27 feet	Loose to very dense
Native soils consisting of boulders and cobbles with varying amounts of sand and gravel	About 30 to 40 feet, Maximum depths explored	Very dense

Stratification boundaries on the boring log represent the approximate location of changes in soil and material types; in-situ, the transition between materials may be gradual. Further details of the borings can be found on the Boring Logs in Appendix A.

Based on our experience the sand fill and native sand/gravel/cobble/boulder soils are considered to be essentially non-expansive. A summary of laboratory test results is included in Appendix B.

3.2 Groundwater

The borings were observed for groundwater while drilling. The groundwater levels are noted on the Boring Logs, and are summarized below.

Boring No.	Shallowest depth to groundwater while drilling or immediately after drilling	Depth to groundwater on 9/28/18 in selected boring completed as monitoring well
1**	17 feet	18.4 feet
2	14.1 feet	N/A*
3	19 feet	N/A*
4	15 feet	N/A*

* Due to safety concerns, boring was backfilled after obtaining initial groundwater measurement and subsequent groundwater measurements were not obtained.
** After drilling, a temporary monitoring well was installed in the boring.

This observation represents the groundwater condition at the time of the field exploration, and may not be indicative of other times or at other locations. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions.

Zones of perched and/or trapped groundwater may also occur at times in the subsurface soils overlying bedrock, on top of the bedrock surface or within permeable fractures in the bedrock materials. The location and amount of perched water is dependent upon several factors, including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, fluctuations in water features, seasonal and weather conditions.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. Groundwater levels during construction or at other times in the life of the structure may be higher or lower than the level indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on subsurface conditions encountered in the borings, the site appears suitable for the proposed construction from a geotechnical point of view provided certain precautions and design and construction recommendations outlined in this report are followed. We have identified geotechnical conditions that could impact design and construction of the proposed structures.

4.1.1 Existing Fill Materials

Up to about 12 feet of fill materials was encountered in the borings drilled at the subject site. It should be noted that fill depths presented in the boring logs are approximate and the depth and composition of fill should be expected to vary. We do not possess any information regarding whether the fill was placed under the observation of a geotechnical engineer.

Based upon the results of our field exploration and laboratory testing, it is our opinion the existing fill should not be used to support foundations, interior slabs, or exterior slabs-on-grade construction without complete removal and modification.

If the owner is willing to accept a higher risk of movement for non-building foundations, interior slabs and exterior flatwork, consideration could be given to overexcavating a portion of the existing fill materials below these elements, compacting the base of the overexcavation using a large vibratory roller, and moisture conditioning and compacting the material back to grade.

It should be noted that there exists the potential for construction debris and/or domestic trash to be encountered within the fill on some portions of the site. Because construction debris was not encountered within the borings, the potential for encountering construction debris and/or domestic trash is considered to be low. The fill materials should be observed for the presence of trash and debris during site grading and construction.

The existing fill can be reused as engineered fill below foundations and slabs-on-grade, provided any deleterious materials are removed and some movement can be tolerated. Some removal and replacement may be required if unsuitable or soft materials are exposed.

4.1.2 Dewatering

Groundwater was measured in all borings at depths of about 14.1 to 19 feet below existing ground surface at the time of our field exploration. We understand improvements extending 15 feet or more below grade are planned. Based on the proposed construction, groundwater will be encountered during construction, and will require dewatering both during construction and for the life of the structures. Based on the subsurface conditions and depth to groundwater, aggressive dewatering systems such as well points will likely be required during construction. A specialty dewatering contractor should be consulted to design an appropriate dewatering system for the project.

We anticipate permanent dewatering will most likely not be provided around below-grade tanks or below-grade elements. Below-grade structures must be designed to resist buoyancy forces if permanent dewatering is not provided. Additional recommendations are presented in the **Buoyancy** section of this report.

4.1.3 Loose Soils

Subsurface conditions encountered in the borings indicate that loose soils may be locally present. Consequently, loose soils could be encountered below foundations at bearing depth. Prior to placing fill or constructing the foundation on soft/loose, subgrade soils, it may be necessary to stabilize these soils by several passes of relatively large, vibratory construction equipment along the bottom of the excavation to densify these materials.

4.1.4 Existing Structures

We anticipate the existing building will remain, but the storage bin structures will be demolished and removed. Demolition of the existing structures should include the removal of foundation systems and existing fill associated with the structures.

Existing foundation systems should be completely removed. In the unlikely event drilled pier foundations are encountered, the existing piers should be truncated a minimum depth of 3 feet below areas of planned new construction. If piers are encountered, the contractor should consider surveying existing pier locations so new construction does not encounter abandoned pier locations.

In addition, existing utilities associated with the current structures (if any) should be completely removed or fully grouted in-place.

All materials derived from the demolition of the existing foundations and exterior flatwork should be removed from the site and should not be allowed for use in any on-site fills, unless the materials are properly processed and meet the criteria presented in the **Import Material Specifications** section of this report.

4.1.5 Shoring

Based on the proximity to existing improvements, if excavation slopes cannot be safely excavated in accordance with Occupational Safety and Health Administration (OHSA) recommendations, shoring may be required. The depth of excavation and location of adjacent utilities and existing improvements will influence the type of shoring system that may be used. Shoring systems commonly used in similar site and subsurface conditions include soil nails, soldier post and lagging, etc. A qualified shoring contractor should design and install the shoring system.

4.1.6 Deep Backfill Zones

If full-depth removal of the existing fill is desired, excavation of the existing fill to native soils will result in excavations and backfills exceeding 12 feet. We understand the digester tanks and other improvements may extend up to 15 feet or more below grade, with backfills expected to be of similar depth. The magnitude of settlement of the deep backfill zones associated with the tank and improvement construction will be directly related to the type of fill material used, the degree of compaction, and the thickness of the fill zone. If the on-site sand soils are used as the fill material, the settlement of fill zones about 15 feet or less in thickness are estimated to be about 1 to 2 inches. This assumes that the degree of compaction for fill zones is maintained in accordance with this report. Using clean angular gravel or flowable fill for backfill could reduce settlement.

4.1.7 Difficult Excavation

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. However, specialized heavy-duty equipment may be required for excavation into the cobble and boulders to facilitate rock break-up and removal. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

4.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. All earthwork on the project should be observed and evaluated by Terracon.

4.2.1 Site Preparation

Stripped materials consisting of demolition debris (not meeting the criteria presented in **Material Types** section of this report), unsuitable fills and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

The site should be initially graded to create a relatively level surface to receive fill and to provide for a relatively uniform thickness of fill beneath the proposed structures. All exposed areas that will receive fill, once properly cleared, should be scarified to a minimum depth of 12 inches, conditioned to near optimum moisture content and compacted. It is imperative the moisture content of prepared materials be protected from moisture loss.

Although evidence of underground facilities such as basements was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. However, specialized heavy-duty equipment may be required for excavation into the cobble and boulders to facilitate rock break-up and removal. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

The stability of subgrade soils may be affected by precipitation and seasonal groundwater conditions, repetitive construction traffic or other factors. Where unstable conditions are encountered or develop during construction, workability may be improved by overexcavation of wet zones and mixing these soils with crushed gravel or recycled concrete and recompaction. Lightweight excavation equipment may be required to reduce subgrade pumping.

4.2.2 Material Types

Fill for this project should consist of engineered fill. Engineered fill is fill that meets the criteria presented in this report and has been properly documented.

Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable location for placement
On-site sand and gravel soils	SC, SM, SP-SM, SP, GP-GP, GP	On-site sand and gravel soils are considered suitable for reuse as compacted fill below foundations, slabs-on-grade and as general fill.
Processed demolition debris (concrete) mixed with sand or gravel soils[4]	--	Properly processed concrete is considered suitable for reuse as compacted fill below interior and exterior slabs-on-grade and general fill.

Fill Type [1]	USCS Classification	Acceptable location for placement
Imported soils	Varies	Imported soils meeting the gradation outlined herein can be considered acceptable for use as engineered fill beneath foundation areas.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Care should be taken during the fill placement process to avoid zones of dis-similar fill. Improvements constructed over varying fill types are at a higher risk of differential movement compared to improvements over a uniform fill zone.
3. Demolition debris (concrete) should be processed to maximum individual particle size of 3 inches and blended with on-site soils prior to reuse at a ratio of 50 percent concrete debris to 50 percent soil. We are aware of instances in which demolition debris had environmental concerns. Assessment of environmental conditions is outside the scope of this investigation.

Imported soils for general fills (if required) should meet the following material property requirements:

Gradation	Percent finer by weight (ASTM C136)
3”	100
No. 4 Sieve	50-100
No. 200 Sieve	< 30

- Liquid Limit……30 (max)
- Plasticity Index……..15 (max)
- Maximum Expansive Potential (%)……..1.0*

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at optimum water content. The sample is confined under a 200 psf surcharge and submerged.

4.2.3 Compaction Requirements

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

Item	Description
Fill lift thickness	8-inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6-inches in loose thickness when hand-guided equipment (e.g. jumping jack, plate compactor) is used
Compaction requirements [1]	Minimum of 98% of the material's standard Proctor maximum dry density (ASTM D698)
Moisture content cohesionless soil (sand and gravel) [2]	-3 to +3 % of the optimum moisture content

1. We recommend that engineered fill be tested for water content and compaction during placement. Should the results of the in-place density tests indicate the specified water or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified water and compaction requirements are achieved.

4.2.4 Excavation and Trench Construction

Excavations into the subsurface soils will encounter a variety of conditions. The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required maintaining stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current Occupational Safety and Health Administration (OSHA) excavation and trench safety standards.

Soils penetrated by the proposed excavations may vary significantly across the site. The soil classifications are based solely on the materials encountered in the exploratory borings. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

4.2.5 Grading and Drainage

All grades must be adjusted to provide positive drainage away from the structures during construction and maintained throughout the life of the proposed project. Infiltration of water into utility or foundation excavations must be prevented during construction. Water permitted to pond near or adjacent to the perimeter of the structures (either during or post-construction) can result in significantly higher soil movements than those discussed in this report. As a result, any estimations of potential movement described in this report cannot be relied upon if positive drainage is not obtained and maintained, and water is allowed to infiltrate the fill and/or subgrade.

Exposed ground should be sloped at a minimum of 5 percent grade for at least 10 feet beyond the perimeters of the structure. Backfill against footings and in utility trenches should be well compacted and free of all construction debris to reduce the possibility of water infiltration. After building construction and prior to project completion, we recommend that verification of final

grading be performed to document that positive drainage, as described above, has been achieved.

Where paving or flatwork abuts the structure, care should be taken that joints are properly sealed and maintained to prevent the infiltration of surface water.

4.2.6 Earthwork Construction Considerations

Upon completion of grading operations, care should be taken to maintain the moisture content of the subgrade. Construction traffic over prepared subgrade should be minimized and avoided to the extent practical. Construction traffic over processed clay subgrade will eventually reduce the moisture content and increase the density of the subgrade. Subsequent wetting of these materials will result in undesirable movement.

The site should also be graded to prevent ponding of surface water on prepared subgrade or in excavations. In areas where water is allowed to pond over a period of time, the affected area should be removed and allowed to dry out.

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Should unstable subgrade conditions develop, stabilization measures will need to be employed. Options for subgrade stabilization can include removal of unsuitable material and replaced with approved fill material. An alternative can include the use of Tensar BX-1200 geogrid (or approved equivalent) overlain by Colorado Department of Transportation (CDOT) Class 5 or 6 aggregate base course. The depth of aggregate base course will depend on the severity of unstable soils.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during overexcavation operations, excavations, subgrade preparation; placement and compaction of controlled compacted fills, and backfilling of excavations into the completed subgrade.

4.2.7 Corrosion Test Results

The table below lists the results of electrical resistivity, pH testing, and water-soluble sulfate. These values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials that will be used for project construction, and should be considered during design and construction of underground materials.

Boring	Depth (feet)	Soluble Sulfate[1] (%)	pH	Electrical Resistivity (ohm.cm)
1	0 to 5	<0.10	8.1	4,600
4	0 to 5	<0.10	8.6	11,000

1. Results of water-soluble sulfate testing indicate that samples of the on-site soils have an exposure class of S0 when classified in accordance with Table 4.2.1 of the ACI Design Manual. The results of the testing indicate ASTM Type I Portland Cement is suitable for project concrete in contact with on-site soils. However, if there is no (or minimal) cost differential, use of ASTM Type II Portland Cement is recommended for additional sulfate resistance of construction concrete. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

4.3 Foundation Recommendations

Based upon the results of the field exploration and laboratory testing program, the following foundation systems were evaluated for use in supporting the proposed building and improvements:

- Shallow spread footing/mat foundation constructed on new engineered fill
- Micropiles

Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, it is our opinion the proposed treatment building and improvements may be constructed on spread footing or mat foundation systems constructed on native soils or new engineered fill, provided all existing fill materials are removed to native soils, moisture conditioned and placed as new fill, and provided the owner is willing to accept the risk of movement.

If the building and improvements are more tolerant of movement, these structures may be constructed on spread footings on a zone of modified existing fill, provided the owner is willing to accept higher amounts of movement.

If the owner is not willing to accept the risk of movement associated with shallow foundations, the proposed structures may be constructed on a micropile foundation system bottomed in the native soils underlying the fill. We can provide design and construction criteria for a micropile foundation system, if desired.

4.3.1 Footing/Mat Foundation Recommendations

Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, the proposed building and improvements may be constructed on spread footing or mat foundation systems bottomed on new engineered fill, provided the owner understands and is willing to accept the associated risk of movement for each alternative.

Design recommendations for spread footing foundation systems are presented in the following paragraphs.

Description	Value	
Material at base of footing excavation	Native soils or new engineered fill over native soils	New engineered fill over existing fill
Overexcavation/modification depth	All fill below foundations (must be overexcavated to native soils and replaced with engineered fill.	Minimum of 3 feet below lowest foundation element
Supporting stratum	Native soil or new engineered fill over native soils	Zone of new engineered fill over existing fill materials
Maximum net allowable bearing pressure	2,500 psf [1,2]	2,000 psf
Minimum dead load pressure	N/A	N/A
Void Thickness, if needed	N/A	N/A
Modulus of subgrade reaction	35 pci	11 pci
Coefficient of friction (sliding)	0.4	0.4
Minimum footing dimensions	Isolated footings: 24 inches Continuous footings: 16 inches	
Minimum embedment below finished grade for frost protection [3]	3 feet	
Approximate total movement from foundation loads [4]	Less than about 1 inch	About 1 to 2 inches
Estimated differential movement from foundation loads [4,5]	About ½ to ¾ inch	About ¾ to 1 inch

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any existing fill or lower strength soils, if encountered, will be excavated and replaced with engineered fill as recommended in this table.
2. Maximum allowable soil bearing pressure can be increased by 1/3 for transient loading conditions.
3. For perimeter footings, footings beneath unheated areas, and footings that will be exposed to freezing conditions during construction. Interior footings may bottom at a minimum depth of 12 inches below finished grade in heated areas.
4. Foundation movement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of engineered fill, and the quality of the earthwork operations and footing construction.
5. Differential settlement is considered over a distance of about 40 feet.

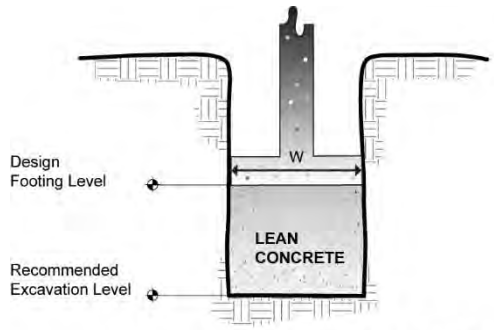
Footings should be proportioned on the basis of equal total dead load pressure to reduce differential movement between adjacent footings. Additional foundation movements greater than those presented in the previous table could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction and throughout the life of the structure. Failure to maintain the proper drainage as recommended in the **Grading and Drainage** section of this report will nullify the movement estimates provided above.

The footing/mat foundation system should only be considered if all existing fill is removed to native soils or if a portion of the existing fill is modified as described previously, and provided some foundation movement (as associated with each option) can be tolerated.

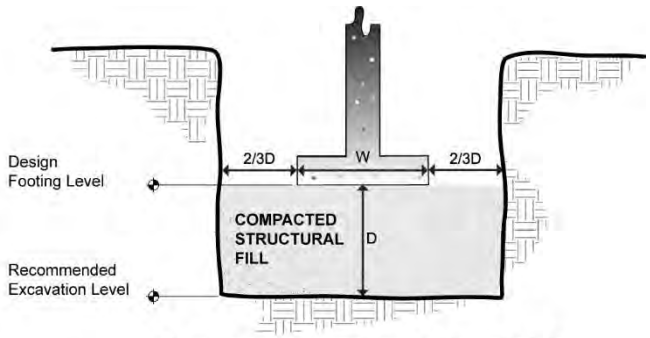
Unstable subgrade conditions may be encountered at the base of the footing/mat excavations. Unstable surfaces will need to be stabilized prior to backfilling excavations and/or constructing spread footings. The use of angular rock, recycled concrete and/or gravel pushed into the yielding subgrade is considered suitable means of stabilizing the subgrade. The use of bi-axial geogrid materials in conjunction with gravel could also be considered and could be more cost effective.

Unstable subgrade conditions should be observed by the geotechnical engineer to assess the subgrade and provide suitable alternatives for stabilization. Stabilized areas should be proofrolled prior to continuing construction to assess the stability of the subgrade.

Overexcavation below new foundation elements should extend laterally beyond all edges of the outside footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with approved fill placed in lifts of 8 inches or less in loose thickness (6 inches or less if using hand-guided compaction equipment) and compacted to at least 98 percent of the material's standard effort maximum dry density (ASTM D698). The overexcavation and backfill procedures are illustrated in the following figures.



Lean Concrete Backfill



Overexcavation / Backfill

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

The base of all foundation excavations should be free of water and loose soil prior to concrete placement. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, or frozen, the affected soil should be removed prior to placing concrete.

Footings, foundations and masonry walls should be detailed and reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

4.3.2 Buoyancy

Groundwater was encountered at depths of 14.1 to 19 feet during the field exploration. We understand improvements extending 15 feet or more below grade are planned. We do not anticipate that permanent dewatering will be provided for the below grade tanks or other improvements. Because permanent dewatering will most likely not be provided around below grade tanks or below grade elements, the tanks and/or below grade elements must be designed to resist buoyancy forces. We recommend the tanks and/or below grade elements be designed to resist buoyancy forces calculated by assuming water will be at the exterior ground surface.

4.4 Thrust Block Recommendations

It is not known at this time whether thrust blocks will be constructed for the proposed facility. However, we have provided the following recommendations if they are included. Thrust blocks bearing on and against undisturbed natural soils or properly compacted fill/backfill can be evaluated and designed using the following parameters. Stabilization of thrust block excavations may be required where loose soils are encountered.

Description	Design Parameter
Bearing material	Native soils or properly compacted engineered fill
Allowable soil bearing pressure[1]	2,000 psf
Ultimate passive pressure [2]	275 psf/ft
Ultimate Coefficient of sliding friction [2]	0.4 times the vertical dead load

1. The allowable soil bearing pressure applies to dead loads plus design live load conditions. Unstable soils, if encountered, should be removed and replaced with engineered fill or stabilized by other suitable methods. Terracon should be contacted to provide site specific recommendations if unstable soils are encountered in thrust block excavations.
2. For evaluating resistance to lateral movement (or sliding) of thrust blocks. The sides of the excavation must be nearly vertical and concrete should be placed neat against these vertical faces or backfill must be compacted to at least 95 percent of the standard Proctor maximum dry density for the passive earth pressure values to be valid. Passive pressure requires movement to generate the resistance and should only be used when movement is tolerable and the soil is well compacted and will not be removed. The passive resistance and friction factor are ultimate values. As such, appropriate factors of safety should be applied.

4.5 Seismic Considerations

Based on our subsurface exploration and laboratory testing, it is our opinion that the soils have a low risk of liquefaction. The following table presents the seismic site classification based on the 2015 International Building Code:

Code Used	Site Classification
2015 International Building Code (IBC) [1]	D

1. In general accordance with the *2015 International Building Code*, Section 1613.3.2.
2. The 2015 International Building Code (IBC) requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100-foot soil profile determination. The deepest boring of this exploration extended to a maximum depth of about 40 feet and this seismic site class definition considers that similar soil conditions exist below the maximum depth of the subsurface exploration. Additional exploration to deeper depths could be performed to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a higher seismic site class.

4.6 Interior Floors

Slab-on-grade floors may be utilized for the interior floor systems for the building and improvements, provided slabs are constructed on native soils or new engineered fill, all existing fill is removed/modified (as discussed previously) and provided some slab movement can be tolerated. We estimate slab movement to be less than about 1 inch if the subgrade soils are modified as outlined above.

If a higher amount of movement can be tolerated, slab-on-grade floors could be constructed on a partial zone of new engineered fill, provided the subgrade materials are modified by overexcavating the materials to a depth of at least 3 feet, compacting the base of the overexcavation using a large vibratory roller, and properly moisture conditioning and compacting the material back to grade. We estimate slab movement using the above approach to be about 1 to 2 inches.

4.6.1 Interior Floor Recommendations

If the owner cannot accept the risk of slab movement, a structural floor should be used. If the owner is willing to accept the risk associated with movement of a slab-on-grade floor system, slabs-on-grade could be constructed on new engineered fill, or a partial zone of new engineered fill underlain by existing fill soils prepared as recommended above.

For structural design of concrete slabs-on-grade, a modulus of subgrade reaction of 130 pounds per cubic inch (pci) may be used for point or limited area loads for floors supported on an engineered fill.

Additional floor slab design and construction recommendations are as follows:

- Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement.
- Control joints should be provided in slabs to control the location and extent of cracking.
- Interior trench backfill placed beneath slabs should be compacted in accordance with recommended specifications outlined below.
- Floor slabs should not be constructed on frozen subgrade.
- Other design and construction considerations, as outlined in Section 302.1R of the *ACI Design Manual*, are recommended.

Movements of slab-on-grades using the above outlined techniques will likely be reduced and tend to be more uniform. The estimates outlined previously assume that the other recommendations in this report are followed. Additional movement could occur should the subsurface soils become wetted to significant depths, which could result in potential excessive movement causing uneven floor slabs and severe cracking. This could be due to over watering of landscaping, poor drainage, improperly functioning drain systems, and/or broken utility lines. Therefore, it is imperative that the recommendations outlined in this section and in the **Grading and Drainage** section of this report be followed.

4.7 Exterior Flatwork

Exterior slabs-on-grade and flatwork constructed on the existing fill will have a low to moderate risk of movement. The risk of movement can be reduced if the subgrade materials are modified by overexcavating the materials to a depth of at least 3 feet, compacting the base of the overexcavation using a large vibratory roller, and properly moisture conditioning and compacting the material back to grade.

For areas of exterior flatwork where the owner would like to reduce the movement to less than about 1-inch, existing fill materials below exterior flatwork should be overexcavated to native soils and prepared as recommended in the **Interior Floors** section of this report.

4.7.1 Exterior Flatwork Recommendations

For structural design of exterior concrete slabs-on-grade, a modulus of subgrade reaction of 130 pci may be used for point or limited area loads for exterior slabs-on-grade at this site.

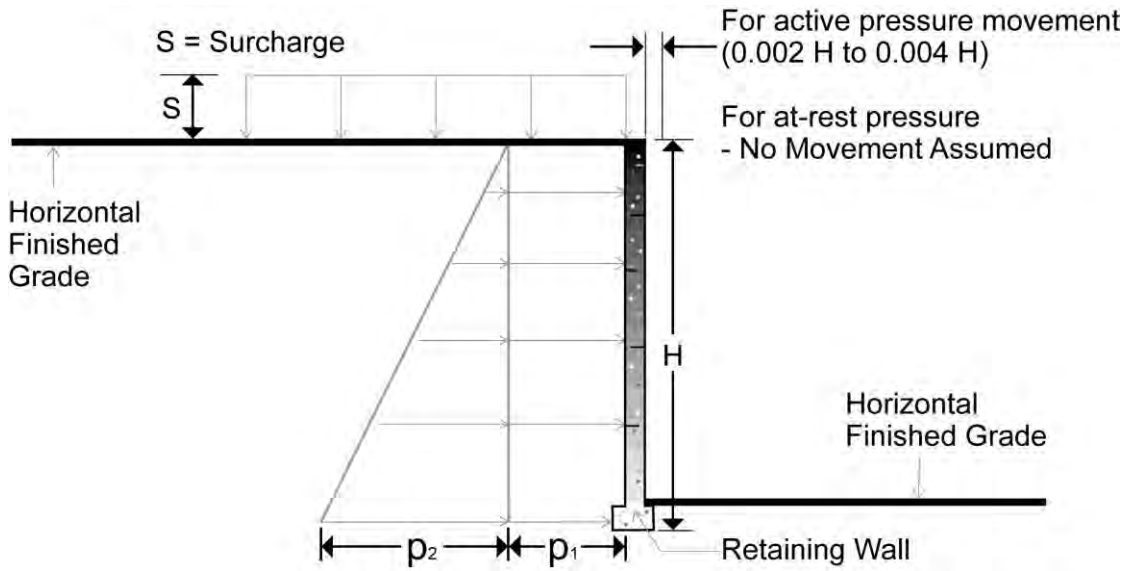
Additional slab design and construction recommendations are as follows:

- Minimizing moisture increases in the backfill.
- Controlling moisture-density during placement of backfill.
- Positive separations and/or isolation joints should be provided between exterior slabs and the addition to allow independent movement.
- Control joints should be provided in slabs to control the location and extent of cracking.
- Exterior slabs should not be constructed on frozen subgrade.
- Other design and construction considerations, as outlined in Section 302.1R of the *ACI Design Manual*, are recommended.

Movements of exterior slab-on-grades using the above technique will likely be reduced and tend to be more uniform. Additional movement could occur should the subsurface soils become wetted to significant depths, which could result in potential excessive movement causing uneven exterior slabs and severe cracking. This could be due to over watering of landscaping, poor drainage, and/or broken utility lines. Therefore, it is imperative that the recommendations outlined in the **Grading and Drainage** section of this report be followed.

4.8 Lateral Earth Pressures

Temporary shoring (if required) or the below-grade structure walls with unbalanced backfill levels should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of walls that are able to move in order to “mobilize” the active earth pressures. The "at-rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Earth Pressure Conditions	Coefficient For Backfill Type[1]	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	0.33	40	(0.33)S	(40)H
At-Rest (Ko)	0.50	60	(0.50)S	(60)H
Passive (Kp)	3.0	360	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted to at least 95 percent of standard Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters

To control hydrostatic pressure behind earth-retaining walls we recommend that a drain be installed below the foundation of the wall with a collection pipe leading to a reliable discharge. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or floor loading; these values should be added where applicable. Heavy

construction equipment (such as cranes) should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

The preceding data are applicable only to cast-in-place concrete or modular block walls up to 15 feet in height. **If taller single walls, tiered walls, or Mechanically Stabilized Earth (MSE) walls will be included in the proposed development, additional site-specific studies and laboratory testing will be required.** The lateral earth pressure recommendations given in the following paragraphs are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. Lateral earth pressures are not used in the design of mechanically stabilized earth (MSE or modular block - geogrid reinforced backfill walls), and our scope of services does not include conducting strength testing of either foundation soils or potential retained backfill that form the basis of MSE retaining wall design. MSE walls are typically subcontracted as design-build structures, since design details are often manufacturer specific. We would be available to discuss and provide an appropriate scope of testing and geotechnical engineering to determine design parameters specific to recommendations for the design of such wall systems upon request.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated location and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site

safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

Field Exploration Description

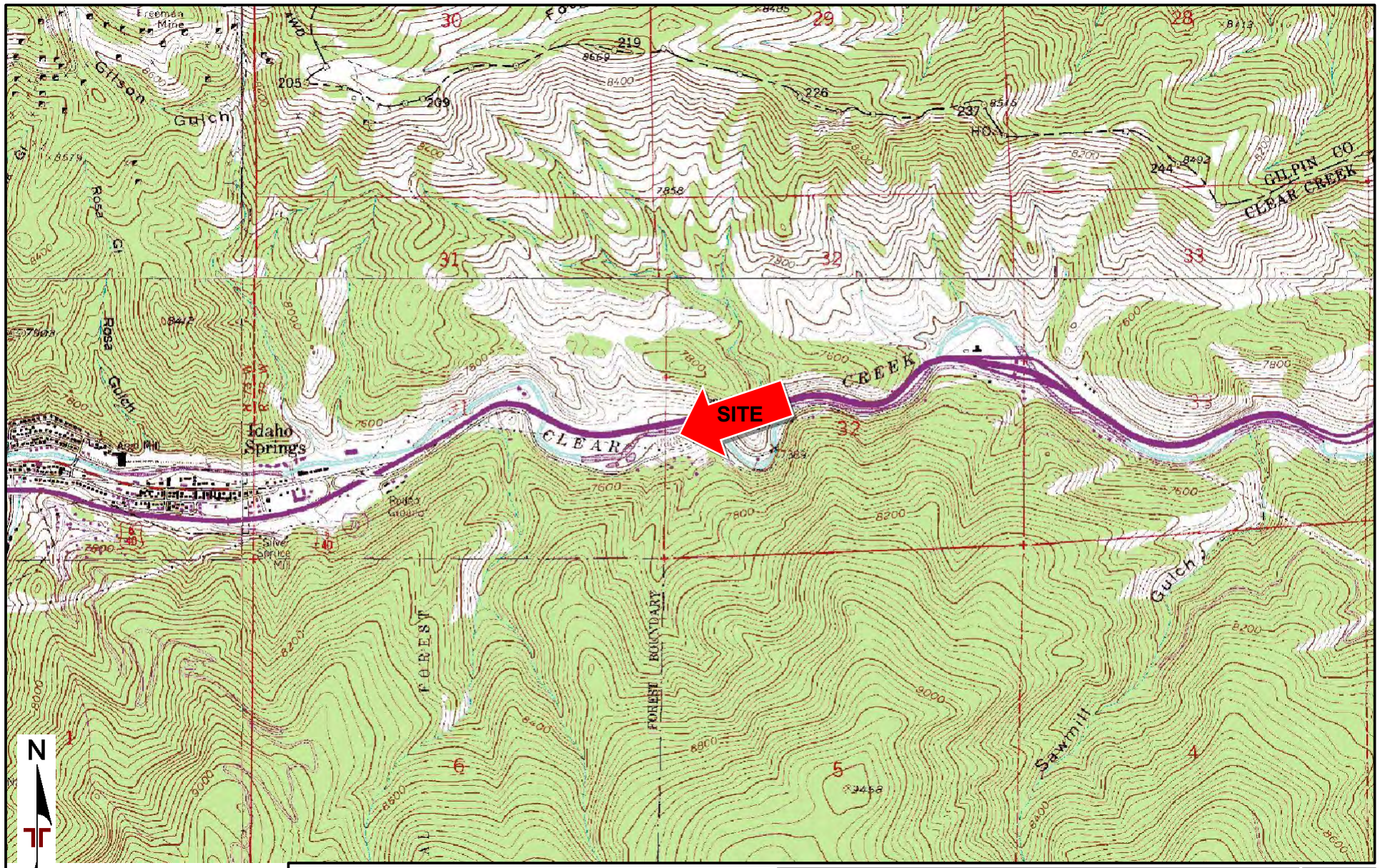
The locations of borings are presented in Exhibits A-2 and A-3. The borings were located in the field by measuring with a measuring wheel from property lines and/or existing site features. The latitude and longitude coordinates of the boring locations were obtained by a recreational grade GPS unit. The accuracy of the latitude and longitude values is typically about +/- 25 feet when obtaining the values using this method. Boring elevations were determined using a level and assigning the top of slab at the southwest corner of the slab south of the existing treatment building an elevation of 100.0 feet. The accuracy of the boring locations and elevations should only be assumed to the level implied by the method used.

The borings were drilled with a CME-55 truck-mounted drill rig with using ODEX drilling techniques. During the drilling operations, lithologic logs of the borings were recorded by the field engineer. Relatively undisturbed samples were obtained at selected intervals utilizing a 2-inch outside diameter standard split-spoon sampler. Bulk samples were obtained from auger cuttings. Penetration resistance values were recorded as the standard penetration test (SPT). This test consists of driving the sampler into the ground with a 140-pound hammer free-falling through a distance of 30 inches. The number of blows required to advance the standard split-spoon sampler 18 inches (final 12-inches are recorded) or the interval indicated, is recorded. The blow count values are indicated on the boring logs at the respective sample depths.

An automatic hammer was used to advance the samplers in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The standard penetration test provides a reasonable indication of the in-place density of sandy type materials, but only provides an indication of the relative stiffness of cohesive materials since the blow count in these soils may be affected by the soils moisture content. In addition, considerable care should be exercised in interpreting the N-values in gravelly soils, particularly where the size of the gravel particle exceeds the inside diameter of the sampler.

Groundwater measurements were obtained in the borings at the time of drilling. Due to safety concerns, borings not completed as temporary monitoring wells were backfilled with auger cuttings and patched with asphalt, where applicable. Some settlement of the backfill (and patches) may occur and should be repaired as soon as possible.



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: CENTRAL CITY, CO (1/1/1972), BLACK HAWK, CO (1/1/1972), IDAHO SPRINGS, CO (1/1/1974) and SQUAW PASS, CO (1/1/1974).
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager:	WDR
Drawn by:	CMW
Checked by:	SBM
Approved by:	WDR

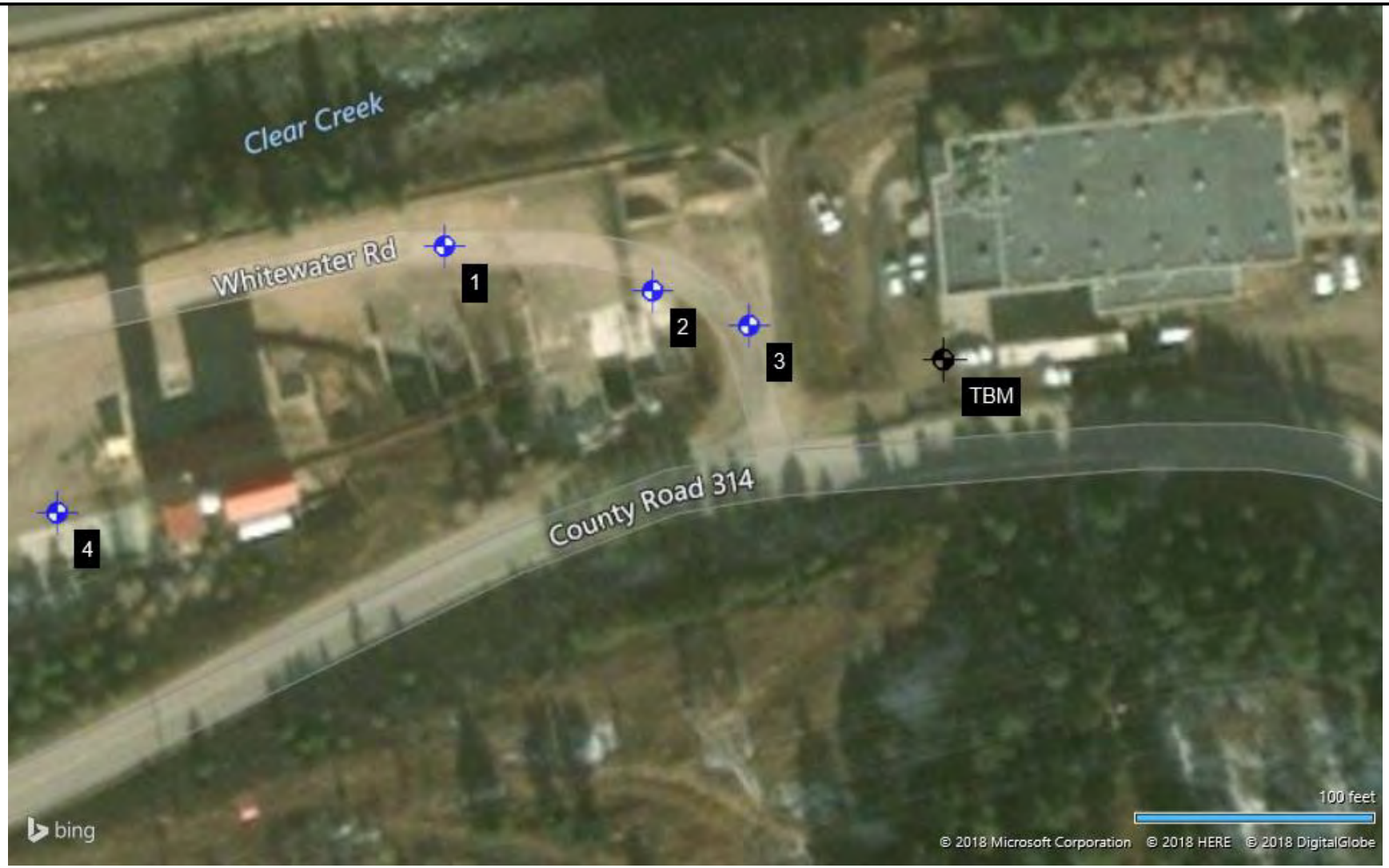
Project No.	25185147
Scale:	1"=2,000'
File Name:	A-2 & A-3
Date:	9/27/2018

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO 80033-1729

SITE LOCATION

PROPOSED IDAHO SPRINGS WWTP EXPANSION
980 COUNTY ROAD 314
IDAHO SPRINGS, COLORADO

Exhibit
A-2



N

LEGEND 1 Approximate Boring Location

TBM Temporary Benchmark: Top of slab, SW corner of slab south of treatment building. Reported elevation = 7387.5 feet.

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: WDR	Project No. 25185147
Drawn by: CMW	Scale: AS SHOWN
Checked by: SBM	File Name: A-2 & A-3
Approved by: WDR	Date: 9/27/2018

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO 80033-1729

AERIAL IMAGE EXPLORATION PLAN

PROPOSED IDAHO SPRINGS WWTP EXPANSION
980 COUNTY ROAD 314
IDAHO SPRINGS, COLORADO

Exhibit A-3

LEGEND

1 Approximate Boring Location

TBM Temporary Benchmark: Top of slab, SW corner of slab south of treatment building. Reported elevation = 7387.5 feet.

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: WDR	Project No. 25185147
Drawn by: CMW	Scale: AS SHOWN
Checked by: SBM	File Name: A-4
Approved by: SBM	Date: 9/27/2018

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO 80033-1729

BORING LOCATION PLAN

PROPOSED IDAHO SPRINGS WWTP EXPANSION
980 COUNTY ROAD 314
IDAHO SPRINGS, COLORADO

Exhibit
A-4

BORING LOG NO. 1

PROJECT: Proposed Idaho Springs WWTP Expansion

CLIENT: JVA Inc

SITE: 980 County Road 314
Idaho Springs, Colorado

LOCATION See Exhibits A-2 & A-3

Latitude: 39.7439° Longitude: -105.4779°

Approximate Surface Elev: 7388.6 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.1	7388.5+/-	**APPARENT AGGREGATE BASE COURSE**, (about 1-1/2 inches)
		FILL - CLAYEY SAND (SC), trace gravel, fine to coarse grained, brown to black, medium dense to dense, varies to silty sand (SM), with gravel
12.0	7376.5+/-	**POORLY GRADED GRAVEL (GP)**, with sand and cobbles, fine to coarse grained, brown, loose
22.0	7366.5+/-	**CLAYEY SAND (SC)**, with gravel, fine to coarse grained, brown, medium dense
27.0	7361.5+/-	**BOULDERS & COBBLES**, with sand and gravel, gray, very dense
30.0	7358.5+/-	***Boring Terminated at 30 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		27-26-19	6		
5		12-14-11	6	NP	16
		12-26-17	8		
10		12-15-10			
15		3-3-4			
20		5-3-5			
25		11-15-11			
30		50/0"			

WATER LEVEL OBSERVATIONS: ▽ 17 feet while drilling; ▼ 18.4 feet on 9/28/18

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
5-1/4 inch ODEX

Abandonment Method:
Boring completed as a 2" well with concreted surface flush mount

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
The elevation of the boring was obtained using a level and referencing the top of slab at the southwest corner of the slab south of the existing treatment building with a reported elevation of 7387.5 feet.

WATER LEVEL OBSERVATIONS

▽ *17 feet while drilling*

▼ *18.4 feet on 9/28/18*

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

Boring Started: 09-07-2018 | Boring Completed: 09-07-2018
Drill Rig: CME-55 | Driller: Vine
Project No.: 25185147 | Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 25185147 PROPOSED IDAHO SP.GPJ TERRACON_DATATEMPLATE.GDT 10/3/18

BORING LOG NO. 2

PROJECT: Proposed Idaho Springs WWTP Expansion

CLIENT: JVA Inc

SITE: 980 County Road 314
Idaho Springs, Colorado

LOCATION See Exhibits A-2 & A-3

Latitude: 39.7438° Longitude: -105.4776°

Approximate Surface Elev: 7387.6 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.1	7387.5+/-	**APPARENT AGGREGATE BASE COURSE**, (about 1 inch)				
3.0	7384.5+/-	**FILL - SILTY SAND (SM)**, with gravel, fine to coarse grained, whitish gray, very dense	50/8"	11	NP	16
		FILL - CLAYEY SAND (SC), with gravel, fine to coarse grained, black to brown, medium dense to very dense	50/4"			
			14-7-3	6		
12.0	7375.5+/-	**POORLY GRADED GRAVEL (GP)**, with sand and cobbles, fine to coarse grained, brown, loose to medium dense, varies to clayey sand (SC) with gravel at 19 feet	3-4-3			
			3-2-3	16		
			9-11-11			
27.0	7360.5+/-	**BOULDERS & COBBLES**, with sand and gravel, gray, very dense				
30.0	7357.5+/-		50/0"			
		Boring Terminated at 30 Feet				

DEPTH (Ft.): 5, 10, 15, 20, 25, 30

WATER LEVEL OBSERVATIONS: 17 feet while drilling; 14.1 feet at completion of drilling

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
5-1/4 inch ODEX

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
The elevation of the boring was obtained using a level and referencing the top of slab at the southwest corner of the slab south of the existing treatment building with a reported elevation of 7387.5 feet.

WATER LEVEL OBSERVATIONS
17 feet while drilling
14.1 feet at completion of drilling

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

Boring Started: 09-07-2018 | Boring Completed: 09-07-2018
Drill Rig: CME-55 | Driller: Vine
Project No.: 25185147 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 25185147 PROPOSED IDAHO SP.GPJ TERRACON_DATATEMPLATE.GDT 10/3/18

BORING LOG NO. 3

PROJECT: Proposed Idaho Springs WWTP Expansion

CLIENT: JVA Inc

SITE: 980 County Road 314
Idaho Springs, Colorado

LOCATION See Exhibits A-2 & A-3

Latitude: 39.7438° Longitude: -105.4775°

Approximate Surface Elev: 7390.9 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description
0.3	7390.5+/-	**ASPHALT**, (about 4 inches)
		FILL - CLAYEY SAND (SC), with gravel, fine to coarse grained, black to brown, medium dense to very dense, varies to poorly graded gravel with silt and sand (GP-GM)
7.0	7384+/-	**SILTY SAND (SM)**, with gravel, fine to coarse grained, black to greenish gray, loose to medium dense, varies to poorly graded sand with silt and gravel (SP-SM)
28.0	7363+/-	**BOULDERS & COBBLES**, with sand and gravel, black to white, very dense
40.0	7351+/-	***Boring Terminated at 40 Feet***

DEPTH (Ft.)	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		7-5-7			
5		50/4"	6	NP	9
10		6-5-6	8		
15		1-2-4	9	NP	12
20		4-3-4			
25		1-3-5			
30		50/0"			
35		50/0"			
40		50/0"			

WATER LEVEL OBSERVATIONS: 19 feet while drilling; caved to 19.2 feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
5-1/4 inch ODEX

Abandonment Method:
Boring backfilled with auger cuttings upon completion and patched with asphalt.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
The elevation of the boring was obtained using a level and referencing the top of slab at the southwest corner of the slab south of the existing treatment building with a reported elevation of 7387.5 feet.

WATER LEVEL OBSERVATIONS
19 feet while drilling
caved to 19.2 feet

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

Boring Started: 09-07-2018 | Boring Completed: 09-07-2018
Drill Rig: CME-55 | Driller: Vine
Project No.: 25185147 | Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 25185147 PROPOSED IDAHO SP.GPJ TERRACON_DATATEMPLATE.GDT 10/3/18

BORING LOG NO. 4

PROJECT: Proposed Idaho Springs WWTP Expansion

CLIENT: JVA Inc

SITE: 980 County Road 314
Idaho Springs, Colorado

LOCATION See Exhibits A-2 & A-3

Latitude: 39.7435° Longitude: -105.4785°

Approximate Surface Elev: 7390.1 (Ft.) +/-

DEPTH	ELEVATION (Ft.)		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2	7390+/-	**APPARENT AGGREGATE BASE COURSE**, (about 2 inches), fine to coarse grained, light brown								
4.0	7386+/-	**FILL - SILTY SAND (SM)**, with gravel, fine to coarse grained, brown, very dense				50/6"	5		NP	20
		POORLY GRADED GRAVEL (GP), with cobbles and boulders, fine to coarse grained, brown, very dense, varies to silty sand (SM) or clayey sand (SC)	5			50/8"	3			
			10			50/6"				
			15			50/0"				
			20			50/6"	8			
23.0	7367+/-	**BOULDERS & COBBLES**, with sand and gravel, gray, very dense								
			25							
30.0	7360+/-		30			50/0"				
		Boring Terminated at 30 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
5-1/4 inch ODEX

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exhibit A-1 for description of field procedures
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
The elevation of the boring was obtained using a level and referencing the top of slab at the southwest corner of the slab south of the existing treatment building with a reported elevation of 7387.5 feet.

WATER LEVEL OBSERVATIONS

15 feet while drilling

18.6 feet at completion of drilling

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

Boring Started: 09-07-2018 | Boring Completed: 09-07-2018

Drill Rig: CME-55 | Driller: Vine

Project No.: 25185147 | Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 25185147 PROPOSED IDAHO SP.GPJ TERRACON_DATATEMPLATE.GDT 10/3/18

APPENDIX B
LABORATORY TESTING

Laboratory Testing Description

Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer, and were classified in general accordance with the Unified Soil Classification System presented in Appendix C.

At this time, an applicable laboratory-testing program was formulated to determine engineering properties of the subsurface materials. Following the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary, and the Boring Logs were prepared. The Boring Logs are included in Appendix A.

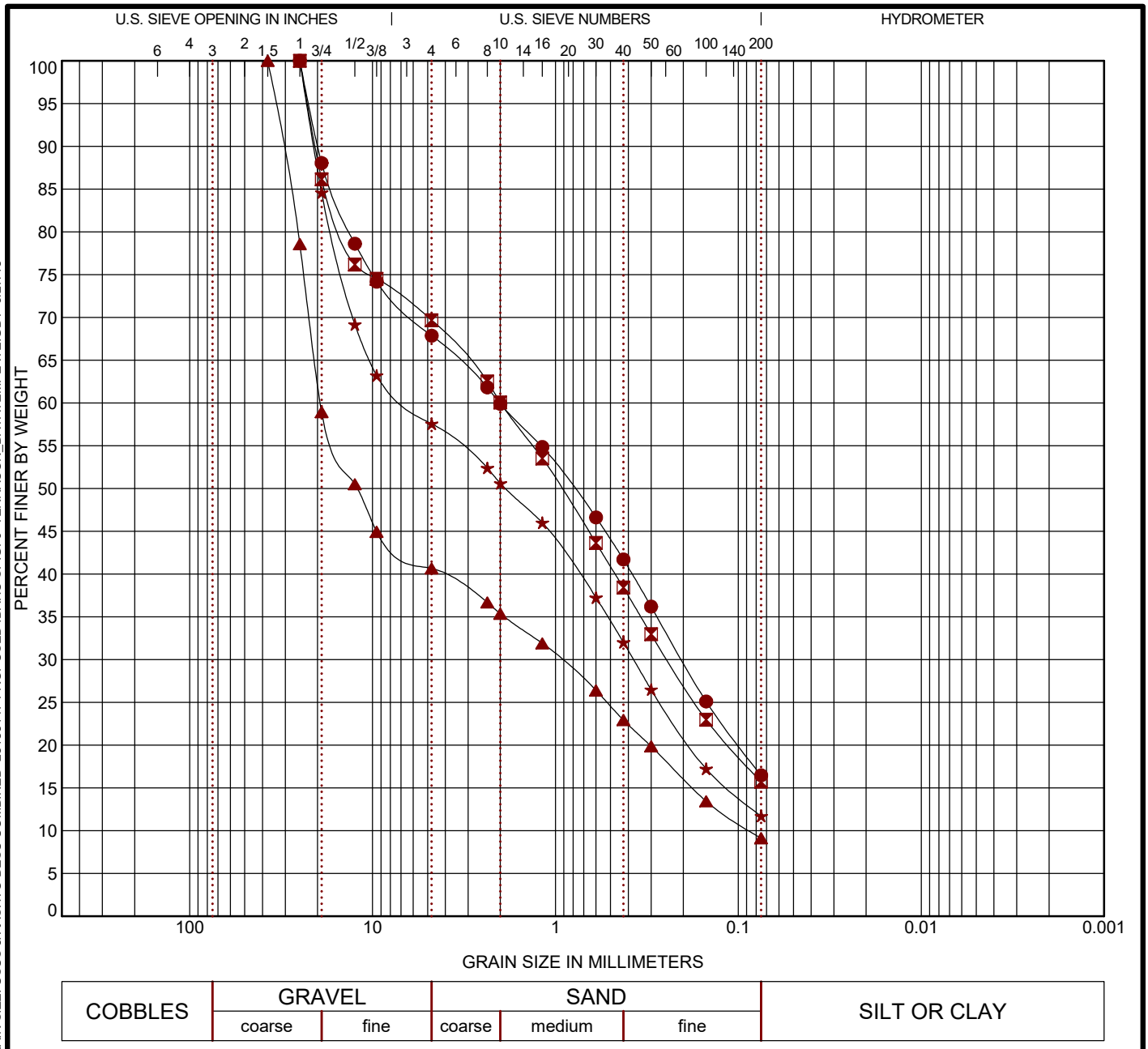
Laboratory test results are included in Appendix B. These results were used for the geotechnical engineering analyses and the development of foundation and earthwork recommendations. All laboratory tests were performed in general accordance with the applicable local or other accepted standards.

Selected soil samples were tested for the following engineering properties:

- Water content
- Dry density
- Grain size distribution
- Atterberg limits
- Swell/consolidation
- pH
- Electrical resistivity
- Water-soluble sulfate content

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
●	1	4 - 5	SILTY SAND with GRAVEL (SM)	A-1-b (0)	6	NP	NP	NP		
⊠	2	2 - 3	SILTY SAND with GRAVEL (SM)	A-1-b (0)	11	NP	NP	NP		
▲	3	4 - 5	POORLY GRADED GRAVEL with SILT and SAND (GP-GM)	A-1-a (0)	6	NP	NP	NP	0.52	223.17
★	3	14 - 15	POORLY GRADED SAND with SILT and GRAVEL (SP-SM)	A-1-b (0)	9	NP	NP	NP	0.36	105.76

	Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	1	4 - 5	25	2.018	0.204		32.1	51.4		16.5	
⊠	2	2 - 3	25	1.99	0.244		30.3	54.0		15.7	
▲	3	4 - 5	37.5	19.285	0.934	0.086	59.4	31.5		9.1	
★	3	14 - 15	25	6.405	0.374		42.4	45.9		11.7	

PROJECT: Proposed Idaho Springs WWTP Expansion

SITE: 980 County Road 314
Idaho Springs, Colorado

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

PROJECT NUMBER: 25185147

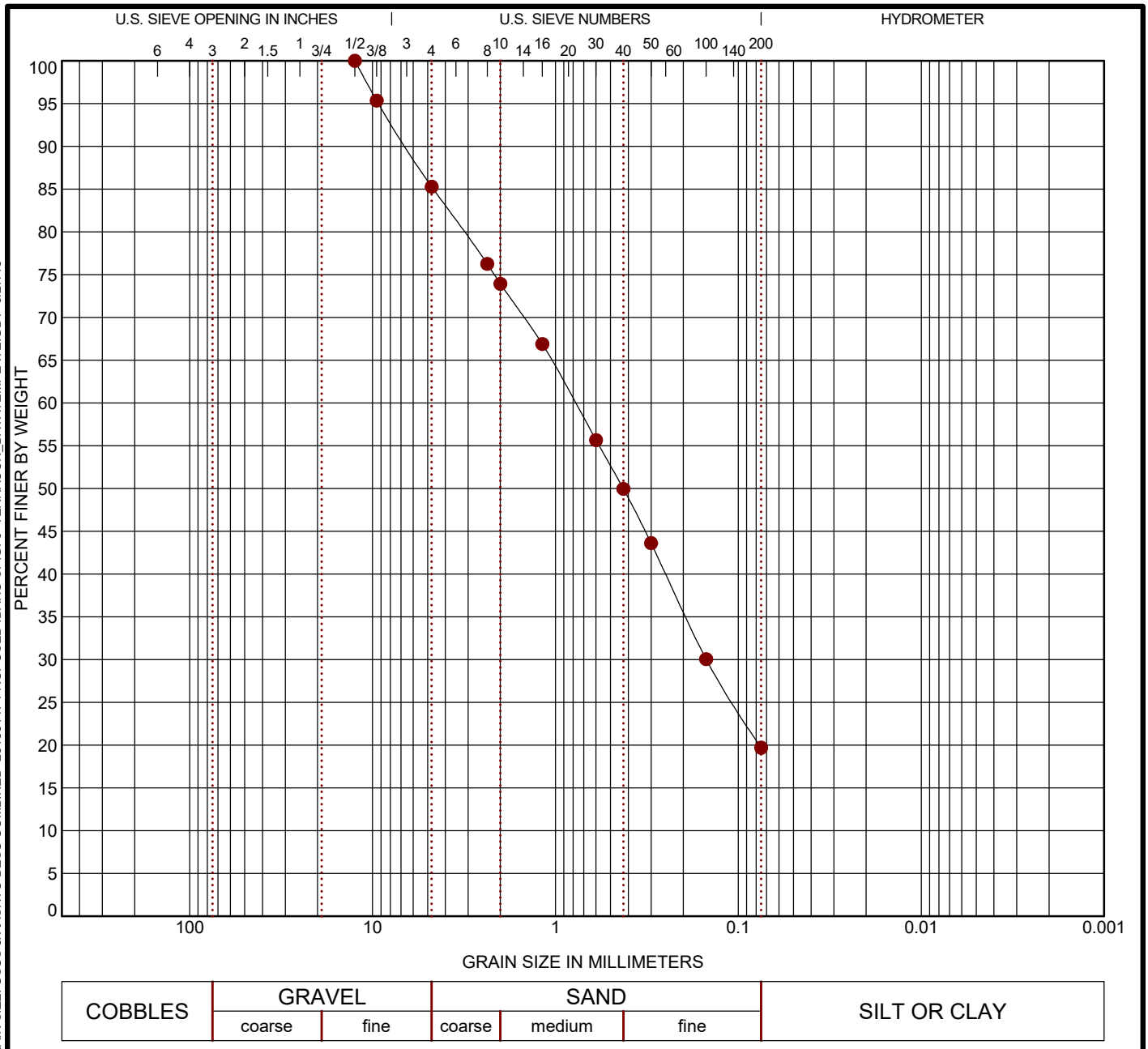
CLIENT: JVA Inc

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS & AASHTO DESC COMBINED 25185147 PROPOSED IDAHO SP.GPJ TERRACON_DATATEMPLATE.GDT 9/27/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	AASHTO Classification	WC (%)	LL	PL	PI	Cc	Cu
4	2 - 3	SILTY SAND (SM)	A-1-b (0)	5	NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
4	2 - 3	12.5	0.779	0.149		14.7	65.6		19.7	

PROJECT: Proposed Idaho Springs WWTP Expansion

SITE: 980 County Road 314
Idaho Springs, Colorado

Terracon
10625 W I 70 Frontage Rd N, Ste 3
Wheat Ridge, CO

PROJECT NUMBER: 25185147

CLIENT: JVA Inc

EXHIBIT: B-3

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS & AASHTO DESC COMBINED 25185147 PROPOSED IDAHO SP.GPJ TERRACON_DATATEMPLATE.GDT 9/27/18

SUMMARY OF LABORATORY TEST RESULTS

Proposed Idaho Springs WWTP Expansion - Idaho Springs, Colorado

Terracon Project No. 25185147

Boring No.	Depth (ft.)	USCS Class.	Initial Water Content (%)	Particle Size Distribution, Percent Passing by Weight					Atterberg Limits		Water Soluble Sulfates (%)	Resistivity Ohm/cm	pH	Remarks
				1-1/2"	#4	#10	#40	#200	LL	PI				
1	0 - 5	SC									<0.10	4,600	8.1	
1	2	SC	6											4
1	4	SM	6	100	68	60	42	16	NV	NP				4
1	7.5	SC	8											4
2	2	SM	11	100	70	60	38	16	NV	NP				4
2	9	SC	6											4
2	19	GP	16											4
3	4	GP-GM	6	100	41	36	23	9	NV	NP				4
3	9	SM	8											4
3	14	SP-SM	9	100	58	51	32	12	NV	NP				4
4	0 - 5	SM									<0.10	11,000	8.6	
4	2	SM	5	100	85	74	50	20	NV	NP				4
4	4	SM	3											4
4	19	SM	8											4

Notes:
Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.
* = Partially disturbed sample
- = Compression/settlement
NV = no value
NP = non-plastic

Remarks:
1 Remolded Compacted density (about 95% of ASTM D698 maximum density near optimum moisture content)
2 Remolded Compacted density (about 95% of ASTM D1557 maximum density near optimum moisture content)
3 Water added to sample
4 Dry density and/or moisture content determined from one ring of a multi-ring sample
5 Minus #200 Only
6 Moisture-Density Relationship Test Method ASTM D698/AASHTO T99
7 Moisture-Density Relationship Test Method ASTM D1557/AASHTO T180

Exhibit B-4

Terracon

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Shelby Tube	Split Spoon
Rock Core	Macro Core	Modified California Ring Sampler
Grab Sample	No Recovery	Modified Dames & Moore Ring Sampler

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Ring Sampler Blows/Ft.	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)
Very Loose	0 - 3	0 - 5	Very Soft	less than 500	0 - 1	< 3	< 24	< 20	Soft
Loose	4 - 9	6 - 14	Soft	500 to 1,000	2 - 4	3 - 5	24 - 35	20 - 29	Firm
Medium Dense	10 - 29	15 - 46	Medium-Stiff	1,000 to 2,000	4 - 8	6 - 10	36 - 60	30 - 49	Medium Hard
Dense	30 - 50	47 - 79	Stiff	2,000 to 4,000	8 - 15	11 - 18	61 - 96	50 - 79	Hard
Very Dense	> 50	≥ 80	Very Stiff	4,000 to 8,000	15 - 30	19 - 36	> 96	>79	Very Hard
			Hard	> 8,000	> 30	> 36			

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

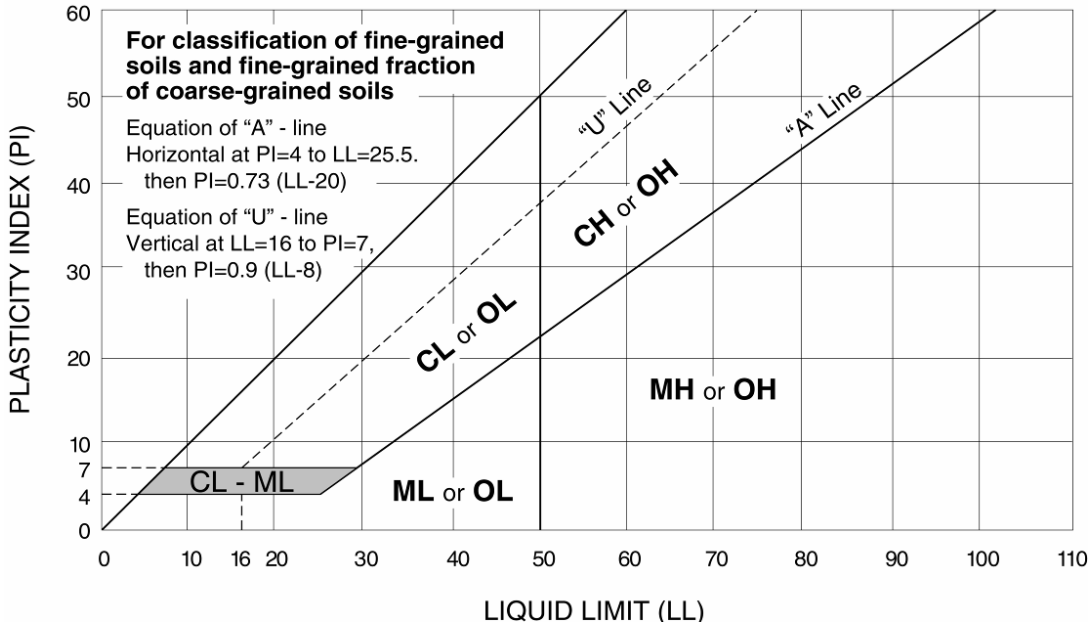


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Exhibit C-2

SECTION 01035

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

1.2 MINOR CHANGES IN THE WORK

A. The Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time, on a Field Order Form.

B. The Contractor may request additional information or clarification by using and submitting a “Request for Information” (RFI).

1.3 WORK CHANGE DIRECTIVE (WCD)

A. Owner-Initiated Work Change Directive: A written statement to the Contractor issued on or after the Effective Date of the Agreement and signed by the Owner and recommended by the Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.
   1. Within 7 days of receipt of a Work Change Directive Form, submit an estimate of cost necessary to execute the change to the Engineer for the Owner's review.
      a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

1.4 CHANGE ORDER (CO)

A. Owner-Initiated Change Order: The Engineer will issue a detailed Change Order Form indicating any changes in the Work that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. The Change Order Form issued by the Engineer is for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
2. Within 7 days of receipt of a Change Order Form, submit an estimate of cost necessary to execute the change to the Engineer for the Owner's review.
    a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

B. There will be no Contractor initiated Change Orders, the Contractor may only request additional information or clarification by using and submitting a “Request for Information” (RFI), on the Contractor’s RFI form. Additional forms may be obtained from the Engineer, and Contractor-Initiated Proposals may also be provided.

C. Upon the Owner's and the Engineer’s approval and signature from the Contractor the Change Order Form becomes valid

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01039

COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements

B. Coordination

C. Field engineering

D. Alteration project procedures

E. Preconstruction conference

F. Progress meetings

G. Requests for information

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01340 – Shop Drawings and Product Data

C. Section 01700 – Contract Closeout

1.3 GENERAL REQUIREMENTS

A. Refer to General Conditions for Owner meetings and other requirements

B. Engineer will schedule and administer pre-construction meeting according to agenda
   1. Prepare agenda for meetings including items required by Owner and Contractor
   2. Notify Contractor and Owner four days in advance of meeting date
   3. Preside at meeting

C. Contractor will schedule and administer site mobilization and weekly progress meetings. Contractor will also be responsible for coordination, field engineering, alteration, project procedures, cutting and patching procedures outlined herein. If work progress does not warrant a meeting, all parties can mutually agree to postpone meeting.
   1. Arrange for the attendance of Contractor's agents, employees, subcontractors, and suppliers as appropriate to the agenda
   2. Record the minutes; include all significant proceedings and decisions
   3. Reproduce and distribute copies of minutes within one week after each meeting
      a. To all participants in the meetings

b. To Engineer
c. To Owner

4. Owner and other inspecting parties such as the geotechnical engineer/technician as well as plant operators may attend meetings
5. Engineer will attend weekly meetings either via phone or on site

D. Representatives of contractors, subcontractors, and suppliers attending the meetings shall be qualified and authorized to act on behalf of the entity each represents

1.4 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various Sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later by others.

B. Verify that utility requirement characteristics of operating equipment are compatible with available utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment, and coordinate preparation of grading and other requirements for installation utility work by others.

C. Coordinate completion and clean-up of Work of separate Sections in preparation for final completion and for portions of Work designated for Owner’s use

D. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.5 FIELD ENGINEERING

A. Employ a Land Surveyor registered in the State of Colorado and acceptable to the Engineer and Owner.

B. Contractor will locate and protect survey control and reference points.

C. Control datum for survey is that established by Owner provided survey and shown on Drawings.

D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.6 ALTERATION PROJECT PROCEDURES

A. Materials: As specified in product Sections; match existing products and work for patching and extending work.

B. Where new work abuts or aligns with existing, perform a smooth and even transition. Patched work to match existing adjacent work in texture and appearance.

C. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Engineer.

D. Where a change of plane of 1/4-inch or more occurs, submit recommendation for providing a smooth transition for Engineer review.

E. Patch or replace portions of existing surfaces, which are damaged, lifted, or showing other imperfections.

F. Finish surfaces as specified in individual product sections.

1.7 PRECONSTRUCTION CONFERENCE

A. Engineer will schedule a conference after Notice of Award

B. Location: On site

C. Attendance
1. Owner's Representative
2. Engineer and his professional consultants
3. Geotechnical Engineer
4. Contractor's Project Manager
5. Contractor's Superintendent
6. Major Subcontractors
7. Others as Appropriate

D. Agenda:
1. Execution of Owner Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors and suppliers, list of products, Schedule of Values, and Construction Project Schedule in critical path format.
5. Designation of personnel representing the parties in Contractor, Owner, and the Engineer.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, cost proposal requests, Change Orders and Contract closeout procedures.
7. Construction scheduling and updates.
8. Scheduling activities of Geotechnical Engineer, equipment manufacturers representatives, and other field tests
9. Critical work sequencing
10. Major equipment deliveries and priorities
11. Procedures for maintaining Record Documents
12. Construction facilities, controls and construction aids
13. Temporary utilities provided by Owner
14. Safety and first-aid procedures
15. Security and housekeeping procedures

16. Procedures for testing

1.8 PROGRESS MEETINGS

A. Contractor will schedule and administer meetings throughout progress of the Work at weekly intervals. If work progress does not warrant meeting, all parties can mutually agree to postpone the weekly meeting.

B. Location of the Meetings: The project field office of the Contractor, or other locations arranged for by Contractor, convenient to all parties

C. Contractor will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within one week to Contractor, Owner, participants, and those affected by decisions made.

D. Attendance
   1. Owner's Representative
   2. Engineer, and his professional consultants as needed
   3. Contractor's Superintendent
   4. Subcontractors as appropriate to the agenda
   5. Suppliers as appropriate to the agenda
   6. Others, as appropriate

E. Suggested Agenda
   1. Review Minutes of Previous meetings
   2. Review Unresolved issues from Last Meeting
   3. Review of Work Progress
   4. Field Observations, Problems, Conflicts and Decisions
   5. RFI Review
   6. Review of Submittals Schedule and Status of Submittals
   7. Schedule
      a. General Schedule Issues
      b. Review of off-site fabrication and delivery schedules
      c. Planned progress during succeeding work period (3-week “Look ahead”)
      d. Maintenance of construction project schedule
      e. Corrective measures to regain project schedules
   8. Maintenance of Quality and Work Standards
   9. Change Orders
   10. New PR’s
   11. Accepted Change Orders
   12. Pay Requests
   13. Other Business

1.9 REQUESTS FOR INFORMATION (RFI)

A. The Contractor shall prepare and submit an RFI upon the discovery of the need for interpretation of the Contract Documents or additional information.
   1. Only the Contractor shall submit RFIs to the Engineer.

2. RFIs shall be submitted on Engineer's RFI form. Engineer will provide a template for the Contractor upon request.

B. RFI shall include:
1. Project Name
2. Engineer Job Number
3. Date
4. Name of Contractor
5. Name of Engineer
6. RFI number, numbered sequentially
7. Related specification section number, title, and related paragraphs, as needed
8. Drawing number and detail references, as needed
9. Field conditions
10. Contractor's proposed solution. If the Contractor's solution(s) affect contract times or contract price, Contractor shall state the effects on the RFI.
11. Contractor's signature
12. Relevant attachments including but not limited to drawings, descriptions, measurements, photos, product data, and shop drawings

C. Electronically Submitted RFIs
1. Contractor shall submit one (1) complete RFI file in Adobe Acrobat PDF format

D. Engineer's Response
1. Engineer will review each RFI, determine action required, and respond.
2. Engineer will review and respond to each RFI within seven (7) working days
3. If Engineer receives an RFI after 1:00 P.M. local time, the RFI will be considered as received the following working day.
4. Engineer will not respond to RFIs requesting approval of submittals, approval of substitutions, coordination and information already indicated in Contract Documents, adjustment in contract time or contract amount, or erroneous RFIs.
5. Engineer may respond to RFIs on related issues with a single response.
6. If Engineer requests additional information as a result of the RFI, any further action or RFIs submitted by the Contractor will restart a new seven (7) day review period.
7. Contractor shall submit any request for change of contract time or contract price utilizing proper Change Order forms.

E. Contractor shall log and track all RFIs submitted organized by RFI number.
1. RFI log shall be submitted at each progress meeting
2. RFI log shall include:
   a. Project name
   b. Name, address, and phone number of Contractor
   c. Contractor representative name
   d. RFI number
   e. RFI description
   f. RFI submittal date
   g. RFI response date
   h. Related Change Order number, as needed

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01080

IDENTIFICATION SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Color coding, lettering, and tagging of all new exposed pipe and electrical equipment

1.2 RELATED SECTIONS

A. Section 09900 – Coatings

B. Section 16050 – Basic Electrical Materials and Methods

1.3 REFERENCES

A. ANSI 13.1 – Scheme for the Identification of Piping Systems

PART 2 PRODUCTS

2.1 MATERIALS

A. Coatings: As specified in Section 09900

B. Nameplates: Plastic, two colors for surface and core

PART 3 EXECUTION

3.1 LOCATION OF IDENTIFICATION

A. Lettering and flow direction arrows
   1. Near equipment served
   2. Close to valve or flanges
   3. Adjacent to branches, tees and changes in direction of pipeline
   4. At intervals of not more than 20 feet on straight runs, unless otherwise indicated by Engineer

3.2 LETTERING

A. Lettering to be provided by:
   1. Paint, stencil
   2. Cylindrically coiled printed plastic sheets meeting ANSI A13.1-2007
      a. Seton, Setmark Pipe Markers
      b. Or accepted equal

B. Letter size as follows:

Outside Diameter of Pipe Or Covering (inch)	Minimum Height of Letters (inch)
¾ Through 4	¾
>4 to <8	1 1/4
8 or larger	2 1/2

3.3 NAME PLATES

A. Provide nameplates on all electrically powered equipment and electrical enclosures
   1. Size: Approximately 3-inch wide by 2-inch high, on red plastic surface engraved through to a yellow core
   2. Label: “Danger” in capital ½ inch letters on top line. The balance of sign in 3/8-inch capital letters reading: “Do not perform any equipment maintenance until main power disconnect is turned off and padlocked”
   3. Provide additional electrical nameplates of the size and colors indicated in the individual specification sections
   4. Install in prominent location agreed to by the Engineer and Owner

B. Provide nameplate at all non-potable water outlets
   1. Size: approximately 3-inch wide by 2-inch high, on red plastic surface engraved through to a white core
   2. Label: “Non-Potable Water” top line and “Do Not Drink” second line in ½ inch capital letters
   3. Securely attach to wall (if possible) or attach with stainless steel chain

3.4 ALUMINUM LETTERS (BUILDING IDENTIFICATION)

A. Manufacturers:
   1. Artcraft Sign Company, Denver
   2. Or accepted substitution

B. Material: Aluminum

C. Text Size and Font: 8-inch high, font to be confirmed by Owner/Engineer

D. Finish: Bronze anodized

E. Locate signs where shown on Drawings. If not shown, locate as directed by Engineer

3.5 SCHEDULED COLOR CODING

A. All 24-inch pipe and smaller

B. Bands where scheduled: 6-inch-wide, at 5-foot intervals

C. Provide only bands of color on un-insulated steel and PVC, elsewhere natural finish

3.6 PIPING NOT SCHEDULED

A. Paint to match wall or ceiling, unless otherwise directed by Engineer

B. Appropriately identify and place arrows

C. Un-insulated stainless steel and PVC
   1. Natural finish

3.7 SCHEDULE

A. Paint and letter colors

Piping Description	Pipe Base/Band Color	Color of Letters
Raw Water Influent	Match Existing or Olive Green	White
Potable Water Piping	Match Existing or Dark Blue	White
Backwash Water	Match Existing or Light Brown	White
Compressed Air	Match Existing or Dark Green	White
Gas Line	Match Existing or Red	White
Sewer (Sanitary or Other)	Match Existing or Dark Gray	White

B. For piping not specified above refer to “Ten State Standards-Water Works, 2012 Edition” and/or the CDPHE “Design Criteria for Potable Water Systems, September 2013” as well as consult with Engineer

C. Specifically paint the following items:
   1. Valve hand-wheels and levers: Red
   2. Hoist Hooks, blocks, monorail beams: Match existing

END OF SECTION

SECTION 01200

PAYMENT PROCEDURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.

B. This information is supplemental to the requirements as stated in the General Conditions.

1.2 SUMMARY

A. This Section includes additional administrative and procedural requirements necessary to prepare and process Applications for Payment. Refer to General Conditions for most requirements of the Owner.
   1. Schedule of Values assisting in processing Applications for Payment
   2. Unit Prices for administrative requirements governing use of unit prices
   3. State Revolving Loan Fund project administrative requirements
   4. Construction Progress Schedules

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 PROCEDURES FOR THE SCHEDULE OF VALUES

A. Coordination: coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets
      b. Submittals Schedule
      c. O&M Manuals Schedule
   2. Submit the Schedule of Values to Engineer at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment
   3. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification

Section. Owner or Engineer may request additional line items for clarification and ease of processing pay applications.

1. Identification: include the following Project identification on the Schedule of Values:
   a. Project name and location
   b. Name of Engineer
   c. Engineer's project number.
   d. Contractor's name and address
   e. Date of submittal
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Change Orders (numbers) that affect value.
   d. Dollar value.
   e. Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders result in a change in the Contract Sum.

1.5 APPLICATION FOR PAYMENTS

A. General

1. Submit itemized payment request as required in General Conditions together with Schedule of Values and other submittals as specified herein
2. Contractor shall not "project" work completed beyond the date of Application for Payment submittal for the purpose of payment request

B. Each Application for Payment shall be consistent with previous applications and payments as certified by the Architect and paid for by the Owner.
   1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements

C. Payment Application Times: Each progress payment date is as indicated in the Agreement. The period of construction Work covered by each Application or Payment is the period indicated in the Agreement

D. Application Preparation: Complete every entry on the form, including notarization and execution by person authorized to sign legal documents on behalf of the Owner. Incomplete applications will be returned without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
   2. Include amounts of Change Orders issued prior to the last day of the construction period covered by the application

E. Transmittal
   1. Submit copy of each Application for Payment to the Engineer by means ensuring receipt within 24 hours
   2. Transmit each copy with a transmittal form listing attachments, and recording appropriate information related to the application in a manner acceptable to the Engineer

F. Initial Application for Payment
   1. Administrative actions and submittals that must precede or coincide with submittal of the first Application for Payment include the following:
      a. List of subcontractors
      b. List of principal suppliers and fabricators
      c. Schedule of Values
      d. Contractor's Construction Schedule (preliminary if not final)
      e. Schedule of principal products
      f. List of Contractor's staff assignments
      g. Copies of building permits
      h. Copies of authorizations and licenses from governing authorities for performance of the Work
      i. Certificates of insurance and insurance policies
      j. Performance and payment bonds, if required

G. Application for Payment at Substantial Completion

1. Following issuance of the Certificate of Substantial Completion, submit an Application for Payment. This application shall reflect any Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of Work
    a. Administrative actions and submittals that shall precede or coincide with this application include:
        i) Occupancy permits and similar approvals
        ii) Warranties (guarantees) and maintenance agreements
        iii) Test/adjust/balance records
        iv) Maintenance instructions
        v) Meter readings
        vi) Start-up performance reports
        vii) Change-over information related to Owner's occupancy, use, operation and maintenance
        viii) Final cleaning
        ix) Application for reduction of retainage, and consent of surety
        x) Advice on shifting insurance coverages
    b. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion

H. Application for Final Payment
1. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Price, previous payments, and sum remaining due.
2. Application for Final Payment will not be considered until the following have been accomplished:
    a. Completion of Project closeout requirements
    b. Completion of items specified for completion after Substantial Completion
    c. Assurance that unsettled claims will be settled
    d. Assurance that Work not complete and accepted will be completed without undue delay
    e. Transmittal of required Project construction records to Owner
    f. Proof that taxes, fees and similar obligations have been paid
    g. Removal of temporary facilities and services
    h. Removal of surplus materials, rubbish and similar elements

1.6 PROCEDURES FOR THE CONSTRUCTION PROGRESS SCHEDULE

A. Coordination: coordinate preparation and updates of Contractor’s Construction Schedule with the preparation of Schedule of Values.
1. Correlate line items in the Construction Schedule with required project tasks, including the following:
    a. Mobilization/demobilization
    b. Permits and regulatory requirements
    c. Submittals
    d. Equipment
    e. O&M Manuals
    f. Work breakdown of major project work

g. Major subcontractors work
h. Startup and commissioning
i. Training
j. Substantial completion
k. Final completion
l. Milestones and operational shutdown requirements

B. Utilize the Critical Path Method (CPM) type construction schedule to establish preliminary progress schedule and track Work progress
   1. After acceptance by Engineer of preliminary Progress Schedule submitted per requirements of General Conditions, set preliminary Progress Schedule as the Construction Baseline Schedule
   2. Update and submit the construction progress schedule on a monthly basis with the pay application
      a. Monthly submittal should indicate progress of tasks, changes to baseline schedule logic, work additions such as change orders, milestone and contract date changes
      b. Submit two (2) color print copies, 11” x 17” size, and one Adobe pdf copy
      c. Upon request provide copy of project schedule CPM data file

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01340

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submission of all shop drawings and product data as required by the Contract Documents for all equipment and materials to be furnished under this contract unless specifically indicated otherwise

1.2 RELATED SECTIONS

A. Section 01600 – Materials and Equipment

B. Section 01730 – Operations and Maintenance Data

C. Specification Divisions 2 thru 16

1.3 SUBMITTALS

A. Definitions
   1. Technical submittals: Shop drawings, product data and samples prepared by Contractor, subcontractors, suppliers, or manufacturers
      a. Shall be submitted by the Contractor to Engineer for approval for the use of Equipment and Materials to complete the Work or as needed to describe the following:
         i) Operation and maintenance
         ii) Technical properties
         iii) Installation
      b. Shop drawings: Custom prepared data for the Project and Work including performance and capacity curves, diagrams, bills of material, instructions, and other information
      c. Product data: Non-custom prepared printed information for the Project and Work on materials and products
      d. Samples: Fabricated and non-fabricated tangible samples of products and material
         i) Used for visual inspection and testing and analysis
   2. Informational submittals: Reports, administrative informational submittals, certification and guarantees not including and defined as shop drawings, samples and product data
      a. Reports: Include laboratory reports and tests, technical procedures and records and design analysis
      b. Administrative informational submittals: Submittals necessary for administrative records such as construction photographs, work records, schedules, standards, record project data, safety data, and similar information submittals
      c. Certification: Includes manufacturer or supplier certificates and guarantees

B. General Requirements
   1. Quality
      a. Shall be of suitable quality for legibility and reproduction purposes
      b. Shall be useable for reproduction yielding legible hard copy
      c. Submittals not conforming to specified requirements herein and as specified in Divisions 2 through 16 shall be subject to rejection by Engineer and upon Engineer request, Contractor shall resubmit documents that are in conformance
   2. Dimensions
      a. English units shall be provided on submittals
      b. Metric units are acceptable in addition to English units
      c. English units shall govern
   3. Form of submittals
      a. Submittals shall be transmitted in electronic format as specified herein
      b. Scanned submittals are acceptable
      c. Electronic project documents and submittals shall be transmitted in the following format:
         i) Native electronic format, nonproprietary
         ii) Adobe PDF produced from native electronic format
      d. Filename:
         i) Shall be consistent for the initial and any subsequent submission revisions for a single submittal
         ii) Contractor shall use a consistent naming convention for all submittals
            a) Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., #001, #001A, #001B, etc.)
   4. Non-conforming submittals shall be subject to rejection by Owner and/or Engineer
   5. Submittal completion requirements
      a. Submittals shall include design criteria, dimensions, construction materials and all other information specified for a complete submittal to facilitate Engineer review of the submittal information adequately
      b. In the event various drawings are included a submittal for a class of Equipment, Contractor shall annotate clearly which parts apply to furnished Equipment
         i) Information not pertaining to the submittal shall be clearly annotated. Highlighting of such information will cause rejection of the submittal by the Engineer
      c. Contract Drawings
         i) Copies or portions thereof will not be allowed as acceptable fabrication or erection drawings
         ii) In the event Contract Drawings are used by the Engineer for erection drawings to annotate information on erection or identify reference details, Engineer title block and professional seal shall be removed and replaced with the Contractor's title block on the Contract Drawing(s). Contractor shall revise such erection drawings for subsequent revisions by the Engineer to Contract Drawings

C. Preparation
   1. Shop Drawings

a. Drawings shall be presented in a clear and thorough manner:
b. Identify details by reference to sheet and detail, schedule or room numbers shown on Contract Drawings
c. Identify equipment by reference to equipment name and tag number shown on Contract Drawings
d. Scale and Measurements: Make drawings accurate to a scale with sufficient detail to show the kind, size, arrangement and function of component materials and devices
e. Minimum sheet size: 8.5" by 11"
f. Fabrication drawing size: 11" by 17" or 24" by 36"

2. Product Data
   a. Clearly mark each copy to identify pertinent products or models submitted for review
   b. Identify equipment by reference to equipment name and P&ID number
   c. Catalog cut sheets: Cross-out or hatch irrelevant data

D. Technical Submittals: Shop Drawings and Product Data Submittal Requirements
1. Shop Drawings and Product Data shall include the following, at a minimum:
   a. Specifications of manufacturer(s)
   b. Equipment parts and catalogs
   c. Bills of materials, material lists, and schedules
   d. Shop erection and fabrication drawings
   e. Drawings shall include equipment dimensions, weights, installation location requirements, plates required, main components, support details, anchor bolt details/sizes/locations, support base sizes, baseplate sizes, spacing and clearance requirements for installation, erection, operation and maintenance disassembly
   f. Electrical requirements:
      i) Shall include schematic diagrams including one-line diagrams, terminal block numbers, internal wiring diagrams, external connections, controls, and any other information as requested in individual specification sections
   g. List of spare parts
   h. Instruction and Operation and Maintenance (O&M) manuals
      i) As specified herein and in Specification Section 01730
   i. Manufacturer’s performance testing of equipment
   j. Concrete mix design data and information
   k. Performance characteristics and capacities
   l. External connections, anchorages, and supports required
   m. Other drawings, parts, catalogs, specifications, samples, or data necessary for the Engineer to determine conformance with Contract Documents
2. Samples – Office samples shall be of sufficient size and quantity to clearly illustrate:
   a. Functional characteristics of the product, with integrally related parts and attachment devices
   b. Full range of color, texture and pattern
   c. Comply with requirements identified in individual specification sections

E. Construction Schedule: Designate in the construction schedule, or in a separate coordinated shop drawing schedule, the dates for submission and the dates that reviewed Shop Drawings and Product Data will be needed, if accelerated review is requested

F. Field samples and Mock-ups:
   1. Contractor shall erect, at the Project Site, at a location acceptable to the Engineer and Owner
   2. Size or area: as specified in the respective specification section
   3. Fabricate each sample and mock-up complete and finished
   4. Remove mock-ups at conclusion of Work or when acceptable to Engineer

1.4 CONTRACTOR RESPONSIBILITIES

A. Review shop drawings and product data prior to submission for accuracy and completeness of each submission

B. Approve and stamp each submission before submitting to Engineer

C. Determine and verify:
   1. Field measurements
   2. Field construction criteria
   3. Catalog numbers and similar data
   4. Conformance with specifications and identification of all deviations
   5. Confirm assignment of unit responsibility

D. Prior to each submission, carefully review and coordinate all aspects of each item being submitted

E. Verify that each item and the corresponding submittal conform in all respects with specified requirements of the Work and of the Contract Documents with respect to means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto

F. Make submissions promptly in accordance with Construction Schedule, and in such sequence as to cause no delay in the Work or in the work of any other Contractor

G. Limit requirement for accelerated submittal review by Engineer to no more than 10% percent of total number of submittals
   1. Accelerated submittal review period: less than 14 calendar days

H. Notify Engineer in writing, at time of submission, of any deviations in the submittals from Contract Document requirements:
   1. Identify and tabulate all deviations in transmittal letter
   2. Indicate essential details of all changes proposed, including modifications to other facilities that may be a result of the deviation
   3. Include required piping and wiring diagrams

1.5 SUBMISSION REQUIREMENTS

A. Make submissions far enough in advance of scheduled dates for installation to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmissions, and for placing orders and securing delivery

B. In scheduling, allow fourteen (14) calendar days for review by Engineer following receipt of submission in Engineer's office:
   1. Time required to mail submissions or resubmissions is not considered a part of review period

C. Submittal Naming and Numbering
   1. Assign a unique number to include all shop drawings, product data and other information required for individual specification sections, beginning with #001.
   2. Resubmissions shall have the original number with a letter, starting with "A". If the first submittal required resubmission, it would be labeled #001A.
   3. Each specification section may still have more than one submittal number for later submissions (i.e., Preliminary O&M Manuals, Final O&M Manuals, etc.)
   4. Contractor shall use a consistent naming convention for all submittals

D. Quantity of Submittals Required
   1. Shop Drawings and Product Data:
      a. Initial submittal:
         i) Electronic – One (1) copy to Engineer
      b. Resubmittal:
         i) Electronic – One (1) copy to Engineer
      c. Final Submittal for Distribution
         i) Paper hard copy - Maximum of two (2) copies for Contractor's use, plus a maximum of three (3) copies which will be distributed by Engineer when approved. Do not submit more than five (5) copies
         ii) One (1) electronic copy to Engineer
      d. As –constructed document submittals
         i) Paper hard copy – Maximum of two (2) copies for Contractor's use, plus a maximum of three (3) copies which will be distributed by Engineer when approved. Do not submit more than five (5) copies
         ii) Electronic – One (1) copy to Engineer and one (1) copy to Owner
   2. Samples
      a. Initial submittal:
         i) Submit three (3) of each sample unless specified otherwise in individual specification section
      b. Resubmittal:
         i) Submit three (3) to Engineer
      c. One (1) sample of approved sample submittal will be returned to Contractor
   3. Informational submittals
      a. Technical reports and administrative submittals
         i) Electronic – One (1) copy to Engineer
         ii) Paper: Three (3) copies to Engineer
      b. Certificates and guarantees:

        i) Electronic – One (1) copy to Engineer
        ii) Paper: Three (3) copies to Engineer
    c. Test reports
        i) Electronic
        ii) Paper (as required)
            a) Owner: Two (2) copies
            b) Engineer: One (1) copy
            c) Contractor: Two (2) copies
            d) Manufacturer/supplier: One (1) copy
4. Instruction and O&M manuals
    a. In accordance to Specification Section 01730
5. At no additional cost to the Owner and whether or not submittals are copyrighted, the Owner may copy and use for staff training and/or internal operations any submittals approved for final distribution as well as required by this Contract

E. Submittal Transmittal Requirements
1. Accompany each submittal with a letter of transmittal showing all information required for identification and checking
2. Shall include:
    a. Drawing numbers and titles
    b. Revision number
    c. Electronic filename
    d. Deviations from Contract Documents: As specified herein
    e. Submittals unidentifiable will be returned for proper identification
    f. Date

F. Submittals Requirements
1. Submittal number
2. Date of submission and dates of any previous submissions
3. Project title and number
4. Owner Contract identification number if applicable
5. Names of:
    a. Contractor
    b. Supplier
    c. Manufacturer
6. Identification of the product, with the specification section number
7. Field dimensions, clearly identified as such
8. Relation to adjacent or critical features of the Work or materials
9. Applicable standards, such as ASTM or Federal Specification numbers
10. Identification of deviations from Contract Documents:
    a. If Contractor proposes to provide material or equipment of Work which deviates from the Project Manual, Contractor shall indicate so under “deviations” on the transmittal form accompanying the submittal copies
    b. Identify all requested deviations as specified and on the copies of Specifications and Drawings required by paragraph below.
11. Confirmation of compliance with Contract Documents and, if applicable, identification of deviations from Contract Documents:

a. Provide the following documents to demonstrate compliance with the contract specifications:
   i) A copy of the relevant Drawing(s) with all addendum updates that apply to the equipment in various Divisions marked to show specific changes necessary for the equipment proposed in the Contractor's submittal
      a) If no changes are required, the Drawing(s) shall be clearly marked "No Changes Required"
      b) Failure to include copies of relevant Drawing(s) with the submittal, whether changes are required or not, shall be cause for rejection of the entire submittal with no further review by Engineer
      c) Relevant Drawing(s) include as a minimum the control diagrams, process and instrumentation diagrams (P&IDs), and Process (P) drawings.
   ii) A copy of each pertinent specification section with all addendum updates included, all referenced and applicable specifications sections, with their respective addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate the requested deviations from the specification requirements:
      a) If deviations from the specifications are indicated and, therefore requested, by the Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation
      b) Failure to include a copy of the marked up specification sections, along with justification for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further review by Engineer

12. Identification of revisions on resubmissions
13. An 8" by 4" blank space for Contractor's and Engineer's stamps
14. Stamp cover sheet of each submittal as identified in letter of transmittal
15. Contractor's stamp: Initialed or signed, certifying review and approval of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Use stamp to include wording similar to the following:

> This submittal has been reviewed by [*Name of Contractor*] and approved with respect to the means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incidental thereto. [*Name of Contractor*] also warrants that this submittal complies with contract documents and comprises no deviations thereto:
> Section No:___ Submittal No:
> Date:_____ By:

G. For equipment that is provided directly by manufacturer without specification provide:
   1. Shop drawings: Illustrate complete assembly of products; foundation, installation and anchor requirements; dimensions and total weights of each, electrical wiring diagrams

2. Product data: Provide manufacturer’s literature including general assembly, materials of construction, model and type, detailed data describing parts and accessories, sufficient data to verify compliance with specifications
3. Manufacturer’s installation instructions: Provide detailed connection requirements and startup instructions
4. Manufacturer’s field report: Indicate personnel present and actual start-up procedures that were performed by manufacturer’s representative
5. Field report and test results shall be submitted to the Engineer by the Contractor

H. Submittal Log:
1. Maintain an accurate submittal log for duration of the Work showing current status of all submissions
2. Show submittal number, section number, section title, submittal description, dates and disposition of submittal
3. Make submittal log available to Engineer for Engineer's review upon request

I. Unless specified otherwise, make submissions in groups to facilitate efficient review and approval:
1. Include all associated items from individual specification sections to assure that all information is available for checking each item when it is received
2. Submit a complete initial submittal including all components when an item consists of components from several sources
3. Partial submittals may be rejected as not complying with provisions of the Contract
4. Engineer will not be held liable for delays due to poorly organized or incomplete submissions
5. Do not include items from more than one specification section for any one submittal number

J. Contractor may require subcontractors to provide drawings, setting diagrams and similar information to help coordinate the Work, but such data shall remain between Contractor and his subcontractors and will not be reviewed by Engineer unless specifically called for within the Contract Documents

K. All submittals for each component of multi-component systems shall be compiled and submitted through the Contractor to the Engineer by the manufacturer having System Responsibility

1.6 DISPOSITION OF SHOP DRAWINGS, PRODUCT DATA, AND INFORMATION SUBMITTALS

A. "No Exceptions Taken": Approved with No Corrections Noted
1. One copy sent to Owner
2. One copy sent to Resident Project Representative
3. One copy retained in Engineer's file
4. Remaining copies returned to Contractor for his use
   a. One copy to be kept on file at Contractor's office at job site
   b. Remaining copies for Contractor's office file, suppliers, or subcontractors

5. No corrections or comments noted on the submittal or on a Submittal Response Summary Sheet
6. Issues or miscellaneous comments pertaining to other related items of the Work may be included in transmittal letter
7. Resubmission not required

B. "Exceptions Noted": Approved with Corrections Noted
1. One copy sent to Owner
2. One copy sent to Resident Project Representative
3. One copy retained in Engineer's file
4. Remaining copies returned to Contractor for his use
   a. One copy to be kept on file at Contractor's office at job site
   b. Remaining copies for Contractor's office file, suppliers or subcontractors
   c. Copies of submittal data in operation and maintenance manuals to be revised according to corrections
5. Comply with corrections or comments as noted on the submittal or on a Submittal Response Summary Sheet
6. Resubmission not required

C. "Revise And Resubmit": Incorrect information provided or Significant Information Still Required
1. One copy sent to Resident Project Representative
2. One copy retained in Engineer's file
3. All remaining copies returned to Contractor for revision and re-submittal
4. Copy of transmittal letter and/or Submittal Response Summary Sheet sent to Owner. A "No Exceptions Taken" or "Exceptions Noted" submittal it will be forwarded to Owner after review per above disposition requirements
5. Submittal is either: incorrectly annotated; specific comments need to be addressed and incorporated in re-submittal; and/or additional information may be required as noted on the submittal or on a Submittal Response Summary Sheet
6. Submitted information may not include or address specific item required per the specification as identified on the submittal or on a Submittal Response Summary Sheet
7. Specific information related to identified item may be required for final approval of submittal
8. Resubmission of entire submittal may be required or resubmission of specific item may be required as identified on the submittal or on a Submittal Response Summary Sheet

D. "Rejected": Returned for Correction
1. One copy sent to Resident Project Representative
2. One copy retained in Engineer's file
3. All remaining copies returned to Contractor
4. Copy of transmittal letter and/or Submittal Response sent to Owner
5. Contractor required to resubmit complete submittal package in accordance with Contract Documents
6. Submittal does not comply with provisions of Contract Documents as noted on the submittal or on a Submittal Response Summary Sheet

7. Resubmission required

E. “Receipt Acknowledged”: For Reference Purposes Only, or for Record Copy:
1. Applicable to manufacturer or Contractor provided calculations and other miscellaneous documentation no subject to Engineer review and approval
2. One copy sent to Resident Project Representative
3. One copy retained in Engineer's file
4. One copy returned to Contractor
5. Copy of transmittal letter sent to Owner
6. Remaining submittal copies destroyed
7. Detailed review and comment by Engineer not required
8. Resubmission not required

1.7 DISPOSITION OF SAMPLES

A. "No Exceptions Taken": Approved with No Corrections Noted
1. One sample sent to Owner
2. One sample sent to Resident Project Representative
3. One sample retained in Engineer's file
4. Acknowledgement: Copy of transmittal letter sent to Contractor
5. Resubmission not required

B. "Exceptions Noted": Approved with Corrections Noted
1. One sample sent to Owner
2. One sample sent to Resident Project Representative
3. One sample retained in Engineer's file
4. Acknowledgement: Copy of transmittal letter sent to Contractor
5. Work performed or products furnished to comply with exceptions noted in acknowledgement
6. Resubmission not required

C. "Rejected": Returned for Correction
1. One sample retained in Engineer's file
2. Remaining samples sent to Contractor for resubmittal and compliance with the Contract Documents as noted in transmittal letter
3. Copy of transmittal letter sent to Owner
4. Resubmission required

1.8 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in submittals required by Engineer and resubmit until approved

B. Transmit each resubmission under new letter of transmittal. Use number of original submittal followed directly by a capital letter corresponding to the number of times a submittal is resubmitted (i.e., #001, #001A, #001B, etc.)

C. Shop Drawings and Product Data

1. Revise initial drawings or data and resubmit as specified for the initial submittal
2. Indicate any changes which have been made other than those requested by Engineer

D. Samples: Submit new samples as required for initial submittal

E. Reimbursement of Resubmission Review Costs:
1. Review of first submittal and one resubmittal will be performed by Engineer at no cost to Contractor
2. Cost for review of subsequent resubmissions will be directly paid by Contractor
3. Engineer will document work-hours required for review and costs for Engineer review will be deducted from payments due Contractor as Change Order deducts
4. Charges for review of resubmissions will include Engineer at maximum rate of $150 per hour and administrative staff at maximum rate of $75 per hour

1.9 PROJECT RECORD SUBMITTALS

A. After completion of the Work and prior to final payment, Contractor shall furnish record documents and final approved shop drawings and samples (as-constructed shop drawings and samples) in the number of copies specified herein.
1. Contractor shall provide additional copies of final approved shop drawings and samples for insertion in Equipment instruction and O&M manuals as required
2. All copies shall be clearly marked “Project Record”

1.10 ENGINEER'S DUTIES

A. Review submittals with reasonable promptness and in accordance with approved submission schedule provided that each submittal has been called for by the Contract Documents and is stamped by Contractor as indicated above
1. No extensions of time are allowed due to Engineer’s delay in reviewing submittals unless all the following criteria are met:
   a. Contractor has notified Engineer in writing that timely review of particular submittal in question is critical to the progress of the Work and Contractor has identified the requested submittal return date.
   b. Engineer has failed to return submittal within 21 days of receipt of the submittal or receipt of said notice, whichever is later
   c. Contractor demonstrates that delay in progress of the Work was directly attributable to Engineer’s failure to return submittal within 21 days
2. No extensions of time are allowed due to delays in progress of the Work caused by rejection and subsequent resubmission of data, including multiple resubmissions
3. Engineer’s review shall not extend to means, methods, techniques, sequences, construction operations, and safety precautions and programs incidental thereto. No information regarding these items will be reviewed whether or not included in submittals
4. In the event that Engineer will require more than 21 calendar days to perform review, Engineer shall so notify Contractor

B. Review drawings and data submitted only for general conformity with Contract Documents

1. Engineer's review of drawings and data returned marked No Exceptions Taken or Exceptions Noted does not indicate a thorough review of all dimensions, quantities, and details of material, equipment device or items shown
2. Engineer's review does not relieve Contractor of responsibility for errors, omissions or deviations nor responsibility for compliance with the Contract Documents

C. Assume that no shop drawing or related submittal comprises a deviation to the Contract Documents unless Contractor advises Engineer otherwise in writing which is acknowledged by Engineer in writing:
   1. Consider and review only those deviations from the Contract Documents clearly identified as such on the submittal and tabulated on the Contractor's transmittal sheet.

D. Review informational submittals for indications of Work or Material deficiencies and will respond to Contractor regarding such deficiencies

E. Return submittals to Contractor for distribution or for resubmission

F. Transmit, unreviewed, to Contractor all copies of submittals received directly from suppliers, manufacturers and subcontractors

G. Transmit, unreviewed, to Contractor all copies of submittals not called for by the Contract Documents or which have not been approved by Contractor

H. Engineer will not review uncalled-for shop drawings or product data except by special arrangement

I. Affix stamp and indicate approval for submittal or resubmission requirements with the following stamp:

☐ NO EXCEPTIONS TAKEN ☐ EXCEPTIONS NOTED
☐ REVISE & RESUBMIT ☐ REJECTED
This review was performed only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Modifications or comments made on the shop drawings and product data during this review do not relieve Contractor from responsibility for compliance with the requirements of the plans and specifications. Contractor is responsible for: dimensions and quantities; information that pertains solely to the fabrication processes or to the means, methods, of construction; coordination of the work of all trades.

JVA, Inc.

Date_____ By_____

1.11 SUBMITTAL SCHEDULE

A. Unless indicated otherwise, provide all submittals required by individual sections of the Contract Documents to establish compliance with the specified requirements.

B. Contractor to produce schedule of submittals for Engineer review

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Construction record photographs prior to commencing and during the course of the Work

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01700 – Contract Closeout: Project Record Documents

1.3 PHOTOGRAPHY REQUIRED

A. Take photographs of the existing conditions prior to commencing work to document existing conditions

B. Take photographs on the date on which each scheduled Application for Payment is due. Intent is for digital photos to be kept as project record

C. CD of Digital photos become the property of Owner

1.4 COSTS OF PHOTOGRAPHY

A. Pay all costs for specified photography and printing
   1. Parties requiring additional photography or prints will pay for them directly

1.5 DELIVERY OF PHOTOS

A. Submit digital photos to the Engineer with monthly pay requests or within 20 days of photo date

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 TECHNIQUE

A. Factual Presentation

B. Correct Exposure and Focus
   1. High resolution and sharpness

2. Maximum depth-of-field
3. Minimum distortion

3.2 VIEWS REQUIRED

A. Photograph from locations to adequately illustrate the condition of construction and the state of the Project
   1. Photographic survey of the existing site
      a. Show all areas to be modified
      b. Show all areas in which Contractor will conduct operations or store equipment
   2. Weekly photographs
      a. Minimum of eight (8) views weekly until final acceptance
      b. Views as designated by the Engineer or Owner

3.3 PHOTOGRAPH REQUIREMENTS FOR PROGRESS SITE PHOTOGRAPHS

A. Responsibility
   1. Site photographs for Owner record of construction progress shall be the responsibility of the Contractor
   2. Contractor shall be responsible for site photographs including the existing and progress of Work

B. Photographs shall include, but not limited to, the following:
   1. Existing site: Photographs of existing site conditions before site work commences
      a. Number of views shall be sufficient to cover the existing site conditions
   2. Progress of work: Shall include photographs from clearing throughout construction
      a. Number of views shall be sufficient to cover progress in Work and shall include a minimum of eight (8) different views
   3. After completion of Work: Shall be sufficient to show completed and finished Work

C. Digital images
   1. Provide images in uncompressed JPEG format
   2. Minimum resolution: 1500 x 2200
   3. Submitted digital images shall not be cropped

D. Identify each digital image file
   1. Name of project
   2. Orientation and description of view
   3. Date and time of exposure

3.4 ADDITIONAL PHOTOGRAPHS

A. Contractor shall provide additional photographs upon the request of the Engineer

B. Additional photographs may include, but not limited to, the following:
   1. Publicity photographs
   2. Special events at Project site
   3. Major phase of Work

4. Substantial Completion
5. Follow-up investigations for on-site events such as construction damage or losses
6. Additional record photographs during final acceptance

3.5 PROJECT RECORD

A. Submit CD of all photos, grouped by date

B. Engineer will distribute, after review
1. One copy of each view to Owner
2. One copy of each view to Engineer's file
3. One copy of each view returned to Contractor for inclusion in Project Record Document

END OF SECTION

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance / Control of installation

B. Inspection and testing laboratory services

C. Qualification of laboratory

D. Laboratory duties

E. Limitations of authority of testing laboratory

F. Contractor's responsibilities

G. Field testing

H. Testing and services schedule

1.2 RELATED SECTIONS

A. Section 01010 - Summary of Work

B. Section 01340 - Shop Drawings, Product Data, and Samples

C. Section 01600 - Material and Equipment

1.3 REFERENCES

A. Conform to reference standard by date of issue current on date of Contract Documents

B. Obtain copies of standards when required by Contract Documents

C. Where specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding

D. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Provide copies of written reports for materials, equipment or systems as scheduled at the end of this section. Reference each report by respective section number.

C. Laboratory Test Reports: Provide written reports of each test and inspection to Engineer. Each report shall include:
   1. Date issued
   2. Project title and number
   3. Testing laboratory name, address and telephone number
   4. Name and signature of laboratory inspector
   5. Date and time of sampling or inspection
   6. Record of temperature and weather conditions
   7. Date of test
   8. Identification of product and specification section
   9. Location of sample or test in the Project
   10. Type of inspection or test
   11. Results of tests and compliance with Contract Documents
   12. Interpretation of test results when requested by Engineer

D. Shop Test Reports: Provide reports detailing results of tests and certification from manufacturer to verify compliance with specifications

E. Field Test Reports: Provide reports detailing results of the tests. Indicate compliance or non-compliance with Contract Documents. Identify corrective action for materials and equipment which fails to pass field tests.

1.5 QUALITY ASSURANCE/CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality

B. Comply fully with manufacturer's instructions, including each step in sequence

C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship

E. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement

F. Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities: Conditions of the Contract

G. Certification of products: Respective sections of specifications

H. Laboratory tests required and standards for testing: Respective sections of specifications

1.6 INSPECTION AND TESTING LABORATORY SERVICES

A. Owner will employ and pay for the services of a testing agency to perform specified laboratory testing of materials where the technical specifications specifically obligate the Owner to provide the services
   1. It is the Contractor’s responsibility to initiate and coordinate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency no less than two (2) working days advance notification to schedule tests.
   2. Employment of the testing agency shall in no way relieve Contractor's obligations to perform the Work of the Contract
   3. Contractor shall employ and pay for the services of a testing agency to perform all specified services and testing not specifically identified in the technical specifications to be provided by Owner related to the design of mixes, products and equipment, to Engineer's review of proposed materials and equipment before, during and after incorporation in the Work and to retest materials and equipment which fail original tests

B. Retesting required because of non-conformance to specified requirements shall be performed by the same testing agency on instructions by the Engineer. Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the Contract Sum/Price

1.7 QUALIFICATION OF TESTING AGENCY

A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories

B. Meet basic requirements of ASTM E 329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction" as applicable

C. Authorized to operate in the State in which the Project is located

1.8 TESTING AGENCY DUTIES

A. Cooperate with Engineer and Contractor; provide qualified personnel after due notice

B. Perform specified inspections, sampling, and testing of materials and methods of construction
   1. Comply with specified standards
   2. Ascertain compliance of materials with requirements of Contract Documents

C. Promptly notify Engineer and Contractor of observed irregularities or deficiencies of work or products

1.9 LIMITATIONS OF AUTHORITY OF TESTING AGENCY

A. Testing Agency Is Not Authorized To
   1. Release, revoke, alter or enlarge on requirements of Contract Documents
   2. Approve or accept any portion of the Work
   3. Owner employed testing agency shall not perform any duties of the Contractor

1.10 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory and testing agency personnel and provide access to Work

B. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and which require testing

C. Provide to the laboratory the preliminary design mix proposed to be used for concrete and other material mixes which require control by the testing laboratory

D. Furnish copies of product test reports as required

E. Furnish Incidental Labor and Facilities
   1. To provide access to Work to be tested
   2. To obtain and handle samples at the project site or at the source of the product to be tested
   3. To facilitate inspections and tests
   4. For storage and curing of test samples

F. Cooperate with testing agency; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested
   1. Notify Engineer and testing agency 24 hours prior to expected time for operations requiring services to allow for scheduling of tests and laboratory assignment of personnel
   2. Make arrangements with testing agency and pay for additional samples and tests required for Contractor's use

1.11 FIELD TESTING

A. Owner shall pay all costs associated with standard field testing of materials as detailed in these specifications. Contractor shall pay all costs for testing of piping and equipment as detailed in these specifications. Owner’s independent firm will take concrete samples, cure and break samples and report results. Owner's independent firm will also provide compaction testing and proctors for backfill operations. Contractor shall pay for all retesting due to tests indicating failed conditions.

B. Provide all required materials, labor, equipment, water, and power required for testing

C. Perform all tests in presence of Engineer and provide one copy of field test results to Engineer same day of tests

D. Repair with no additional compensation all materials and equipment which fail during testing

E. Field testing shall be provided for, but shall not be limited to, the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
02300	Earthwork	O
02616	Site Piping	C
02676	Disinfection of Water System	C
02740	Asphalt	O
03300	Cast-In-Place Concrete	O
15060	Pipe and Pipe Fittings	C

1.12 LABORATORY TESTING AND SERVICES SCHEDULE

A. Testing laboratory services shall be provided for, but shall not be limited to, the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
02300	Earthwork	C
02740	Asphalt Mixes	O
03000	Concrete Mixes	C

1.13 SHOP TESTING AND SERVICES SCHEDULE

A. Shop testing shall be provided for the following:

Specification Section	Type of Material, Equipment, or System	Owner (O) or Contractor (C) Provided
Division 11	Refer to individual specifications for shop testing requirements by manufacturer	C

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities: Electricity, lighting, heating, ventilating, telephone service, water and sanitary facilities

B. Temporary Controls: Barriers, enclosures and fencing, protection of the Work, and water control.

C. Construction Staging Facilities: Access roads, parking areas, progress cleaning, project signage, storage and temporary buildings.

1.2 GENERAL REQUIREMENTS

A. Furnish, install and maintain all temporary utilities to assure continuous service required for the Work, except as allowed herein, and remove on completion of Work. Modify and extend systems, as work progress requires.

B. Furnish, install and maintain all construction aids required for the Work, except as allowed herein, and remove on completion of the Work

C. Furnish, install and maintain fences and barriers as required for protection of the public, property and the Work

D. Contractor may use existing roadways for access and parking only where designated by Owner.

E. Provide a field office for the use of the Contractor's Superintendent, Owner's Representatives, and Engineer in the designated staging area

F. Products may be new or used, but must be serviceable, adequate for the intended purpose, and must not violate the requirements of any applicable codes or standards

G. Clean and repair damage caused by temporary installations or use of temporary facilities. Grade and seed all disturbed areas not detailed on the drawings for other treatment

H. Provide contractor information sign posted at accessible location with contractor name and emergency phone contact information. Provide and post necessary information related to SRF requirements.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies

1. Comply with applicable Federal and State rules and regulations, local codes and ordinances
2. Comply with utility company requirements

1.4 TEMPORARY ELECTRICITY

A. Contractor shall pay all costs associated with power service to the field offices and pay all costs for energy used.

B. Arrange for and pay all costs associated with temporary power service either from the local utility or a portable engine-generator

C. Provide power outlets for construction operations, with branch wiring and distribution boxes located at the site. Provide flexible power cords as required

D. Provide main service disconnect and over current protection at convenient location

E. Pay all costs for installation and removal of temporary electrical service

1.5 TEMPORARY LIGHTING

A. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required

B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required

C. Maintain lighting and provide routine repairs

1.6 TEMPORARY WATER SERVICE

A. Potable water does exist on the site. Provide and pay for all temporary potable water piping and hoses to bring to Contractor’s construction facilities and drinking water stations. Install a meter at a location approved by the Owner.

B. Provide all drinking water required by construction personnel and Owner's representatives. Pay all costs for temporary water service.

1.7 TEMPORARY SANITARY FACILITIES

A. Provide sanitary facilities at staging area
1. As required by laws and regulations
2. Not less than 1 facility

B. Service, clean and maintain facilities and enclosures

1.8 TEMPORARY SANITARY FACILITIES

A. Provide sanitary facilities at staging area

1. As required by laws and regulations
2. Not less than 1 facility

B. Service, clean and maintain facilities and enclosures

1.9 CONSTRUCTION AIDS

A. Provide construction aids and equipment required by personnel and to facilitate the execution of the Work: scaffolds staging, ladders, stairs, ramps, runways, platforms, railways, hoists, cranes, chutes and other such facilities and equipment

B. Relocate construction aids as required by progress of construction, by storage or work requirements, and to accommodate legitimate requirements by Owner

C. Completely remove temporary materials, equipment, and services at completion of the Project

D. Clean, repair damage caused by installation or by use of temporary facilities
1. Remove foundations and underground installations for construction aids
2. Grade the areas for the site affected by temporary installations to required elevations and slopes and clean the area and seed unless specified as shown on the drawings to be different

1.10 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition

B. Provide suitable barriers as required for public protection of Owner's employees

C. Protect non-owned vehicular traffic, stored materials, site and structures from damage

D. Install facilities of a neat and reasonable uniform appearance, structurally adequate for the required purposes

E. Relocate barriers as required by progress of construction

F. Completely remove barriers, including foundations, when construction has progressed to the point that they are no longer needed

G. Clean and repair damage caused by installation, fill and grade the areas of the site to required elevations and slopes and clean the area

1.11 TEMPORARY FENCING

A. Construction: Commercial grade chain link fence

B. Provide additional fencing to protect stored materials & products or to insure public safety and the safety of Owner's employees

C. Provide Owner two (2) keys to lock(s)

D. The site of the work is fenced

1.12 STORMWATER MANAGEMENT

A. Refer to SWMP in the drawings and comply with all conditions of CDPHE Stormwater Discharge Permit. Contractor responsible for both permit filing and any required reporting.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment as necessary.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Perform work in phases and restore areas where work is complete.

1.13 FUGITIVE DUST PERMIT

A. Comply with all conditions of CDPHE Fugitive Dust Permit. Contractor responsible for both permit filing and any required reporting.

B. Contractor to pay for all metered water used in dust abatement

1.14 CONSTRUCTION DEWATERING

A. Comply will all conditions and requirements of CDPHE Construction Dewatering Permit. The Contractor shall be responsible for any permit filing and reporting necessary.

1.15 EROSION AND SEDIMENT CONTROL

A. Install sediment control fencing at site perimeter where necessary to prevent erosion and sedimentation from occurring off site.

B. During and after site grading, maintain a roughened surface on all disturbed areas to minimize erosion potential.

C. Construct and maintain drainage swales with staked straw bale barriers to control drainage patterns and minimize erosion.

D. Provide and maintain gravel sediment traps at inlets to prevent siltation.

E. Provide and maintain rock check dams if required.

F. Soils can be stockpiled on site as directed by Owner. Rock to be hauled off not crushed and stockpiled onsite.

1.16 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification Sections

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage

C. Protect finished driving surfaces, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects

D. Prohibit construction traffic from entering future landscaped areas after grades have been established and topsoil restored

1.17 SECURITY

A. Provide security and facilities to protect Work from unauthorized entry, vandalism, or theft

B. Coordinate with Owner's security program

1.18 ACCESS ROADS

A. Maintain existing roads accessing public thoroughfares to construction staging area.

B. Extend and relocate as Work progress requires. Provide detours necessary for unimpeded traffic flow

C. Provide and maintain access to existing fire hydrants free of obstructions

D. Provide means of removing mud from vehicle wheels before entering public paved streets as required by SWMP and Owner

1.19 PARKING

A. Paved and unpaved surfaces adjacent to the staging area can accommodate construction personnel until the designated building staging area has been established

B. If staging area space is not adequate, provide additional off-site parking at location designated by Owner

1.20 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition

B. Remove waste materials, debris, and rubbish from site periodically and dispose off-site in accordance with local and state regulations. Due to high winds experienced at the site, waste removal must be done immediately after it is generated

1.21 FIELD OFFICES AND SHEDS

A. Construction
   1. Structurally sound, weather-tight, with floors raised above ground
   2. Temperature transmission resistance: Compatible with occupancy and storage requirements
   3. At Contractor's option, portable or mobile buildings modified for office use may be used
   4. Fill and grade sites for temporary structures to provide surface drainage
   5. Construct temporary field offices and storage sheds on proper foundations, provide connections for utility services
      a. Secure portable or mobile buildings for winds to 110 mph
      b. Provide steps and landings at entrance door
   6. Mount thermometer at convenient outside location, not in direct sunlight
   7. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment and services
   8. Remove temporary field offices, contents, and service at a time they are no longer needed
   9. Remove storage sheds when they are no longer needed
   10. Remove foundations and debris; grade the site to required elevations and clean the areas

B. Contractor's Office and Facilities
   1. Size: As required for general use and to provide space for project progress meetings
   2. Furnishings in meeting area
      a. Conference table and chairs for at least 12 persons
      b. Racks and files for project record documents in, or adjacent to, the meeting area
      c. Engineer and Owner will have use of meeting area and telephone when on site. Meeting area: 200 square feet minimum, minimum dimension 8 feet
   3. Other furnishings: Contractor's option
   4. One 10-inch outdoor-type thermometer

C. Existing facilities at the site shall not be used for field offices or storage

D. Fire protection equipment. Contractor shall provide and maintain fire extinguishers and active fire hydrants where indicated, maintain fire lanes to hydrants, and provide other equipment as necessary for proper fire protection during construction. Such equipment shall be for fire protection only.

1.22 REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Final Application for Payment

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated

C. Clean and repair damage caused by installation or use of temporary work

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01600

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Administrative and procedural requirements governing Contractor's selection of products for use in Project and for Work including, but not limited to, the following:
   1. Definitions
   2. General Requirements for Materials and Equipment
   3. Environmental Conditions
   4. Submittals
   5. Quality Assurance and Qualifications
   6. System Responsibility
   7. Transportation and Shipment
   8. Delivery, Storage and Handling
   9. Maintenance Materials
   10. Warranty
   11. Equipment and Product Selection and Identification
   12. Examination, Installation, Adjusting and Cleaning

1.2 RELATED SECTIONS

A. Section 01010 – Summary of Work

B. Section 01340 – Shop Drawings, Product Data, and Samples

C. Section 01400 – Quality Control

D. Section 01650 – Starting of Systems

E. Section 01730 – Operation and Maintenance Data

F. Section 03000 – Concrete

G. Section 11229 – Coarse Bubble Aeration

H. Section 11316 – Rotary Lobe Sludge Pumps

I. Section 11321 – Grit Classifier

J. Section 11322 – Mechanically-Induced Vortex Grit Removal Equipment

K. Section 11332 – Center Flow Band Screen and Washer Compactor

L. Section 11377 – Rotary Lobe Blowers

M. Section 11380 – Dewatering System (Installation Only)

N. Section 11635 – Automatic Sampler

O. Section 15100 – Valves, Cocks, and Hydrants

P. Section 15835 – Exhaust Fans

Q. Section 15850 – Air Outlets and Inlets

1.3 REFERENCES

A. American Bearing Manufacturers Association (AFBMA)
   1. Std 9-90 – Load Ratings and Fatigue Life for Ball Bearings
   2. Std 11-90 – Load Ratings and Fatigue Life for Roller Bearings

B. American Gear Manufacturer Association (AGMA)

C. ANSI B1.1-89 – Unified Screw Threads

D. ANSI B 1.20. 1-83-Pipe Threads, General Purpose (Inch)

E. ANSI B16.1-89-Cast Iron Pipe Flanges and Flanged Fittings, Class 125

F. ANSI B18.2.1-81-Square and Hex Bolts and Screws, Including Askew Head Bolts, Hex Cap Screws, and Log Screws

G. ANSI B18.2.2-87-Square and Hex Nuts

H. NSF/ANSI 60-2012 – Drinking Water Treatment Chemicals – Health Effects

I. NSF/ANSI 61-2012 – Drinking Water System Components – Health Effects

J. Hazardous (Classified) Locations: Conform to requirements of NFPA70 Articles 500 through 504

1.4 DEFINITIONS

A. Definitions used in this specification section are not intended to change the meaning of other terms used in the Contract Documents, such as “specialties,” “systems,” “structure,” “finished,” “accessories,” and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry

B. Products: Items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term “product” includes the terms “material”, “equipment”, “system”, and terms of similar intent

C. Named products: Items identified by manufacturer’s product name, including make or model number of other designation, shown or listed in the manufacturer’s published

product literature that is current as of date of Contract Documents

D. Foreign products: Distinguished from “domestic products” are items substantially manufactured (50 percent or more of value) outside of the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens or, nor living within, the United States and its possessions are also considered to be foreign products

E. Materials: Products substantially shaped, cut, worked, mixed, finished, refined, or otherwise fabricated, processed, or installed to form a part of the Work

F. Equipment: Product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping

G. Special tools, instruments, devices, or accessories: Any tools, instruments, devices or accessories required for repair, adjustment or maintenance of equipment which are designed especially for the equipment in question or which are not normally kept in stock by local tool suppliers

H. Responsible manufacturer: Unless otherwise specified, responsible manufacturer shall be manufacturer of driven equipment. Agents, representatives or other entities who are not a direct component of manufacturing corporation will not be acceptable as a substitute for manufacturer's corporation in meeting this requirement

1.5 GENERAL REQUIREMENTS

A. The section applies to all equipment provided under this contract

B. The requirements of detailed specifications take precedence over this section in the event of an apparent conflict

C. Provide all new equipment and materials, except as specified or required by testing

D. Equipment and materials removed from existing structure: Do not use in completed Work except where specifically indicated or specified

E. Contractor to coordinate equipment with other parts of the Work, including verification or compatibility of structures, piping, wiring and equipment components

F. Contractor is responsible for all alterations in the Work to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or specifications:
   1. The arrangement of equipment shown on the Drawings is based upon information available to the Owner at the time of the design and is not intended to show exact dimensions unique to a specific manufacturer
   2. More than one manufacturer has been used for mechanical layout and design to accommodate all named manufacturer's

3. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements as provided by the Contractor
4. Structural supports, foundations, connected piping, valves and electrical conduit specified may have to be altered as coordinated by the Contractor during the submittal process to accommodate the actual equipment provided by the Contractor
5. No additional payment will be made to the Contractor for such revisions and alterations

G. Do not use any material or equipment for any purpose other than that for which is designed or specified

H. Equipment lists presented in these specifications and as specified on the Drawings are included for the convenience of the Engineer and Contractor and are not to be considered as complete listings of all equipment, devices and material to be provided under this contract:
   1. Contractor shall prepare his own material and equipment take-off lists as necessary from the contract Drawings, addenda and this project manual to meet the requirements of this project

1.6 ENVIRONMENTAL CONDITIONS

A. Project is a wastewater treatment plant where dilute concentrations of corrosive chemicals, gasses, fuels, high humidity, and other constituents may be expected to be present

B. Various corrosive or explosive mixtures of liquids including; oxidizers (chlorine and chlorine dioxide), solvents, grease, gasoline and other hazardous materials may be present

C. Minimum Design Criteria:
   1. Altitude: 7,500 feet above mean sea level
   2. Outdoor air temperature: -30 to 105 degrees F
   3. Relative Humidity:
      a. Summer time: 95 percent
      b. Winter time: 5 percent

1.7 SUBMITTALS

A. Provide submittals in accordance with Section 01340 – Shop Drawings, Product Data, and Samples

B. Submittals for products are specified in Section 01340 – Shop Drawings, Product Data, and Samples and in Divisions 2 through 16

C. All submittals for each component of multi-component systems shall be compiled and submitted through the Contractor to the Engineer by the manufacturer having system responsibility

D. Provide a copy of this specification section with all addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate the requested deviations from the specification requirements.

E. Provide Certificate of System Responsibility

F. Tanks, ventilation duct and other equipment mounted outdoors with anchorage and mounting product data for reference purposes:
   1. Include wind loads
   2. Include snow loads

G. Manufacturer's certified data showing location of critical speeds in relation to operating speeds

H. Inverter duty motors: Include motor manufacturer's certification that motor is compatible with variable frequency controllers (drives) to be used with motor as specified in Section 16150 and Section 16200

1.8 QUALITY ASSURANCE AND QUALIFICATIONS

A. Source limitations and interchangeability: To the fullest extent possible, provide products of the same kind from a single source

B. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer’s or producer’s nameplate or trademarks on exposed surface of products that will be exposed to view in occupied spaces or on the exterior
   1. Labels: Locate required product labels and stamps on concealed surfaces, or where required for observation after installation, on inconspicuous, accessible surfaces.
   2. Equipment nameplates: Provide a permanent nameplate on each item of service – connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. Nameplate shall contain, but not limited to, the following information and other essential operating data:
      a. Name of product and manufacturer
      b. Model and serial number
      c. Capacity
      d. Speed
      e. Ratings
      f. Operating and power characteristics
      g. Labels of tested compliance with codes and standards
   3. Refer to additional requirements specified in Divisions 2 through 16

C. Installers Qualifications:
   1. Equipment and material: Installed and placed in service by or under guidance of qualified personnel having knowledge and experience necessary for proper results
   2. Where Contractor's or subcontractor's employees are not properly qualified, use personnel such as factory authorized field representative of equipment supplier

1.9 SYSTEM RESPONSIBILITY

A. Equipment systems made up of two or more components shall be provided as a single system by the responsible manufacturer. Unless otherwise specified, the Contractor shall assign system responsibility to, and obtain each system from the manufacturer of the driven equipment. The manufacturer shall design and provide all components of the system to enhance proper operation, compatibility of all components, ease of construction and efficient maintenance. The responsible manufacturer shall coordinate selection and design of all system components such that all equipment is compatible and operates properly to achieve the performance requirements specified. The Contractor is responsible to the Owner for performance of all systems as provided in the General and Special Conditions.

B. Nothing in this provision shall be construed as relieving the Contractor of overall responsibility for the Work of this Contract and the performance of all systems as specified under paragraphs 00700 – Standard General Conditions, Article 13

1.10 TRANSPORTATION AND SHIPMENT

A. Shipment preparation: Contractor shall require manufacturers and suppliers to prepare equipment and materials for shipment in a manner to facilitate unloading and handling, and to protect against damage or unnecessary exposure in transit and storage, for contractor supplied equipment. Provisions for protection shall include the following:
   1. Crates or other suitable packaging materials
   2. Covers and other means to prevent corrosion, moisture damage, mechanical, injury, and accumulation of dirt in motors, electrical equipment, and machinery
   3. Suitable rust-preventive compound on exposed machined surfaces and unpainted iron and steel
   4. Grease packing or oil lubrication in all bearings and similar items

B. Marking
   1. Each item of equipment and material shall be tagged or marked as identified in the delivery schedule or on submittals
   2. Complete packing lists and bills of material shall be included with each shipment.
   3. Each piece of every item need not be marked separately, provided that all pieces of each item are packed or bundled together and the packages or bundles are properly tagged or marked

1.11 DELIVERY, STORAGE, AND HANDLING

A. Delivery
   1. Arrange deliveries of equipment and materials in accordance with construction schedules, in ample time to facilitate inspection prior to installation and to avoid delay of Work. Coordinate to avoid conflict with work and conditions at the site
   2. Deliver products in undamaged condition, in manufacturer's sealed, weather tight, original container or packaging, with identifying labels intact and legible, all in accordance with manufacturer's instructions and recommendations using means and methods that will prevent damage, deterioration, and loss, including theft
   3. Control delivery schedules to minimize long-term storage at the Site and to prevent overcrowding of construction spaces. Coordinate delivery and installation to ensure

minimum holding or storage times for items known or recognized to be flammable hazardous, easily damaged, or sensitive to deterioration, theft, and other sources of loss

4. Products delivered to Work site shall be in undamaged condition, in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing
5. Mark deliveries of component parts of equipment to identify the equipment, to permit easy accumulation of parts, and to facilitate inspection and measurement of quantity or counting of units
6. Immediately on delivery, inspect shipment to ensure:
   a. Product complies with requirements of Contract Documents and reviewed Submittals
   b. Quantities are correct
   c. Containers and packages are intact and labels are legible
   d. Equipment and materials are properly protected and undamaged
7. Include complete packing lists and bills of material with each shipment including equipment identification number assigned by Drawings and Specifications of this Contract
8. Deliver anchor bolts together with templates sufficiently early to permit setting when structural concrete is placed

B. Storage
1. If there is no interior space available from the Owner for storage of delivered equipment and material at the project site:
   a. Provide adequate facilities for storage in accordance with Section 01500
   b. Provide off-site storage and protection when site does not permit on-site storage or protection and if acceptable to Owner in accordance with the General Conditions
2. Submit and maintain insurance for equipment and materials at off-site storage
3. Requests for payment of stored equipment and materials by the Contractor may be rejected if storage facilities do not conform to these specifications or manufacturer's written recommendations.
4. Store equipment and materials immediately on delivery, and protect until completion of the Work. Store in accordance with manufacturer’s instructions with seals and labels intact and legible
5. Store equipment and materials in a manner that will not endanger the supporting construction
6. Store equipment and materials that are subject to damage by elements in weathertight enclosures
7. Maintain temperature and humidity within ranges required by manufacturer
8. Protect motors, electrical equipment, plumbing fixtures, and machinery of all kinds against corrosion, moisture deteriorations, mechanical injury, and accumulation of dirt or other foreign matter
9. Protect electrical equipment, controls, and insulation against moisture, water, and dust damage
10. Immediately after delivery and inspection, connect and operate continuously all space heaters furnished in electrical equipment

11. Protect exposed-machined surfaces and unpainted iron and steel as necessary with suitable rust-preventive compounds
12. Protect bearings and similar items with grease packing or oil lubrication
13. Handle and store steel plate, sheet metal, and similar items in a manner to prevent deformation
14. Exterior storage:
    a. Provide substantial platforms, blocking, or skids to support fabricated products aboveground and to prevent soiling or staining. Cover products subject to discoloration or deterioration from exposure to elements, with impervious sheet coverings. Provide adequate ventilation to avoid condensation
    b. Store loose granular materials on solid surface areas to prevent mixing with foreign matter
    c. Provide surface drainage to prevent flow or ponding of rainwater
15. Equipment and materials shall not show any pitting, rust, decay or other deleterious effects of storage prior to final acceptance of Work
16. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure products are maintained under specified conditions and free from damage or deterioration
    a. Prepare stored materials lists with schedules of maintenance activities and frequency of activities required to maintain the quality of the equipment and the warranty from the manufacturer
    b. List dates and activities of storage requirements such as rotating moveable parts
    c. Update lists weekly and include in progress meeting agenda
17. Protect painted surfaces against impact, abrasion, discoloration or other damage:
    a. Repaint any damaged areas with manufacturer provided touch-up paint
18. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation
19. Installed products stored prior to start-up:
    a. Equipment and materials shall not show any pitting, rust, decay or other deleterious effects of storage when installed in the Work
    b. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations, dust, dirt, water and paint. Remove when no longer needed

C. Handling
1. Provide equipment and personnel necessary to unload and handle equipment and materials, by methods to prevent damage or soiling to equipment and materials or packaging
2. Handle by methods to prevent bending or overstressing. Where lifting points are designated, lift components only at those points
3. Provide additional protection to surrounding surfaces as necessary to prevent damage

D. Maintenance of storage
1. Inspect stored equipment and materials on a scheduled basis
2. Verify that storage facilities comply with manufacturer's product storage requirements, including environmental conditions continually maintained

3. Verify that surfaces of products exposed to elements are not adversely affected; that any weathering of finishes is acceptable under requirements of Contract Documents
4. For mechanical and electrical equipment in long-term storage, provide manufacturers service instructions to accompany each item, with notice of enclosed instructions on exterior of package. Service equipment on a regularly scheduled basis.

E. Protection after installation
1. Provide substantial coverings as necessary to protect installed equipment and materials from damage from subsequent construction operations
2. Remove when no longer needed or as specified

1.12 MAINTENANCE MATERIALS

A. Spare Parts:
1. Store spare parts, wherever required by detailed technical specification sections, in accordance with the provisions of this paragraph
2. Tag all spare parts with permanent, labeled tags or packaging by equipment designation number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate)
3. Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping
4. Unless otherwise specified, spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box:
   a. Provide box with a hinged wooden cover and locking hasp
   b. Hinges to be strap type
   c. Paint the box and identify with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts"
5. Prepare and provide a neatly typed inventory of spare parts taped to the underside of the box cover

1.13 WARRANTY

A. Warranty all equipment and materials against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, leakage, breakage or other failure

B. Unless otherwise specified, for all equipment and materials provide manufacturer's warranty for a period of 2 years from the date of Substantial Completion

C. Warranties that begin at the time of shipment, delivery or within a limited time period from date of shipment or delivery or any other qualification that does not conform to the definition of Substantial Completion are not acceptable

D. Cost of all manufacturer warranties are considered as part of the Bid price

PART 2 PRODUCTS

2.1 MATERIALS

A. Suitable for the intended service conditions

B. Structural and miscellaneous fabricated steel in equipment shall conform to American Institute of Steel Construction (AISC) standards, except as otherwise specified

2.2 FABRICATION

A. Design, fabricate, and assemble in accordance with the best modern manufacturing and shop practices

B. Manufacture parts to standard sizes and gages

C. Two or more items of the same type shall be identical by the same manufacturer and interchangeable

2.3 EQUIPMENT AND PRODUCT SELECTION

A. General product requirements: Provide products that comply with the Contract Document, are undamaged, and unless otherwise indicated or specified, are new at time of installation
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a 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. Continued availability: Where, because of the nature of its application, the Owner is likely to need replacement parts or additional amounts of a product at a later date, either for maintenance and repair or replacement, provide standard, domestically produced product for which the manufacturer has published assurances that the product and its parts shall be available to the Owner at a later date. A reasonable doubt regarding such future availability will be grounds for rejection of products other than named products
   4. As specified in each applicable Specification Sections, Drawings, codes, standards, and regulatory agencies
   5. Fabricated products:
      a. Design, fabricate, and assemble products in accordance with best engineering and shop practices
      b. Manufacture like parts of duplicate units to standard interchangeable sizes and gauges. Two or more items of same kind shall be identically made by the same manufacturer
      c. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically accepted in writing by Owner
      d. Ensure that material or equipment are not used for any purpose other than that for which it is designed or is specified

e. Labels and nameplates shall be provided where required by regulatory agencies or in accordance to state identification and essential operation data

6. Provide products of the same kind from a single source to the fullest extent possible

2.4 EQUIPMENT AND PRODUCT IDENTIFICATION

A. Nametags: Identify all valves, instruments, devices, with the equipment tag designation numbers and prefix and suffix letters as specified and/or shown on the Process and Instrumentation Drawings (P&IDs). Identification shall also be in accordance with Section 01080 – Identification Systems.

B. Nameplates: Identify all pumps and equipment with the equipment tag designation numbers and prefix and suffix letters as specified and/or shown on the Process and Instrumentation Drawings (P&IDs):

1. Provide engraved or machine stamped non-corrosive metal nameplate fastened to the pump or equipment base plate with screws or drive pins of the same material
2. Nameplate material shall not corrode or discolor in moist or salt water spray atmosphere
3. Name plates indicate the following:
   a. Manufacturer
   b. Date of manufacture
   c. Name of product
   d. Model and size
   e. Serial Number
   f. Capacity: Rating in gpm or SCFM (if a fan or blower) and feet of head or inches water column
   g. Impeller or wheel diameter (if a fan)
   h. Impeller diameter
   i. Operating and power characteristics
   j. As specified herein and in Divisions 2 through 16
4. Motor Nameplates:
   a. All motors for pumps and other equipment having motors shall be identified as specified elsewhere under this Section and in Divisions 2 through 16

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install any equipment showing such effects. Replace damaged equipment with identical new equipment

3.2 INSTALLATION

A. Install all equipment, accessories and materials in accordance with the manufacturer's written recommendations unless otherwise specified in the individual equipment detailed technical specifications

B. Each product shall be securely anchored in place except as required for proper movement and performance

C. Each product shall be located and aligned with other Work

D. Manufacturer’s Instructions
   1. Contractor shall obtain and distribute hard copies and electronic copies of manufacturer’s instructions and recommendations to parties involved in installation including a copy to Engineer
   2. Maintain one (1) set of complete instructions at job site during installation and until completion
   3. Handle, install, connect, clean, conditions, and adjust products in accordance with such instructions and in conformity with specified requirements

3.3 ADJUSTING

A. Perform all required adjustment tests, operation checks, and other startup activities required

3.4 CLEANING

A. Perform under provisions of Section 01700 – Contract Closeout

B. Repaint all painted surfaces which are damaged prior to final equipment acceptance to Owner's satisfaction

C. Clean exposed surfaces and protect as necessary and required to prevent any damage or deterioration at the time of Substantial Completion

END OF SECTION

SECTION 01650

STARTING OF SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Starting systems

B. Demonstration, instructions, and training

C. Testing, adjusting, and balancing

1.2 RELATED SECTIONS

A. Section 01730 – Operation and Maintenance Data

1.3 STARTING SYSTEMS

A. Provide Engineer with start-up and training schedule at least 14 days prior to the startup of the equipment

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage

C. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer

D. Verify wiring and support components for the equipment are complete and tested

E. Execute start-up under supervision of responsible manufacturer's representative in accordance with manufacturers' instructions

F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and supervise placing equipment or system in operation

G. Submit a written report certifying that equipment or system has been properly installed and is functioning correctly

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel within 7 days prior to date of Substantial Completion

B. Utilize Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation, maintenance, and troubleshooting

C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location

D. Prepare and insert additional data in Operations and Maintenance Manuals when need for additional data becomes apparent during instruction

E. The amount of time required for instruction on each item of equipment and system is that specified in individual sections

F. Owner may videotape training sessions. Contractor and manufacturer's trainer to cooperate with videotaping

1.5 TESTING, ADJUSTING, AND BALANCING

A. Contractor will employ and pay for services of an independent firm to perform testing, adjusting, and balancing as required by individual specification sections or on the Drawings

B. Reports will be submitted by an independent firm to the Engineer, through the Contractor, indicating observations and results of tests and indicating compliance or non-compliance with specified or regulatory requirements and with the requirements of the contract

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Substantial completion

B. Final acceptance

C. Project record documents

D. Closeout procedures

E. Final cleaning

F. Final adjustment of accounts

G. Final application for payment

1.2 RELATED SECTIONS

A. Section 00700 – General Conditions

B. Section 01500 – Construction Facilities and Temporary Controls

C. Section 01340 – Shop Drawings and Product Data

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Prior to requesting inspection for certification of Substantial Completion, complete the following and list exceptions in the request:
   1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100% completion for the portion of the Work claimed as Substantially Complete
      a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Price
      b. If 100% completion cannot be shown, include a list of incomplete items, the value of incomplete Work, and reasons the Work is not complete. All items remaining outstanding on the Contractor's punch list shall include a projected date of completion and/or correction with an explanation of why such item is not presently completed
   2. Advise Owner of pending insurance changeover requirements
   3. Submit specific warranties, workmanship Bonds, maintenance agreements, final certifications, and similar documents

4. Obtain and submit releases enabling Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases
5. Submit record drawings, instruction books and operating manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information
6. Deliver tools, spare parts, extra stock, and similar items
7. Make final changeover of permanent locks and transmit keys to Owner. Advise Owner's personnel of changeover in security provisions
8. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes

B. Inspection Procedures: On receipt of a request for inspection, Engineer will either proceed with inspection or advise Contractor of unfilled requirements. Engineer will prepare the Certificate of Substantial Completion following inspection or advise Contractor of construction that must be completed or corrected before the certificate will be issued
   1. Engineering will repeat inspection when requested and assured by Contractor that the Work is Substantially Complete.
   2. Results of the completed inspection will form the basis of requirements for final acceptance

1.4 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
   1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required
   2. Submit an updated final statement, accounting for final additional changes to the Contract Price
   3. Submit a certified copy of Engineer’s final inspection list of items to be completed or corrected, endorsed and dated by Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and shall be endorsed and dated by Engineer.
   4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the Date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work
   5. Submit consent of surety to final payment
   6. Submit evidence of final, continuing insurance coverage complying with insurance requirements

B. Reinspection Procedure: Engineer will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to Engineer.

1. Upon completion of reinspection, Engineer will prepare a certificate of final acceptance. If the Work is incomplete, Engineer will advise Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance
2. If necessary, reinspection will be repeated, but at the expense of the Contractor who will reimburse the Owner for these services by the Engineer

1.5 PROJECT RECORD DOCUMENTS

A. General
1. Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Engineer's reference during normal working hours
2. Maintain on site, one set of the following record documents; record actual revisions to the Work:
   a. Contract Drawings
   b. Specifications
   c. Addenda
   d. Change Orders and other Modifications to the Contract
   e. Reviewed shop drawings, product data, and samples
   f. Field test reports
   g. Construction photographs
3. Store Record Documents and samples separate from documents used for construction
   a. Provide files and racks for storage of documents
   b. Provide locked cabinet or secure storage space for samples

B. Record Drawings
1. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings
2. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown
3. Mark which drawing is most capable of showing conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings
4. Give particular attention to concealed elements that would be difficult to measure and record at a later date
   a. Record information concurrently with construction progress
   b. Mark record sets with red erasable pencil. Use other colors to distinguish between variations in separate categories of the Work. Mark each document "Project Record" in neat, large, printed letters
   c. Mark new information that is important to Owner but was not shown on Contract Drawings or Shop Drawings
   d. Note related Change Order numbers where applicable
   e. Organize record drawing sheets into manageable sets. Bind sets with durable-paper cover sheets; print suitable titles, dates, and other identification on the cover of each set

f. Upon completion of the Work, submit record drawings to Engineer for Owner's records

5. Contract Drawings and approved Shop Drawings: Legibly mark each item to record actual construction, including:
   a. Measured depths of elements of foundation in relation to finish grade or first floor datum
   b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvement
   c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
   d. Field changes of dimensions and details
   e. Changes made by Addenda or Change Order(s), if any
   f. Details not on original Contract Drawings
   g. References to related Shop Drawings and Modifications

C. Record Specifications: Maintain one complete copy of the Project Manual including addenda. Include with the Project Manual one copy of other written construction documents, such as Change Orders and Modifications issued in printed form during construction
   1. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications.
   2. Give particular attention to substitutions and selection of options and information on concealed construction that cannot otherwise be readily discerned later by direct observation.
   3. Note related record drawing information and product data.
   4. Upon completion of the Work, submit record Specifications to Engineer for Owner's records

D. Record Product Data: Maintain one copy of each product data Submittal. Note related Change Orders and markup of record drawings and specifications.
   1. Mark record documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the Site and from the manufacturer's installation instructions and recommendations.
   2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
   3. Upon completion of markup, submit complete set of record product data to Engineer for Owner's records
   4. Legibly mark and record at each Product section description of actual Products installed, including the following:
      a. Manufacturer's name, product model, number, trade name and supplies
      b. Product substitutions or alternates utilized
      c. Changes made by Addenda, field order or change order

E. Record Samples Submitted: Immediately prior to Substantial Completion, Contractor shall meet with Engineer and Owner's personnel at the Project Site to determine which Samples are to be transmitted to Owner for record purposes. Comply with Owner's instructions regarding packaging, identification, and delivery to Owner.

F. Miscellaneous Record Submittals: Refer to other Specification Sections for requirements of miscellaneous record keeping and Submittals in connection with actual performance of the Work. Immediately prior to the date or dates of Substantial Completion, complete miscellaneous records, and place in good order. Identify miscellaneous records properly and bind or file, ready for continued use and reference. Submit to Engineer for Owner's records
   1. For electrical refer to Section 16900

G. Maintenance Manuals: Contractor shall organize operation and maintenance data as specified in Section 01730

H. Submit documents to Engineer with claim for final Application for Payment

I. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes

J. Make documents and samples available at all times for inspection by Engineer

K. Label each document "Project Record" in neat, large printed letters

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 CLOSEOUT PROCEDURES

A. General
   1. Comply with requirements stated in the Owner's General Conditions of the Contract and in these specifications for administrative procedures in closing out the Work
   2. 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 inspection
   3. Provide submittals to Engineer/Owner that are required by governing or other authorities
   4. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due

B. Operation and Maintenance Instructions: Arrange for each installer of Equipment that requires regular maintenance to meet with Owner's personnel at Project Site to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not experienced in operation and maintenance procedures. Include a detailed review of the following items:
   1. Maintenance manuals
   2. Record documents
   3. Spare parts, materials and tools
   4. Lubricants and fuels

5. Identification systems
6. Control sequences
7. Hazards, hazardous chemicals data sheets
8. Cleaning
9. Warranties and bonds
10. Maintenance agreements and similar continuing commitments

C. As part of instruction for operating Equipment, demonstrate the following procedures:
1. Startup
2. Shutdown
3. Emergency operations
4. Noise and vibration adjustments
5. Safety procedures
6. Economy and efficiency adjustments
7. Effective energy utilization

3.2 FINAL CLEANING

A. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
1. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion
   a. Remove labels that are not permanent labels
   b. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition
   c. Wipe surfaces of mechanical and electrical Equipment. Remove excess lubrication and other substances
2. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction
3. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the Site and dispose of lawfully.
   a. Where extra materials of value remaining after completion of associated Work become Owner's property. Dispose of these materials as directed by Owner

3.3 CONTRACTOR'S CLOSEOUT SUBMITTALS

A. Evidence of Payment and Release of Liens: As specified in the General Conditions

B. Final inspection reports by all regulatory agencies demonstrating the agencies' final approval

C. At Contract close-out, deliver Record Documents to Engineer for the Owner

D. Accompany Submittal with Transmittal Letter in Duplicate, Containing
   1. Date
   2. Project title and number
   3. Contractor's name and address
   4. Title and number of each Record Document
   5. Signature of Contractor or his authorized representative

3.4 FINAL ADJUSTMENTS OF ACCOUNTS

A. Submit a Final Statement of Accounting to Engineer

B. Statement Shall Reflect All Adjustments to the Contract Sum
   1. The original Contract Sum
   2. Additions and deductions resulting from
      a. Previous Change Orders
      b. Deductions for uncorrected Work
      c. Deductions for liquidated damages
      d. Deductions for reinspection payments
      e. Other adjustments
   3. Total Contract Sum, as adjusted
   4. Previous payments
   5. Sum remaining due

3.5 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the General Conditions of the Contract

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittals

B. Format

C. Content of each volume

D. Manual for equipment and systems

E. Instruction of Owner's personnel

1.2 QUALITY ASSURANCE

A. Preparation of data shall be done by personnel
   1. Trained and experienced in maintenance and operation of the described products
   2. Completely familiar with requirements of this section
   3. Skilled as a technical writer to the extent required to communicate essential data
   4. Skilled as a draftsman competent to prepare required drawings

B. Manuals for equipment systems shall be prepared by the equipment manufacturer or system supplier

C. Compile product data and related information appropriate for Owner's maintenance and operation of products furnished under the Contract

D. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent sections of Specifications

1.3 SUBMITTALS

A. Submit under provisions of Section 01340

B. Manuals for equipment and systems
   1. Submit one electronic copy to Engineer to review
      a. No partial payments will be made for equipment and systems on hand or installed until preliminary manuals are submitted and acceptable
      b. See Section 01340 for electronic submittal requirements, for the preliminary copy of the O&M manual an electronic submittal is allowable

C. Submit two (2) final copies no less than 30 days prior to putting the equipment or system in service. If final manuals differ from accepted preliminary manuals, submit two (2) copies of any necessary supplemental material with instructions for insertion for conforming Engineer's and Owner's copies of preliminary manuals to final manuals
   1. Engineer will compare with accepted preliminary manual
   2. If identical or otherwise acceptable, Contractor will be so notified. Two (2) copies will be transmitted to Contractor, three (3) copies will be held for later transmittal to Owner
   3. If not acceptable, four (4) copies will be returned to Contractor for revision or retained by Engineer and the necessary revision data requested from Contractor at Engineer's option
   4. No portion of the Work is substantially complete until final equipment and system manuals relating to that portion of the Work are accepted by Engineer
   5. Submit three (3) copies of any revisions found desirable during instruction of Owner's personnel with instructions for insertion for revising Owner's and Engineer's copies of manual

D. Manual for materials and finishes
   1. Submit an electronic copy 15 days prior to request for final inspection
      a. Engineer will review
      b. One copy will be returned to Contractor with comments, one (1) retained in Engineer's file
      c. No final inspection shall be conducted until preliminary manuals are submitted
   2. Submit two (2) final copies, revised in accordance with Engineer's comments, within 10 days after final inspection
      a. Copies retained by Engineer for later transmittal to Owner
      b. No final payment shall be made until final manuals are submitted
   3. Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment specifications

1.4 FORMAT

A. Prepare data in the form of an instructional manual for use by Owner's personnel

B. Presentation of Information
   1. Size: 8 ½" by 11"
   2. Paper: 20 lb weight minimum, white, for typed pages
   3. Text: Manufacturer's printed data or neatly typewritten
   4. Drawings
      a. Provide reinforced punched binder tab, bind in with text
      b. Reduced to 11" by 17" and folded to 8 ½" by 11"
      c. Where reduction is impractical, folded and placed in 8 ½" by 11" envelopes bound in text
      d. Suitably identified on drawings and envelopes
   5. Provide flysheets for each separate product or each piece of operating equipment
      a. Provide typed description of product and major component parts of equipment

b. Provide indexed tabs, may be in color

6. Spine and cover: identify each volume with typed or printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" preceded by the word. "PRELIMINARY" or "FINAL" as applicable. Final manuals to list information on the cover and the spine. List the following:
   a. Title of project, reference Owner and project location as applicable
   b. Identity of separate structure as applicable
   c. Identity of general subject matter covered in manual and specification section number
7. As much as possible, assemble and bind material in the same order as specified

C. Binders
1. Preliminary manuals: Commercial quality permanent 3-ring or 3-post binders with durable, cleanable, hard plastic covers. GBC bound manual may be accepted upon review by Engineer
2. Final manuals: Commercial quality permanent 3-ring or 3-post binders with durable, cleanable, hard plastic covers with clear plastic cover and spine pockets suitable for title and cover inserts. Manufacturer's pre-printed binder may be accepted upon review by Engineer. "Deluxe Round Ring View Binder" as manufactured by Wilson Jones or accepted substitution
3. Final electronic manual: Provide one copy in digital format, all documents to be in native file format (Word, Excel, AutoCAD, pdf) or converted from native file format into Adobe pdf. Provide one copy on an electronic disk, CD or DVD

D. Arrange content by systems under section numbers and sequence of table of contents of this Project Manual

E. Provide tabbed flyleaf for each separate product and system, with typed description of product and major component parts of equipment

F. Electronic Manual: Compile in an electronic book format with Chapter bookmarks (equal to tabbed fly leafs) and OCR (optical character recognition) to allow for document searches.

1.5 CONTENTS OF EACH VOLUME

A. Neatly typewritten table of contents for each volume, arranged in a systematic order
1. Contractor, name of responsible principal, address and telephone number
2. A list of each product required to be included, indexed to the content of the volume
3. List, with each product, the name, address and telephone number of
   a. Subcontractor or installer
   b. Maintenance contractor, as appropriate
   c. Identify the area of responsibility of each
   d. Local source of supply for parts and replacement
4. Identify each product by product name and other identifying symbols as set forth in Contract Documents

B. Product Data
   1. Include only those sheets which are pertinent to the specific product
   2. Annotate each sheet to
      a. Clearly identify the specific product of part installed
      b. Clearly identify the data applicable to the installation
      c. Delete references to inapplicable information

C. Drawings
   1. Supplement product data with drawings as necessary to clearly illustrate
      a. Relations of component parts of equipment and systems
      b. Control and flow diagrams
   2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation
   3. Do not use Project Record Documents as maintenance drawings

D. Written text, as required to supplement product data for the particular installation
   1. Organize in a consistent format under separate headings for different procedures
   2. Provide a logical sequence of instructions for each procedure

E. Copy of each warranty, bond and service contract issued
   1. Provide information sheet for Owner's personnel, give
      a. Proper procedures in the event of fracture
      b. Instances which might affect the validity of warranties or bonds

1.6 MANUALS FOR EQUIPMENT AND SYSTEMS

A. Provide an operation and maintenance manual for each item of equipment or system listed in the schedule of manuals in the quantity listed in the submittal schedule

B. Content for each of equipment and system as appropriate
   1. Description of unit and component parts
      a. Function, normal operating characteristics and limiting conditions
      b. Performance curves, engineering data and tests
      c. Complete nomenclature and commercial number of all replaceable parts
   2. Operating procedures
      a. Startup, break-in, routine and normal operating instructions
      b. Regulation, control, stopping, shutdown and emergency instructions
      c. Summer and winter operating instructions, as applicable
      d. Special operating instructions
   3. Maintenance procedures
      a. Routine operations
      b. Guide to "trouble-shooting"
      c. Disassembly, repair and reassembly
      d. Alignment, adjusting and checking
   4. Servicing and lubrication schedule

    a. List of lubricants required
5. Manufacturer's printed operating and maintenance instructions
6. Description of sequence of operation by control manufacturer
7. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance
    a. Predicted life of parts subject to wear
    b. Items recommended to be stocked as spare parts
8. As-installed control diagrams by controls manufacturer
9. Each contractor's coordination drawings
    a. As-installed color-coded piping diagrams
10. Charts of valve tag numbers with the location and function of each valve
11. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage
12. Other data as required under pertinent sections of specifications

C. Content for each electric and electronic item or system, as appropriate
1. Description of system and component parts
    a. Function, normal operating characteristics and limiting conditions
    b. Performance curves, engineering data and tests
    c. Complete nomenclature and commercial number of replaceable parts
2. Circuit directories of panelboards
    a. Electrical service
    b. Controls
    c. Communications
3. As-installed color-coded wiring diagrams
4. Operating procedures
    a. Routine and normal operating instructions
    b. Sequences required
    c. Special operating instructions
5. Maintenance procedures
    a. Routine operations
    b. Guide to "trouble-shooting"
    c. Adjustment and checking
6. Manufacturer's printed operating and maintenance instructions
7. List of original manufacturer's spare parts, manufacturer's current prices and recommended quantities to be maintained in storage
8. Other data as required under pertinent sections of specifications

D. Prepare and include additional data when the need for such data becomes apparent during instruction of Owner's personnel

E. Additional requirements for Operation and Maintenance Data: The respective sections of specifications

1.7 INSTRUCTIONS OF OWNER'S PERSONNEL

A. Prior to final inspection or acceptance, fully instruct Owner's designated operating and maintenance personnel in the operation, adjustment and maintenance of all products, equipment and system

B. Operation and maintenance manual constitutes the basis of instruction
   1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance

1.8 Additional requirements for specialized instruction of Owner's personnel are given in the detailed equipment specifications

A. Equipment and systems Operation and Maintenance manuals shall be prepared for each of the following

Specification Section	Type of Equipment or System
11229	Coarse Bubble Aeration
11316	Rotary Lobe Sludge Pumps
11321	Grit Classifier
11322	Mechanically-Induced Vortex Grit Removal Equipment
11332	Center Flow Band Screen and Washer Compactor
11377	Rotary Lobe Blowers
11635	Automatic Sampler
15835	Exhaust Fans
16150	Variable Frequency Drive and Control Equipment
16900	Control System

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolition, removal, salvage and disposal of existing site features, piping, structures and materials where indicated on the drawings and as specified in this section

B. Demolition and removal of concrete foundations, sidewalks, concrete and asphaltic paving

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

C. Section 02950 - Seeding

1.3 SUBMITTALS

A. Permits and Certificates.
   1. Permits and notices authorizing demolition
   2. Certificates of severance of utility service
   3. Permit for transport and disposal of debris

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 specifications

B. Accurately record actual locations of capped utilities and subsurface obstructions

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable State and local codes for demolition of structures, safety of adjacent structures, dust control, and disposal

B. Obtain required permits from authorities

C. Notify affected utility companies before starting work and comply with their requirements

D. Do not close or obstruct roadways, sidewalks, or hydrants without written permission from Owner

E. Conform to applicable regulatory procedures when discovering hazardous or contaminated materials

1.6 SCHEDULING

A. Schedule and submit under provisions of Division 1 specifications

B. Provide detailed descriptions for demolition and removal procedures

C. Notify Engineer and Owner of any demolition work one (1) week prior to commencement

D. Coordinate all demolition work with Engineer and Owner

PART 2 PRODUCTS

2.1 SALVAGE OF MATERIALS

A. Contractor shall coordinate with Owner for items to be salvaged. Contractor to provide Owner at least two weeks to determine if item shall be salvaged before deeming the item waste

B. All existing construction and items not salvaged to Owner shall be considered waste and shall become the property of Contractor for off-site disposal

C. Remove and reinstall as indicated on Drawings and herein the following Equipment and Materials:
   1. Dewatering system

2.2 HANDLING AND STORAGE

A. Contractor shall carefully disassemble Equipment and Materials that are to be reused and returned to Owner in such a way to avoid any damage. Contractor shall store such Equipment and Materials in such a way to avoid any damage, corrosion, or staining

2.3 FILL MATERIALS

A. Fill Material: Use of on site fill material shall meet provisions of Section 02300 and be in accordance with Geotechnical recommendation

PART 3 EXECUTION

3.1 INSPECTION

A. Verify areas to be demolished are unoccupied and discontinued in use

B. Do not commence work until conditions are acceptable to Engineer and Owner

C. Existing conditions of Equipment and Materials, structures, surfaces, or properties that could be misinterpreted as damaged as a result of demolition work shall be photographed and filed with Owner and Engineer prior to commencement of Work

3.2 PREPARATION

A. Provide, erect, and maintain temporary barriers, enclosures, security fences and shoring at demolition locations in accordance with Division 1 and other related specifications to protect personnel and public

B. Protect existing structures and utilities which are not to be demolished

C. Provide temporary wiring and connections to maintain existing telephone, electrical, instrumentation and control systems in service during construction as required

D. Protect existing electrical and controls equipment and cabinets from dust and debris intrusion. Set up temporary barriers to preclude dust from being introduced into cabinets and equipment. Additionally, seal all cabinets and equipment while demolition is occurring. Control and or turn off existing heating and ventilation systems that will introduce or distribute dust and debris from the demolition operations.

E. Mark location of existing utilities

3.3 GENERAL REQUIREMENTS

A. Sprinkle Work with water to minimize dust where applicable. Provide hoses and water connections for this purpose.

B. Do not use water to extent causing flooding, contaminated runoff, or icing

C. Remove demolished material from the site

D. Repair damage to adjacent structures

E. Remove existing exposed piping and electrical wiring and conduit to be abandoned to structural surface, cut flush, and finish to match existing surfaces

F. Remove buried piping, wiring, and conduit to be abandoned as required for the Work. Plug the remainder flush.

3.4 DISPOSAL

A. Do not store or burn waste materials on-site

B. Transport demolition debris to designated off-site disposal area

C. If hazardous materials are encountered during demolition work, Contractor shall comply with applicable regulations and laws regarding the removal, handling, and protection of environment and human health

3.5 CONNECTION TO EXISTING CONSTRUCTION

A. Cut and remove portions of existing construction as necessary to allow for proper installation of new construction Equipment and Materials

B. Shore and brace existing structures to maintain safe structure conditions and until permanent structures and supports are completed
   1. Contractor shall repair all damage in result of installation of shoring and bracing

C. Cap, seal or abandon pipe and cable as indicated on Drawings and specified herein

3.6 CLEANUP AND REPAIR

A. Contractor shall remove tools, equipment and demolished materials from Site upon completion of demolition work
   1. Remove protections
   2. Interior areas shall be broom clean
   3. Inspect and clean all electrical control cabinets, interior and exterior, exposed to dust and debris during the demolition process

B. Contractor shall repair demolition performed in excess of that required or indicated
   1. Surfaces and structures to remain shall be repaired to the existing conditions prior to commencement of demolition work

3.7 SITE DEMOLITION

A. Disconnect, remove, cap and identify designated utilities within demolition area.

B. Coordinate with Owner and Engineer to determine timing and sequencing of abandonment existing utilities.

C. Remove asphalt paving, parkway, fencing, and other concrete work to facilitate construction. Remove concrete to nearest joint beyond demolition area.

D. Remove and replace storm sewer items where shown on the Drawings.

E. Backfill areas excavated caused as a result of demolition, in accordance with Section 02300

F. Rough grade and compact areas affected by demolition to maintain site grades and contours as shown on drawings

G. Remove demolished materials from site

H. Do not burn or bury materials on site, unless otherwise directed by Owner. Leave site in clean condition.

3.8 ELECTRICAL DEMOLITION

A. General:
   1. Remove, relocate and extend existing installation as required to accommodate new construction.

B. Existing electrical service:
   1. Work by Public Service Company
      a. Coordination with Contractor to determine electrical service requirements and placement
   2. Work by Contractor:
      a. Provide standby power conduit and cables for temporary use during construction. Completely remove temporary service after new permanent service is installed.

3.9 BUILDING DEMOLITION

A. Remove and dispose of all remaining portions of structures on site

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, and Division One and other related specification sections apply to work of this section.

1.2 SECTION INCLUDES

A. Clearing, grubbing and site preparation

B. Removal and disposal of debris

C. Handling, storage, transportation, and disposal of excavated material

D. Sheeting, shoring, bracing and protection work

E. Pumping and dewatering as required or necessary

F. Backfilling

G. Pipe embedment

H. Construction of fills and embankments

I. Excavation for buildings & structures

J. Pavement Subgrade preparation

K. Trench Stabilization

L. Final grading

M. Slope Stabilization

N. Appurtenant work

1.3 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02370 – Erosion and Sedimentation Control

C. Section 02468 - Micropiles

D. Section 02740 – Flexible Paving

E. Section 02750 – Rigid Paving

F. Section 02950 – Seeding

G. Section 03300 – Cast-In-Place Concrete

1.4 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO)

B. American Society for Testing and Materials (ASTM):
   1. C33 – Concrete Aggregates
   2. C136 – Sieve Analysis of Fine and Coarse Aggregates
   3. D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-Inch Drop
   4. D1241 – Material for Soil Aggregate Subbase, Base and Surface Courses
   5. D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
   6. D4253 – Test Methods for Maximum Index Density of Soils and Unit Weight of Soils Using a Vibratory Table
   7. D4254 – Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
   8. D4318 – Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   9. D6938 – Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)

C. American Concrete Institute (ACI):
   1. 229 – Controlled Low-Strength Materials

D. Council of American Building Officials/American National Standards Institute (CABO/ANSI):
   1. A117.1 – Accessible and Useable Buildings and Facilities Standards

E. Colorado Department of Transportation (CDOT)

F. Occupational Safety and Health Administration (OSHA):
   1. Part 1926 – Safety and Health Regulations for Construction

1.5 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Product Data: Submit on all products or materials supplied herein

C. Test Reports: Indicate supplier, sieve analysis, optimum moisture content and density in accordance with ASTM D698 if appropriate for crushed rock or gravel, pipe embedment and material for fills and embankment

1.6 REGULATORY REQUIREMENTS

A. Burning will not be allowed on-site. Comply with all applicable codes, regulations, and laws.

B. Comply with all rules, regulations, and ordinances set forth by local regulatory agencies, Clear Creek County, and CDPHE

C. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

D. Obtain and comply with all requirements of the City of Idaho Springs, Clear Creek County, and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

E. For public improvements only, in the event of a conflict between municipal standards and this specification, municipal standards for products and installation will govern.

F. Excavation work will be performed in compliance with the City of Idaho Springs, Clear Creek County, and current OSHA requirements.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent structures and surrounding areas from damage during excavation, filling, and backfilling

B. Protect work from erosion or other similar types of damage until the project has been accepted. Leave protection in place for subsequent contractors' use.

C. Do not backfill or construct fills during freezing weather. Backfill or construct fills only when temperature is 35°F and rising

D. Do not use frozen materials, snow, or ice in any backfill or fill area

E. Do not backfill or construct fill on frozen surfaces

F. Protect excavated material from becoming frozen

G. Do not backfill or construct fills or embankments during periods of heavy rainfall or precipitation when soil moisture conditions will not allow proper compaction to be achieved

H. Do not remove trees from outside excavation or fill areas unless authorized by the Owner; protect from permanent damage by construction activities

I. Provide temporary bridges for roadways, walkways, driveways, etc.

1.8 QUALITY ASSURANCE

A. All imported material to be free of hazardous and organic wastes, “clean” as defined by EPA, and approved for its intended use by the Owner or project Geotechnical Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. General - Soil materials, whether from sources on or off the site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.

B. Classification of Excavated Materials:
   1. No classification applies. Remove and handle all excavated materials regardless of its type, character, composition, condition, or depth.
   2. Waste Materials:
      a. Waste materials are considered unacceptable materials for compaction or placement fill. Site fills will not include environmental pollutants, hazardous substances or waste, hazardous products or by-products.
      b. Transport and properly dispose of any rubble and waste materials found in excavation off the Owner’s property
      c. If hazardous, transite or asbestos containing materials are found in excavation, stop work immediately and notify the Owner within one hour of discovery. Comply with special handling requirements.

C. Fills and Embankments
   1. To the maximum extent practical use excess earth from onsite excavation for fills and embankments.
   2. Free from rocks or stones larger than 12 inch in greatest dimension and free from brush, stumps, logs, roots, debris, and organic and other deleterious materials
   3. Fill and embankment material must be acceptable to Engineer
   4. No rocks or stones larger than 6 inch in upper 18 inches of fill or embankment. Where allowed, distribute rocks and stones through the fill to not interfere with compaction.

D. Imported Fill for Fills and Embankments:
   1. The Contractor is responsible for obtaining additional material for fills and embankments as necessary to meet the requirements shown on the Drawings.
   2. Imported fill conforming to the following:
      a. Gradation (percent finer by weight ASTM C136): 3” – 100% passing, No. 4 Sieve – 50-100% passing, and No. 200 Sieve – less than 30% passing (maximum)
      b. Liquid Limit: 30 (maximum), Plasticity Index: 15 (maximum), Group Index: 10 (maximum)

E. Engineered Fill

1. Engineered fill shall adhere to the recommendations provided in the Geotechnical Report
2. Existing fill at the site requires processing per the Geotechnical Report to be used as engineered fill. Existing fill shall be processed per the requirements of the Geotechnical Report and shall meet the requirements for engineered fill. Utilization of existing fill shall be coordinated with the Engineer and Owner prior to use.
3. Imported engineered fill, such as a ½-inch minus, CDOT Class 7 Aggregate Road Base, conforming to the following:
   a. Gradation: 3" – 100% passing (percent finer by weight ASTM C136), No. 4 Sieve – 50-100% passing, and No. 200 Sieve – 30% (maximum)
   b. Liquid Limit: 30 (maximum), Plasticity Index: 15 (maximum), maximum expansive potential- 1% measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at optimum water content. The sample is confined under a 200 psf surcharge and submerged.

F. Topsoil
1. Topsoil is defined as fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth for areas to be seeded or planted. Coordinate testing requirements with Engineer and Owner.
2. Clean topsoil free of plants and seeds will be spread to 4-inch minimum depth or as specified by Drawings, whichever is greater.

G. Grubbings
1. Grubbings are defined as the first 1 inch of surface vegetation and topsoil consisting of primarily existing grass groundcover free of roots, brush, and other objectionable material and debris.
2. Reuse grubbing and surface topsoil containing plants and seeds in designated revegetation areas only.

H. Pipe Embedment: Graded gravel
1. Comply with City of Idaho Springs requirements for pipe embedment for public utilities.

2. 1-1/2" Washed rock

Sieve Size (Inch)	Percent Passing by Weight
2"	100
1-1/2"	95-100
1"	80-95
3/4"	30-45
1/2"	10-25
3/8"	<1

3. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4”	90-100
1/2”	25-60
3/8”	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

4. Well-Graded Sand

Sieve Size	Percent Passing by Weight
3/8”	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	10-30
No. 200	2-10

5. Squeegee

Sieve Size	Percent Passing by Weight
3/8”	100
No. 4	85-100
No. 8	30-70
No. 16	5-40
No. 30	0-15
No. 50	0-10
No. 100	0-5
No. 200	<1

I. Compacted Trench Backfill
   1. Shall be excavated material finely divided, free of debris, organic material, and stones larger than 6 inches in greatest dimension without masses of moist, stiff clay, or topsoil
   2. In upper 18 inches, no rock or rock excavated detritus, larger than 6 inches except with specific approval from Geotechnical Engineer.
   3. No rock greater than 3 inches in greatest dimension within 3 feet of top of pipe
   4. Graded gravel: as specified or shown on Drawings for pipe embedment

J. Coarse Base Rock
   1. Granular material, maximum 3 inches, less than 10% passing 1-inch sieve.
   2. Free of trash, clay and dust

3. Compaction as specified by Geotechnical Engineer

K. Road Base
1. Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	Percent Passing by Weight
1”	100
3/4"	90-100
No. 4	35-55
No. 30	10-30
No. 200	2-9

2.2 ACCESSORIES

A. Controlled Low Strength Material (Flow Fill)
1. Comply with City of Idaho Springs requirements and ACI 229 for the use of flowable fill within the right-of-way or for public utility trench backfill.
2. Product will be a lean, sand-cement slurry, “flowable fill” or similar material with a 28-day unconfined compressive strength between 50 and 200 psi.

B. Non-woven geotextile fabric
1. Needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Product must be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Product must meet AASHTO M288-06 Class 3 for elongation > 50%.
   a. Mirafi 140N or accepted substitution

PART 3 EXECUTION

3.1 EXAMINATION

A. Field verify the location of all underground utilities, pipelines and structures prior to excavation

3.2 PERFORMANCE — GENERAL

A. Contractor to verify quantities of cuts and fills and perform all earthwork required to meet the grades as shown on the Drawings, including but not limited to, additional import or export required to handle compaction, building and pavement subgrade preparation, and pipe bedding.

B. Perform work in a safe and proper manner with appropriate precautions against hazard

C. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities

D. Contain all construction activity on the designated site and within the limits of work. Cost of restoration offsite will be the responsibility of the Contractor

E. Maintain service to pipelines and utilities indicated on Drawings during construction

3.3 PREPARATION

A. Clearing and Grubbing
   1. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris.
   2. Strip subgrade for fills and embankments of surface vegetation, sod, tree stumps and organic topsoil. Strip and stockpile all on-site material meeting the topsoil definition for all areas receiving grading where shown on Drawings
   3. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.
   4. Remove and dispose of tree stumps and roots over 3 inches in diameter to a minimum depth of 18 inches below the natural surface or 5 feet below finished surface level, whichever is lower.
   5. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted
   6. Backfill all excavated depression include grub holes with approved material

B. Preservation of Trees
   1. Do not remove trees outside fill or excavated areas, except as authorized by Engineer
   2. Protect trees and their roots within the drip line that are to remain from permanent damage by construction operation
   3. Trim standing trees in conflict with construction operations as directed by Owner and Engineer.

C. Topsoil Stripping
   1. Strip onsite material meeting the topsoil definition to minimum depth of 4 inches from areas to receive grading as shown on Drawings.
   2. Stockpile topsoil in areas designated by Owner and indicated on Drawings where it will not interfere with construction operations and activities and existing facilities
   3. At the completion of work in each area, place and grade topsoil to maintain gradient as indicated and required. Roughen surface as required for erosion control.

D. Waste and Debris
   1. Stockpile all acceptable grubbing for reuse in native revegetation areas
   2. Remove and dispose of all waste materials and debris from clearing, grubbing, stripping and demolition off site

E. Stockpiles
   1. Segregate materials suitable for the following:
      a. Topsoil
      b. Embankments and fills

c. Backfill
d. Spoils and waste only

2. No excavation will be deposited or stockpiled at any time so as to endanger stability of banks or structures, health of trees and shrubs to be protected, or portions of the Work, either by direct pressure or indirectly by overloading banks contiguous to the operation
3. Stockpile soil materials away from edge of excavations
4. Do not obstruct or prevent access to roads, driveways, ditches, natural drainage channels, and utility control devices
5. If in result of adjacent structures, easement limitations, or other restrictions sufficient storage is not available within Project limits, Contractor will arrange for off-site areas for stockpiling and for moving material to and from the storage area at no additional cost to the Owner

3.4 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations will be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work.

B. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

C. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner

D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage will be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, will be borne by the Contractor at no additional expense to the Owner

3.5 DEWATERING

A. General
1. All dewatering activities in accordance with all federal, state, and local regulations regarding site drainage, dewatering, and erosion and sediment control including permitting requirements
2. Design and provide dewatering system using accepted and professional methods consistent with current industry practice to eliminate water entering the excavation under hydrostatic head from the bottom and/or sides. Design system to prevent differential hydrostatic head, which would result in floating out soil particles in a manner, termed as a “quick” or “boiling” condition. System will not be dependent solely upon sumps and/or pumping water from within the excavation where differential head would result in a quick condition, which would continue to worsen the integrity of the excavation’s stability

3. Provide and maintain adequate dewatering equipment including power supply, if necessary, to remove and dispose of surface and groundwater entering excavations, trenches, and other parts of the Work
4. Provide dewatering system of sufficient size and capacity to prevent ground and surface water flow into the excavation and to allow all Work to be installed in a dry condition
5. Control groundwater in a manner that preserves strength of foundation soils, does not cause instability or raveling of excavation slopes, and does not result in damage to existing structures. Where necessary to these purposes, lower water level in advance of excavation, utilizing wells, wellpoints, jet educators, or similar positive methods
6. Keep each excavation dry during subgrade preparation and continually thereafter until the structure to be built or the pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result
7. Dewater excavations which extend to or below groundwater by lowering and keeping the groundwater level beneath such excavation at least 12 inches below the bottom of the excavation
8. Design, furnish, install, test, operate, monitor and maintain dewatering system of sufficient scope, size and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of groundwater and permit excavation and construction to proceed on dry, stable subgrades
9. Divert surface water or otherwise prevent it from entering excavated areas or trenches to the extent practical without damaging adjacent property
10. Maintain all drainage pipes, keep clean and free of sediment during construction and final cleanup
11. Open pumping with sumps and ditches will be allowed, provided it does not result in boils, loss of fines, softening of the ground, or instability of slopes
12. No additional payment will be made for any supplemental measures to control seepage, groundwater, or artesian head
13. Dewatering to surface waterways requires Colorado Department of Public Health and Environment dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, including water treatment prior to discharge, if necessary

B. Design
1. Contractor will be responsible for the accuracy of the Drawings, design data, and operational records required
2. Contractor will be solely responsible for the design, installation, operation, maintenance, and any failure of any component of the system

C. Damages
1. Contractor will be responsible for and will repair without cost to the Owner any damage to work in place, or other contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, adjacent structures, natural resources, habitat, existing wells, and the excavation including, damage to the bottom due to heave and including but not limited to, removal and pumping out of the excavated area that may result from Contractor's negligence, inadequate or improper

design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system

2. Remove sub grade materials rendered unsuitable by excessive wetting and replace with approved backfill material at no additional cost to the Owner

D. Maintaining Excavation in Dewatered Condition
   1. Dewatering will be a continuous operation. Interruptions due to power outages, or any other reason will not be permitted
   2. Continuously maintain excavation in a dry condition with positive dewatering methods during preparation of subgrade, installation of pipe, and construction of structures until the critical period of construction and/or backfill is completed to prevent damage of subgrade support, piping, structure, side slopes, or adjacent facilities from flotation or other hydrostatic pressure imbalance
   3. Provide standby equipment on site, installed, wired, and available for immediate operation if required to maintain dewatering on a continuous basis in the event any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional cost to Owner
   4. System maintenance will include supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain excavation in dewatered condition

E. System Removal
   1. Remove dewatering equipment from the site, including related temporary electrical service
   2. Wells will be removed or cut off a minimum of 3 feet below final ground surface, capped, and abandoned in accordance with regulations by agencies having jurisdiction

3.6 SHEETING, SHORING AND BRACING

A. All sheeting, shoring and bracing in accordance with OSHA and IBC requirements

B. Prevent undermining and damage to all structures, buildings, underground facilities, pavements and slabs

C. Contractor will responsible for obtaining all required permits or easements for encroachments into the public right-of-way and for coordinating any encroachments onto adjacent properties.

D. If sheet pile cut off walls are required, submit design calculations, stamped by a Colorado licensed Professional Engineer

E. Contractor will be solely responsible for proper design, installation, operation, maintenance, and any failure of any system component
   1. Engineer review of Contractor’s design and data does not relieve the Contractor from full responsibility for errors or from the entire responsibility for complete and adequate design and performance of the sheeting, shoring and bracing system

F. Provide proper and substantial sheeting, shoring, and bracing, in accordance with OSHA Standards as required, to prevent caving or sliding, to protect workmen and the Work, and to protect existing structures and facilities

G. Design, furnish, build, maintain and subsequently remove, to extent required a system of temporary supports for cut and cover, open cut, temporary bypass road, or trench excavations, including bracing, dewatering, and all associated items to support the sides and ends of excavations where excavation slopes may endanger in-place or proposed improvements, extend beyond construction right-of-ways or as otherwise specified or indicated in the Drawings
   1. Design and build sheeting, shoring, and bracing to withstand all loads that might be caused by earth movement or pressure
   2. Design and build sheeting, shoring and bracing to be rigid, maintain shape and position under all circumstances.

H. Design excavation support system and components for the following to allow safe and expeditious construction of permanent structures without movement/settlement of the ground and to prevent damage to or movement of adjacent buildings, structures, other improvements and underground facilities
   1. To support lateral earth pressures
   2. Loads from utilities, traffic, construction, buildings and surcharge loads

I. Provide sheeting, shoring and bracing equipment and materials onsite prior to start of excavation in each section, making adjustments as required to meet unexpected conditions

J. Contractor will make his own assessment of existing conditions including adjacent property, the possible effects of his proposed temporary works and construction methods, and will select and design support systems, methods, and details as will assure safety to the public, adjacent property, and the completed Work.

K. Employ caution in areas of underground facilities, which will be exposed by hand or other excavation methods acceptable to Owner or Engineer.

L. Space and arrange sheeting and bracing as required to exclude adjacent material and according to the stability of excavation slopes

M. Do not pull trench sheeting before backfilling

N. Do not brace sheeting left in place against the pipe, but support it in a manner that precludes concentrated loads or horizontal thrusts on pipe

O. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment is completed

P. Damages
   1. Contractor will document and all existing damage to adjacent facilities and submit written documentation to Owner and Engineer prior to performing any excavation.

Documentation will include written description of existing damages, measurements, diagrams, maps and associated photographs

2. Repair all damage resulting from excavation and remove and place any existing structure or underground facility damaged during shoring and sheeting and all undermined pavements with Owner-approved equal, concrete or asphalt, at no cost to the Owner.

3.7 TRENCH STABILIZATION

A. Thoroughly compact and consolidate subgrades for concrete structures, precast structures, and utility trench bottoms so they remain firm, dense and intact during required construction activities

B. Remove all mud and muck during excavation

C. Reinforce subgrades with crushed rock or gravel if they become mucky during construction activities

D. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on Drawings

E. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon

F. Scarify trench subgrade to a depth of 6 to 8 inches before compaction

3.8 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot

B. Remove existing unsuitable/uncompacted fill, old foundations, rubble/debris, soft or otherwise unsuitable material, and replace with suitable material in excavation

C. Extend excavations to a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction and inspections

D. Trim to neat lines where details call for concrete to be deposited against earth

E. Excavate by hand in areas where space and access will not permit use of machines

F. Provide dewatering and temporary drainage as required to keep excavations dry.

G. Reshape subgrade and wet as required

H. Notify Geotechnical Engineer when structure excavation has reached designated depth. Do not proceed with structure construction until excavation is approved by Geotechnical Engineer.

I. Per the geotechnical report, for overexcavation and recompaction areas at structures, soils will be excavated to a depth of 3 feet below lowest foundation element. The subexcavation shall be sloped or shored in the interest of safety following local and federal regulations. The toe of the subexcavation slope will be no closer than 1 foot plus the overexcavation depth outside the outermost edge of all concrete footings. Slope will continue to the proposed surface grades.

J. Remove existing fill to minimum 3 feet below floor slabs, footings and mat foundations shall be supported by micropiles. Refer to Section 02468 for micropile requirements

K. Configure subexcavation per Geotechnical Report, Section 01020.

L. Proof roll at a maximum of 24 hours prior to paving or concrete placement to located any soft spots in grade. Contractor to stabilize any soft areas with aggregate base course and compact to 95% of maximum density at optimum moisture content, per ASTM D1557, to a minimum depth of 6 inches. Reshape subgrade and wet as required.

3.9 PAVEMENT OVEREXCAVATION AND SUBGRADE PREPARATION

A. Excavate subgrade for asphalt pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.10 foot. Excavate subgrade for concrete pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.05 foot.

B. Overexcavate and scarify existing soil as required under pavement areas, slabs, curbs and walks to meet the moisture and compaction specifications herein to depth shown on Drawings and as specified in the Geotechnical Report.

C. Extend subgrade preparation a minimum of one foot beyond back of proposed pavement, slabs, curbs and walks.

D. Extend subgrade preparation a minimum of 8 inches beyond back of proposed structure foundation limit per foot of overexcavation.

E. Proof roll with a pneumatic tire equipment with a minimum axle load of 18 kips per axle a maximum of 24 hours prior to paving to locate any soft spots that exhibit instability and deflection beyond subgrade tolerances listed above. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Geotechnical Engineer, will be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas will be proof rolled again and all failures again corrected at the Contractor's expense.

F. If the Contractor fails to place the sub base, base course, or initial pavement course within 24 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction will be performed again at the Contractor's expense.

3.10 FILLS AND EMBANKMENTS

A. Using suitable approved materials, shape, trim, and finish cut slopes to conform with contours and elevations indicated on Drawings

B. Suitable materials will consist of excavations or borrow areas
   1. Borrow
      a. Borrow areas will be arranged by Contractor at no additional cost to Owner and will be subject to approval by Engineer or Geotechnical Engineer.
      b. Includes all topsoils and fill materials from approved offsite locations

C. Place in layers from 4 to 6 inches where high degree of compaction is required such as under foundations and slabs. Lifts of 8 inches are acceptable where heavy, self-propelled compaction equipment is used. Otherwise, place in 8 inch layers. Will be placed on subgrades approved by Engineer or Geotechnical Engineer

D. Will not be placed on frozen surface. Do not place snow, ice or frozen materials in fill

E. Level and roll subgrade so surface materials will be compact and bond with the first layer of fill or embankment
   1. Plow and scarify subgrade to a minimum depth of 12 inches until uniform and free of large clods

F. Place in horizontal layers at maximum uncompacted depth per compaction specifications herein.

G. Spread and level material deposited in piles and windrows before compacting

H. Thoroughly compact each layer by rolling or other means acceptable to Geotechnical Engineer to meet the moisture and compaction specifications herein.

I. Alter compaction methods if material fails to meet specified density

J. Where a trench passes through a fill or embankment, place and compact fill or embankment to 12 inch above the top of the pipe before excavating the trench

K. Add water and harrow, disc, blade, or otherwise work each layer to obtain the uniform moisture content and adequate compaction

L. Refer to geotechnical report for additional requirements for fill and embankment preparation requirements.

3.11 COMPACTION

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. Place backfill and fill uniformly along the full length of each structure as described herein.

C. Refer to geotechnical report for additional requirements for site development material, subexcavation, compaction and related earthwork operations.

D. Percentage of Maximum Dry Density Requirements: Moisture treat and compact soil to not less than the following percentages of maximum dry density and to within the specified moisture content range of optimum moisture content according to ASTM D698 as follows:

Surface Improvement	Compaction %	Moisture Content
Structures	98%	-3 to +3
Paved Areas	95%	-3 to +3
Utility Trenches	95%	-3 to +3
Lawns or Unpaved Areas	90%	-3 to +3
Public Right-of-way	Per municipal standards	

1. Do not deposit or compact tamped or otherwise mechanically compacted backfill if frozen or if in water.
2. Take particular care to compact backfill which will be beneath slabs, pipes, drives, roads, parking areas, curb, gutters, or other surface construction.

3.12 BORROW OR SPOIL AREA

A. Obtain suitable material required to complete fill and embankments from excavation, on-site areas.

B. The location, size, shape, depth, drainage, and surfacing of borrow or spoil pits will be acceptable to Owner.

C. Make all areas regular in shape with graded and surfaced side and bottom slopes when completed

D. Cut side slopes not steeper than 1:1 and uniform for the entire length of any one side

E. Final grade disturbed areas of borrow to uniform slope (maximum slope = 4:1, minimum slope = 50:1).

F. Use material free of debris and deleterious material

G. Contractor is responsible for compliance with Colorado Discharge Permit System and local erosion control permitting requirements for any and all onsite and offsite, disturbed spoil and borrow areas. Upon completion of spoil and/or borrow operations, clean up spoil and/or borrow areas in a neat and reasonable manner to the satisfaction of the offsite property owner, Owner and Engineer.

3.13 DISPOSAL OF EXCESS EXCAVATED MATERIALS

A. Use excess excavated materials in fills and embankments as indicated on the Drawings to the extent needed. Coordinate with Owner and Engineer on locations for excess material placement.

B. Excess material may be spread onsite at locations acceptable to the Owner and the Engineer. Final quantity, location and grade to be determined prior to placement of excess material.
   1. Distribute excess earth from excavations of the site to location/s over unimproved areas of the site identified by the Owner for such purpose. Otherwise, stockpile in neat piles at locations directed by the Owner and the Engineer.
      a. Carefully finish material thus wasted with a drag, blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point
      b. Don not waste excess excavated material in the above manner where the new fill crosses drainages, driveways or other improvements
      c. Distribute and level to thickness indicated on Drawings

C. At the Owner's discretion and with the Engineer's approval, suitable excess excavated materials from onsite may be disposed offsite at locations directed by Owner or specified on the Drawings.

D. Remove debris, junk, broken concrete, broken asphalt, rock, stones, stumps, logs, roots, and other unsuitable material from the site and dispose of it.

3.14 BLASTING

A. Blasting or other use of explosives is not permitted without Engineer and Owner approval

3.15 BLASTING

A. Blasting is not allowed

3.16 TRENCH EXCAVATION

A. Establish alignment and grade or elevation from offset stakes provided by the Contractor's surveyor.

B. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings

C. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection

D. Where grades or elevations are not fixed on the Drawings, excavate trenches to provide a minimum depth of backfill cover over the top of pipe as follows. Coordinate depth of cover with utility owners. Increase depth as required by utility owner and at crossings. Minimum depths are:

1. 2.0 feet for drainage piping
2. 2.5 feet for gas piping
3. 2.5 feet for electric, telecom, and fiber optic conduit
4. 2.0 feet for irrigation piping
5. 4.5 feet for sanitary sewer
6. 4.5 feet for water and process piping
7. Increase depth as required at vertical curves and for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades

E. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation

F. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 200 feet

G. Total length of open trench will be limited to 200 feet unless otherwise approved by the Engineer

H. Except where tunneling or boring is indicated on the Drawings, specified, required by jurisdictional agency or permitted by Engineer, excavate trenches by open cut from the surface

I. Limiting trench widths
1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment
2. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than 1 foot above the top of the pipe
3. Stipulated minimum clearances are minimum clear distances, not minimum average distances
4. Maximum trench width from six inches above the top of pipe to trench bottom is the pipe outside diameter plus 24 inches
5. Limiting trench widths and permissible clearances from 6 inches above top of pipe to trench bottom for installed pressure and non-pressure piping

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
3	1’ 6”	2’ 6”
4	1’ 6”	2’ 6”
6	1’ 6”	2’ 6”
8	1’ 8”	2” 8”
10	2’ 0”	3’ 0”
12	2’ 0”	3’ 0”
16	2’ 8”	3’ 8”
18	3’ 0”	4’ 0”
24	3’ 6”	4’ 6”
36	4’ 6”	5’ 0”

6. If the width of the lower portion of the trench exceeds the maximum permitted, provide special pipe embedment, or concrete encasement as required by loading conditions
7. No excessive trench widths will be allowed to avoid the use of sheeting or shoring and bracing

J. Trench Side Walls
1. Will be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the federal, state, and local ordinances and regulations
2. Sheet and brace where necessary and as specified herein
3. Excavate without undercutting

K. Trench Bottom
1. Will be thoroughly protected and maintained when suitable natural materials are encountered
2. Will be thoroughly compacted and in approved condition prior to placing gravel bedding, if required
3. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support between bell holes or end joints of the installed pipe at the Contractor's option
4. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material approved by Engineer
5. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined
6. PVC pipe will not be laid directly on trench bottom

L. Mechanical excavation
1. Do not use where its operation would damage buildings, culverts, or other existing property, structures, or utilities above or below ground; hand excavate only in such areas
2. Use mechanical equipment of a type and design which can be operated to provide the following:
   a. Rough trench bottom to a controlled elevation
   b. Uniform trench widths and vertical sidewalls are obtained from 1 foot above the top of the installed pipe to the bottom of the trench
   c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls
3. Do not undercut trench sidewalls
4. Recompact trench bottom disturbed by bucket teeth prior to placement of embedment material

M. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the Drawings to provide for installation of granular embedment pipe foundation material

N. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material as Engineer may direct

O. For unstable soils, provide concrete or other bedding as directed by Engineer

P. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined

Q. Cuts in existing surface construction
   1. No larger than necessary to provide adequate working space
   2. Cut a clean groove not less than 1½ inch deep along each side of trench or around perimeter of excavation area
   3. Remove pavement and base pavement to provide shoulder not less than 6 feet wide between cut edge and top edge of trench
   4. Do not undercut trenches, resulting in bottom trench width greater than top widths
   5. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation
   6. Remove pavement for connections to existing lines or structures only to the extent required for the installation
   7. Replace the pavements between saw cuts to match original surface construction

3.17 PIPE EMBEDMENT

A. Embed pipes above and below the bottom of pipe as indicated on the Drawings and as specified herein

B. Granular embedment
   1. Spread and surface grade granular embedment to provide continuous and uniform support beneath pipe at all points between pipe joints.
      a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout length
      b. Barrel of pipe will have a bearing for its full length
   2. Form depressions under each joint to permit the proper jointing. No part of joint will be in contact with trench when pipe is placed in position
   3. After grading, aligning, and placing pipe in final position, and shoring home, deposit and compact sufficient embedment under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent operations
   4. Place and compact embedment material uniformly and simultaneously on both sides of pipe to prevent displacement
   5. Complete embedment promptly after jointing operations and approval to proceed by Engineer
   6. Granular embedment compaction by slicing with shovel or vibrating
      a. Maximum uncompacted thickness of layers: 6 inch
   7. Compacted embedment will be compacted to 90 percent maximum density per ASTM D1557
      a. Maximum uncompacted depth thickness of horizontal layers: 6 inch

C. Arch and concrete encasement
   1. Include in locations indicated on Drawings or where over-width trench conditions need correction as approved by Engineer
   2. Install and form as indicated on Drawings or as specified
   3. Concrete will have a 28-day minimum 3,000 psi compressive strength

D. Do not backfill until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems

3.18 TRENCH BACKFILL

A. Backfilling will be conducted in a continuous manner to prevent damage to the pipe and its coating and kept as close to the pipe laying operation as possible. Backfilling procedures will be in accordance with additional requirements, if any, of local authorities or private right-of-way agreements.

B. Compacted backfill
   1. Provide full depth of trench above embedment at all locations
   2. Beneath pavements, surfacing, driveways, curbs, gutters, walks or other surface construction or structures
   3. In street or highway shoulders
   4. Beneath fills and embankments

C. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to the bottom of the upper trench

D. Site excavated materials
   1. Place job excavated materials in 8 inches maximum uncompacted thickness, uniform layers
   2. Increased layer thickness may be permitted for incohesive material if Contractor demonstrates to Engineer's satisfaction that specified compacted density will be achieved
   3. Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe
   4. Thoroughly compact each layer to meet the moisture and compaction specifications herein.

E. Graded gravel
   1. Deposit in uniform layers of 9 inches maximum uncompacted thickness
   2. Compact with suitable vibrating roller or platform vibrator to not less than 70 percent relative density per ASTM D4253/D4254

F. Uncompacted backfill
   1. Compaction of backfill above pipe embedment in locations other than those specified, is required only to prevent future settlement
   2. May be placed by any method acceptable to Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and will not result in displacement of installed pipe

3. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. Distance may be increased 2 feet for each additional 1 foot of cover

G. Finish the top portion of backfill with at least 4 inches of topsoil or as specified by landscaping specifications, whichever is greater, corresponding to, or better than, that underlying adjoining turf areas.

H. Trench backfill within the public right-of-way will conform to municipal street and utility standards.

I. Trench backfills through unimproved areas should be restored to previous conditions and left 3” above adjacent grades to allow for settlement. Seed all disturbed areas according to erosion control and landscape specifications.

J. Protection of trench backfill
   1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion
   2. Install ditch checks where the ditch grade exceeds 1 percent
      a. Minimum depth: 2 feet below the original ditch or water course bottom for the full bottom width
      b. Minimum width: 18 inches into the side slopes
      c. Minimum thickness: 12 inches

3.19 DRAINAGE MAINTENANCE

A. Do not backfill trenches across roadways, drives, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid

B. Backfill so that water does not accumulate in unfilled or partially filled trenches

C. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade, and contours

D. Do not obstruct surface drainage any longer than necessary

E. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic

F. Provide adequate storm flow conveyance through the site at all times during construction to avoid flooding of any buildings or adjacent property. Provide overland drainage routing when storm sewer inlets are not fully functioning due to erosion and sediment control measures.

3.20 FINAL GRADING

A. After completion of all other outside work and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours, all areas being graded on site

B. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work

C. Grade all surfaces for effective drainage, provide a 2 percent minimum slope except as otherwise shown on the Drawings

D. Provide a smooth transition between adjacent existing grades and new grades

E. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances

F. Slope grades to direct water away from buildings and prevent ponds from forming where not intended

G. Finish subgrades at lawns and unpaved areas to required elevations within a tolerance of plus or minus one (1) inch

H. Finish grades will be no more than 0.1 foot above or below those indicated

I. Finish all ditches, swales and gutters to drain readily

J. Coordinate final subgrade depth with finish landscape treatment and required topsoil depths

K. Topsoil
   1. Clean topsoil, free of plants and seed will be spread to 4-inch minimum depth, or as specified by landscaping specifications and Drawings, whichever is greater, for areas of the site as detailed by the landscape Drawings.
   2. Reuse grubbings and surface topsoil containing plants and seeds in designated revegetation areas only.

3.21 SLOPE AND CHANNEL STABILIZATION – GEOTECH REPORT DOESN”T GIVE GOOD ANSWER

A. Cover channel banks, slopes, bottom and thalweg (water flowline at lowest point in channel) with erosion control fabric mat where grade is steeper than 4H to 1V and where indicated on the Drawings

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric

G. Prior to laying fabric, seed disturbed areas under provisions of related seeding and landscaping specification sections or as specified on Drawings.

3.22 SETTLEMENT

A. Warranty for settlement of all fills, embankments, and backfills is stipulated in the General Conditions from final completion of Contract under which Work is performed

B. Repair or replace within 30 days after notice by Engineer or Owner

3.23 FIELD QUALITY CONTROL

A. Provide under provisions of General Conditions and Division One Specifications

B. Coordinate testing with Owner and Engineer. Owner will employ testing agency for field testing to determine compliance of in-place and backfill materials and compaction in accordance with the specifications, and to verify design bearing capacities.

C. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency 48 hour, two business day advance notification to schedule tests.

D. Fills and Embankment Testing
   1. Two moisture-density relationship tests, ASTM D698, on each type of fill material
   2. One in-place compaction test for each 5,000 square feet every 1.5 feet of vertical lift of material placed
   3. Additional in-place compaction tests at the discretion of the Owner

E. Pipe Embedment and Backfill Testing
   1. Two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate for each type of embedment on backfill material proposed, except granular embedment material
   2. One in-place compaction test every 200 lineal feet of trench in the compacted embedment zone and at every 1.5 feet of vertical lift of backfill materials, per ASTM D6938

3. One in-place compaction test near top of trench for trench depth of 2 feet or less, per ASTM D6938
4. Additional in-place compaction tests at the discretion of the Owner

F. Pavement and Structural Subgrade Testing
1. At a minimum, two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate and adequate for each type backfill material proposed.
2. Perform tests for each footing, concrete site feature, and drainage structure subgrade. Perform tests at every 100 linear feet of subgrade of foundation walls, retaining walls, and every 150 feet for curbing, pans, drainage features, walks, etc. (or portions thereof). Perform tests every 2,000 square feet required of building slab area, exterior slabs and pavement/flatwork areas (with no less than 3 tests). Test at subgrade and at every vertical lift of backfill materials placed.
3. Additional in-place compaction tests at the discretion of the Owner

G. Inspection and approval
1. A qualified Geotechnical Engineer will inspect the natural soil at bottom of excavations for structures
2. Do not prepare subgrade or place concrete until Geotechnical Engineer's inspection has taken place and any resulting recommendations of the Geotechnical Engineer have been fulfilled or until the inspection has been waived by the Geotechnical Engineer
3. Prior to placement of structural fill, overexcavated foundations subgrades will be observed and tested by a qualified Geotechnical Engineer to ensure suitable bearing materials exist
4. Geotechnical Engineer will provide a letter to Engineer to confirm the presence of suitable subgrade material and properly placed fill materials by Contractor in accordance with Drawings and geotechnical report.

H. Retesting of flailed compaction will be performed by Geotechnical Engineer for Owner, but paid for the Contractor

END OF SECTION

SECTION 02370

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This work consists of temporary measures needed to control erosion and water pollution. These temporary measures will include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project and during site restoration, and as directed by Engineer, and as shown on the drawings.

B. The Erosion Control Plan presented in the drawings serves as a minimum for the requirements of erosion control during construction. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then Contractor shall provide additional measures as required to obtain the required protection.

C. Contractor shall include in the bid price for erosion control a minimum of all items shown on the Erosion Control Plan and any additional items that may be needed to control erosion and water pollution.

D. Erosion control plan shall meet the requirements of Best Management Practices (BMPs) set forth by the Clear Creek County and CDPHE

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02220 – Demolition

C. Section 02300 – Earthwork

D. Section 02740 – Flexible Paving

E. Section 02750 – Rigid Paving

F. Section 02950 – Seeding

1.3 REFERENCES AND STANDARDS

A. CDOT – Colorado Department of Transportation

B. UDFCD – Urban Drainage and Flood Control District

C. CDPHE – Colorado Department of Public Health and Environment

1.4 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Submit the following information:
   1. Erosion Control Plan,
   2. Construction schedule for Erosion Control per Article Scheduling,
   3. Sequencing Plan per Article Scheduling,
   4. All applicable permits for Erosion Control.

C. Product data: Submit on all products or materials supplied herein.

1.5 REGULATORY REQUIREMENTS

A. Obtain and comply with all requirements of the City of Idaho Springs, Clear Creek County, and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

B. 401 Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit 401):
   1. Contractor shall apply for and obtain a Construction Dewatering Permit 401 from the Colorado Department of Public Health and Environment.
   2. All costs for this permit shall be the responsibility of Contractor.
   3. This permit requires that specific actions be performed at designated times.
   4. Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.
   5. Contractor shall allow the Colorado Department of Public Health and Environment or other representatives to enter the site to test for compliance with the permit.
   6. Non-compliance with the permit can result in stoppage of all work.

C. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.6 SCHEDULING

A. Sequencing Plan:
   1. Contractor shall submit a sequencing plan for approval for erosion control in conformance with Contractor's overall Construction Plan for approval by the City of Idaho Springs.
   2. Changes to the Erosion Control Sequencing Plan may be considered by the City of Idaho Springs only if presented in writing by the Contractor.

B. Temporary Erosion Control:

1. When so indicated in the Contract Documents, or when directed by the City of Idaho Springs. Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.
2. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc.

C. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.

D. Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.

E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with all applicable municipal or local Municipal Separate Storm Sewer System (MS4) requirements.

B. All materials shall be submitted for approval prior to installation.

C. Natural or biodegradable materials shall be reasonably clean, free of deleterious materials, and certified weed free. Materials may include, but are not limited to, hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel.

D. Grass Seed:
1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.
2. All grass seed shall be approved by Engineer and Owner and in accordance with local regulations prior to installation.

E. Fertilizer and soil conditioners shall be approved by Engineer and Owner and in accordance with local regulations prior to installation.

F. Silt Fence Fabric: woven polypropylene
1. Mirafi 100X, "Envirofence"
2. Or accepted substitution

G. Temporary Slope Stabilization Mat (short term): 1.5 pound photodegradable polypropylene top and bottom nets, 100% straw fiber matrix, with a longevity of 12 months.

1. North American Green S150
2. Or accepted substitution

PART 3 EXECUTION

3.1 GENERAL

A. All temporary and permanent erosion and sediment control practices will be maintained and repaired as needed to ensure continued performance of their intended function.

B. Owner and Engineer will monitor Contractor's erosion control methods. If the overall function and intent of erosion control is not being met, Owner will require Contractor to provide additional measures as required to obtain the desired results.

C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.

3.2 PROTECTION OF ADJACENT PROPERITES

A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.

B. In addition to the erosion control measures required on the drawings, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:
   1. Vegetated buffer strip around the lower perimeter of the land disturbance.
      a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.
   2. Sediment barriers such as straw bales, erosion logs, and silt fences.
   3. Sediment basins and porous landscape detention ponds.
   4. Combination of above measures.

3.3 CONSTRUCTION

A. Stabilization of Disturbed Areas:
   1. Temporary sediment control measures shall be established within five (5) days from time of exposure or disturbance.
   2. Permanent erosion protection measures shall be stablished within five (5) days after final grading of areas.

B. Stabilization of Sediment and Erosion Control Measures:
   1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.
   2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.

3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.

C. Stabilization of Waterways and Outlets:
   1. All onsite stormwater conveyance channels used by Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.
   2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

D. Storm Sewer Inlet Protection: All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.

E. Construction Access Routes:
   1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
   2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
   3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area.
   4. Street washing shall be allowed only after sediment is removed in the manner described above.

3.4 DISPOSITION OF TEMPORARY MEASURES

A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by Owner and Engineer.

B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.

C. Substantial Completion of Erosion Control Measures:
   1. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.
   2. Maintenance of Erosion Control Measures after Substantial Completion: Contractor shall be responsible for maintaining temporary erosion control measures as specified in the drawings and Contract Documents until such time as work has been accepted by the City of Idaho Springs and as specified in Division 1 for Closeout Procedures.

PART 4 MEASUREMENT FOR PAYMENT

4.1 PAYMENT

A. Contractor shall include in the bid price for erosion and sedimentation control work a minimum of all items shown on the Erosion Control Plan, as required by City of Idaho Springs and CDPHE Stormwater and/or Groundwater Discharge Permits and any additional items that may be needed to control erosion and water pollution throughout all phases of the project.

END OF SECTION

SECTION 02468

MICROPILES

PART 1 GENERAL

1.1 SUMMARY

A. This specification, along with the drawings, encompasses the furnishing of all designs, materials, products, accessories, tools, equipment, services, transportation, labor and supervision, and installation techniques required for testing and installing of micropiles and pile-top attachments.

1.2 DESIGN CRITERIA

A. The micropiles shall be designed to meet the specific loading conditions, as shown on the Drawings.

B. The allowable working load on the pile shall not exceed the following values:

1. For compression loads: $P_{allc} = (0.33 * f_c * A_{grout} + 0.4 * f_{ycasing} * A_{casing} + 0.4 * f_{ybar} * A_{bar})$

   Where: P_{allc} = allowable working load (compression)
   f_c = Unconfined Compressive Strength of grout
   A_{grout} = area of grout
   $f_{ycasing}$ = yield strength of casing up to 80 ksi
   A_{casing} = area of steel casing (with allowance for corrosion if appropriate)
   f_{ybar} = yield strength of rebar/core steel up to 80 ksi
   A_{bar} = area of rebar/core steel

2. For tension loads: $P_{allt} = 0.6* (f_{ycasing} * A_{casingT} + f_{ybar} * A_{bar})$

   Where: Pallt = allowable working load (tension)
   fycasing = yield strength of casing
   AcasingT = area of steel casing (at threaded joints if applicable)
   fybar = yield strength of rebar/core steel
   Abar = area of rebar/core steel

C. The micropile top attachment shall effectively distribute the design load (DL) to the concrete footing, such that the concrete bearing stress does not exceed those in the ACI Building Code and the bending stress in the steel plates does not exceed AISC Allowable stresses for steel members.

D. Micropiles shall be designed by a Professional Engineer experienced in design of this work and licensed in the State of Colorado

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. A36 Structural Steel
2. A82 Cold-Drawn Steel Wire for Concrete Reinforcement
3. A252 Welded and Seamless Steel Pipe Piles
4. A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
5. A722 Uncoated High-Strength Steel Bar for Prestressing Concrete
6. A775 Electrostatic Epoxy Coating
7. C33 Concrete Aggregates
8. C109 Compressive Strength of Hydraulic Cement Mortar
9. C188 Density of Hydraulic Cement
10. D3966 Standard Test Method for Piles Under Lateral Load
11. D1784 Polyviny Chloride (PVC) Pipe (Cass 13464-B)
12. C144 Aggregates for Masonry mortar
13. C150 Portland Cement
14. C494 Chemical Admixtures for Concrete
15. D1143 Method of Testing Piles Under Static Axial Compressive Load
16. D3350 Polyethylene Corrugated Tubing
17. D3689 Method of Testing Individual Piles Under Static Axial Tensile Load

B. American Welding Society (AWS):
1. D1.1 Structural Welding Code – Steel
2. D1.2 Structural Welding Code – Reinforcing Steel

C. American Petroleum Institute (API):
1. 5CT (N80) Specification of casing and tubing
2. RP 138-1 Recommended Practice – Standard Procedure for Field Testing Water Based Drilling Fluids

D. American Society of Civil Engineers (ASCE)
1. 20-96 Standard Guidelines for the Design and Installation of Pile Foundations

E. Post Tensioning Institute (PTI)
1. Recommendations for Prestressed Rock and Soil Anchors

1.4 SUBMITTALS

A. Shop Drawings:
1. Drawings showing size, pile top attachment, structural steel, corrosion protection system, and layout of micropiles

B. Calculations: Submit calculations sealed by a Professional Engineer licensed in the State of Colorado

C. Product Data:
1. Grout mix designs

D. Testing and Results:
1. Submit proposed testing procedure

2. Certified test reports showing compliance with specified characteristics and physical properties.
3. Load test results

E. Miscellaneous Submittals:
1. Project record documents for installed materials
   a. Name of Contractor
   b. Project name
   c. Date
   d. Pile location/number
   e. Equipment description
   f. Pier dimensions, length, and diameter
   g. Ground Elevation
   h. Final tip elevation
   i. Pier deviation from plan location
   j. Installation angle from horizontal
   k. Notes on unusual phenomena
   l. Micropile test records, analysis, and details

F. Submit in accordance with Section 01340

1.5 QUALITY ASSURANCE

A. Qualifications:
1. The micropile contractor shall be fully experienced in all aspects of micropile design and construction, and shall furnish al necessary plant, materials, skilled labor, and supervision to carry out the contract. The contractor will have successfully completed at least five projects in the previous five years of similar scope and size.
2. Owner reserves the right to require written documentation of above

B. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

C. Testing:
1. Testing shall be provided by Contractor in accordance with Section 01455 and this section.
   a. Duties of testing personnel shall be to monitor installation of piers and to monitor testing of piles to be load tested.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Hayward Baker

B. DRS Engineering Contractors

C. Or approved equal

2.2 MATERIALS

A. Water: water for mixing grout shall be potable, clean and free from substances which may be in any way deleterious to grout or steel. If water is not potable, it shall be tested in accordance with AASHTO T26 for acceptability

B. Admixtures: Admixtures shall conform to the requirements of ASTM C494. Admixtures which control bleed, improve flowability, reduce water content, and retard set may be used in the grout subject to the review and acceptance of the Owner. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations. Accelerators will not be permitted. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer's recommendations. Their use will only be permitted after appropriate field tests on fluid and set grout properties. Admixtures with chlorides shall not be permitted.

C. Cement: All cement shall be Portland cement conforming to ASTM C150 Type I, Type II, or Type III, and shall be the product of one manufacturer. If the brand or type of cement is changed during a project, additional grout mix tests shall be conducted to ensure consistency of quality and performance in situ.

D. Fillers: Inert fillers such as sand may be used in the grout in special situations (e.g., presence of large voids in the ground, when grout take and travel are to be limited) as approved by the Owner.

E. Bar Reinforcement
   1. Reinforcing steel shall be deformed bars in accordance with ASTM A615 Grade 60 or Grade 75 or ASTM A722 Grade 150.
   2. For cases of tensile loading, bar couplers, if required, shall develop the ultimate tensile stress of the bar, without any evidence of failure. For compressive loading, the coupler shall be compatible with efficient load transfer and overall reinforcement performance requirements.

F. Pipe/Casing
   1. If the casing is to be relied upon to carry loads or reduce deflection, the permanent steel casing/pipe:
      a. Shall meet the tensile requirements of ASTM A252, Grade 3, except the minimum yield strength shall be as used in the design submittal (typically 50,000 psi to 80,000 psi) and minimum elongation shall be 15%.
      b. May be new "Structural Grade" (a.k.a. "Mill Secondary") steel pipe meeting above but without Mill Certification, free from defects (dents, cracks, tears) and with two coupon tests per truckload.

G. Plates and Shapes
   1. Structural steel plates and shapes for pile top attachments shall conform to ASTM A36 or ASTM A 572 Grade 50

H. Centralizers
   1. Centralizers shall be fabricated from plastic, steel, or material that is non-detrimental to the reinforcing steel. Wood shall not be used.

2.3 FABRICATION

A. Conform to approved shop drawings

B. Welds shall conform to requirements of AWS D1.1

C. Hot-dip galvanize after fabrication. Conforming to ASTM A123

2.4 EQUIPMENT

A. Equipment used to install piles shall be specifically designed for installation of piles of this type, and shall be approved by pile manufacturer/designer.

PART 3 EXECUTION

3.1 INSTALLATION

A. The micropile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project. The micropile contractor shall select the drilling method and the grouting procedures used for the installation of the micropiles, subject to the approval of the Owner.

B. The drilling equipment and methods shall be suitable for drilling through the conditions to be encountered, with minimal disturbance to these conditions or any overlying or adjacent structure or service. The borehole must be open to the defined nominal diameter, full length, prior to placing grout and reinforcement.

C. All installation techniques shall be determined and scheduled such that there will be no interconnection or damage to piles in which grout has not achieved final set.

D. Centralizers shall be provided at 10-ft center maximum spacing on central reinforcement. The uppermost centralizer shall be located a maximum of 5 ft from the top of the micropile. Centralizers shall permit the free flow of grout without misalignment of the reinforcement.

E. The central reinforcement steel with centralizers shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted reinforcing bars shall not be driven or forced into the hole such that there will be no interconnection or damage to piles in which the grout has not achieved final set.

F. The Contractor shall check pile top elevations and adjust all installed micropiles to the planned elevations.

3.2 GROUTING

A. The Contractor shall provide systems and equipment to measure the grout quality, quantity, and pumping pressure during the grouting operations. This information is to be measured and recorded by the installing contractor.

B. After drilling, the hole shall be flushed with water and/or air to remove drill cuttings and/or other loose debris. The Contractor shall provide a stable, homogenous neat cement grout or a sand cement grout with a minimum 28-day unconfined compressive strength of 4000 psi. The grout shall not contain lumps or any other evidence of poor or incomplete mixing. Admixtures, if used, shall be mixed in accordance with manufacturer's recommendations. The pump shall be equipped with a pressure gauge to monitor grout pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures used by the Contractor, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The grout should be kept in constant agitation prior to pumping.

C. The grout shall be injected from the lowest point of the drill hole (by tremie methods) until clean, pure grout flows from the top of the micropile. The tremie grout may be pumped through grout tubes, hollow stem augers, or drill rods. Subsequent to tremie grouting, all grouting operations associated with, for example, extraction of drill casing and pressure grouting, must ensure complete continuity of the grout column. The use of compressed air to directly pressurize the fluid grout is not permissible. The grout pressures and grout takes shall be controlled to prevent excessive heave in cohesive soils or fracturing of soil or rock formations. The entire pile shall be grouted to the design cut-off level.

D. Grout within the micropiles shall be allowed to attain the minimum design strength prior to being loaded.

E. If the Contractor uses a post-grouting system, all relevant details including grouting pressure, volume, location and mix design, shall be submitted.

3.3 PILE SPLICES

A. Pile splices shall be constructed to develop the required design strength of the pile section.

B. Lengths of casing and reinforcing steel to be spliced shall be secured in proper alignments and in such a manner that no eccentricity between the axes of the two lengths spliced or angle between them results.

3.4 PILE LOAD TESTS

A. The Contractor shall proof test 2 production micropiles. The piles to be tested will be selected by the Owner. At the Contractor's suggestion, but with the Owner's concurrence, tension tests may be performed based to maximum DL in compression or tension for friction piles with sufficient structural tension capacity.

B. The test sequence shall be as follows:

LOAD	HOLD TIME (MINUTES)
AL	-
0.15 DL	2.5
0.30 DL	2.5
0.45 DL	2.5
0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
1.15 DL	2.5
1.30 DL	10*
1.00 DL	4
0.75 DL	4
0.50 DL	4
0.25 DL	4
AL	4

AL = Alignment Load
DL= Design Load
* Hold until meet acceptance criterion 2 of next paragraph

C. The acceptance criteria for micropile proof load tests are:
   1. The pile shall sustain the compression and tension design capacities (1.0 DL) with no more than 1 in. total vertical movement at the top of the pile as measured relative to the pile prior to the start of testing. If an Alignment Load is used, then the allowable movement will be reduced by multiplying by a factor of (DL-AL)/DL. (This conservatively accounts for the movement in reaching AL.)
   2. Test piles shall have a creep rate at the end of the 130% DL increment which is not greater than 0.040 in./log cycle time from 1 to 10 minutes or 0.080 in./log cycle time from 6 to 60 minutes and has a linear or decreasing creep rate.

D. If a micropile that is proof tested fails to meet the acceptance criteria, the contractor shall be directed to proof test another micropile in the vicinity. For failed piles and further construction of other piles, the Contractor shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement micropiles, incorporating piles of reduced load capacities, modifying the installation methods, increasing the bond length, or changing the micropile type. Any modification which requires changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures shall be at the Contractor's expense.

END OF SECTION

SECTION 02616

SITE PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping and necessary appurtenances for exterior concrete structures and for exterior buried locations:
   1. Wastewater treatment site piping
   2. Other miscellaneous piping

1.2 RELATED SECTIONS

A. Section 02300 – Earthwork

B. Section 02676 – Disinfection of Water Systems

C. Section 03300 – Cast-In-Place Concrete

D. Section 03600 – Non-Shrink Grout

E. Section 15060 – Pipe and Pipe Fittings

F. Section 15100 – Valves, Cocks, and Hydrants

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. American National Standards Institute (ANSI):
   1. B16.1/16.5 – Pipe Flanges and Fittings Package

C. American Society of Testing and Materials (ASTM):
   1. A36 – Standard Specification for Carbon Structural Steel
   2. A48 – Standard Specification for Gray Iron Castings
   3. A53 – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
   4. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
   5. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
   6. A242 – Standard Specification for High-Strength Low-Allow Structural Steel
   7. A276 – Standard Specification for Stainless Steel Bars and Shapes

8. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
9. A449 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
10. A536 – Standard Specification for Ductile Iron Castings
11. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
12. C283 – Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid
13. A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
14. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings
15. B88 – Standard Specification for Seamless Copper Water Tube
16. B96 – Standard Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels
17. B763 – Standard Specification for Copper Alloy Sand Castings for Valve Applications
18. C33 – Standard Specification for Concrete Aggregates
19. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
20. C150 – Standard Specification for Portland Cement
21. C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
22. D429 – Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
23. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
24. D792 – Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
25. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
26. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
27. D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))
28. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
29. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
30. D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
31. D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
32. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
33. D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
34. D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

35. D2454 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
36. D2672 – Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement
37. D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
38. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
39. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
40. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
41. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
42. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
43. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
44. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
45. D3950 – Standard Specification for Strapping, Nonmetallic (and Joining Methods)
46. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
47. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative DensityD6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
48. F412 – Standard Terminology Relating to Plastic Piping Systems
49. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
50. F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
51. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
52. F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
53. F2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

D. American Water Works Association (AWWA):
1. C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2. C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C110 – Ductile-Iron and Gray-Iron Fittings
4. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
6. C150 – Thickness Design of Ductile-Iron Pipe
7. C151 – Ductile-Iron Pipe, Centrifugally Cast

8. C153 – Ductile-Iron Compact Fittings
9. C200 – Standard for Steel Water Pipe 6 In. (150 mm) and Larger
10. C203 – Standard for Coal-Tar Protective Coatings & Linings for Steel Water Pipes
11. C206 – Standard for Field Welding of Steel Water Pipe
12. C207 – Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
13. C213 – Standard for Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
14. C214 – Standard for Tape Coatings for Steel Water Pipelines
15. C219 – Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
16. C500 – Metal-Seated Gate Valves for Water Supply Service
17. C504 – Standard for Rubber-Seated Butterfly Valves
18. C508 – Swing-Check Valves for Waterworks Service 2 In. Through 24 In.
19. C509 – Resilient Seated Gate Valves for Water Supply Service
20. C512 – Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
21. C515 – Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
22. C550 – Protective Interior Coatings for Valves and Hydrants
23. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
24. C604 – Standard for Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger
25. C605 – Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
26. C606 – Grooved and Shouldered Joints C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
27. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
28. C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm)
29. C906 – Polyethylene (PE) Pressure Pipe and Fittings 4 In. (100 mm) Through 63 In. (1,600 mm) for Water Distribution and Transmission
30. M11 – Steel Pipe - A Guide for Design and Installation
31. M17 – Installation, Field Testing, and Maintenance of Fire Hydrants
32. M23 – PVC Pipe Design and Installation
33. M41 – Ductile-Iron Pipe and Fittings

E. Ductile Iron Pipe Research Association (DIPRA):
   1. Thrust Restraint Design for Ductile Iron Pipe

F. Uni-Bell PVC Pipe Assocation (Uni-Bell):
   1. Handbook of PVC Pipe Design and Construction

G. Uni-Bell PVC Pipe Association:
   1. Uni-Pub-8: Tapping Guide for PVC Pressure Pipe

H. Plastics Pipe Institute (PPI):

1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
3. Handbook of Polyethylene Pipe
4. Material Handling Guide

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Shop Drawings:
   1. Provide drawings with pipe and structure details, design standards, reinforcement, dimensions, layout fabrication and assembly drawings and shall include, but not limited to, the following:
      a. Layout of pipe drawings
      b. Pipe and joint details
      c. Restrained joint locations
      d. Specials, fittings, and coupling details
      e. Specification data sheets
      f. Certificates of compliance with applicable standard and specification and testing certificates
   2. Provide additional detailed information including elevations, fittings, specialty materials or fabrications for special or custom features, structures, junctions and/or pipes
   3. Specifications, data sheets and affidavits of compliance for coatings and linings
   4. Provide pipe-laying and installation schedule

C. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications

D. Manufacturers Certificate and affidavits:
   1. Furnish the following prior to fabrication
      a. Details: Pipe, joint, special, fitting and coupling
      b. Shop coating
      c. Shop coatings and linings: specifications, data sheets, and compliance affidavits
   2. Furnish the following prior to shipment
      a. Compliance affidavit for applicable standards
      b. Test certificates

E. Test Reports: Submit all shop and field test reports in accordance with Division 1 Specifications

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications

B. Accurately record actual locations of piping mains, valves, connections, centerline of pressure pipe elevations, and top of gravity pipe elevations

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

1.7 QUALITY ASSURANCE

A. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years

B. All PVC pipe, regardless of diameter, shall be supplied by a single manufacturer

C. Contractor shall conduct visual inspection before installation

D. Provide manufacturer's name and pressure rating marked on piping and valves

E. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational water lines

1.8 REGULATORY REQUIREMENTS

A. Conform to all State and local municipal codes and ordinances, laws and regulations

B. In case of apparent conflict, State and local requirements govern over these specifications

C. In absence of State and local regulations, International Plumbing Code applies

D. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 Specifications

B. Delivery
   1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat, and direct sunlight

C. Storage
   1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: direct sunlight, mud, etc.

2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
    a. Do not stack pipe higher than 5 feet

D. Storage: Use the following precautions for valves, during storage:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage
    a. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary

E. Handling
1. Handle so as to insure installation in sound undamaged condition. Do not damage the pipe by impact, bending, compression or abrasion during handling or storage
2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection
3. Use hooks or straps with broad, well padded contact surfaces for lifting sections of pipe

F. Preparation for Transport:
1. Prepare valves, for shipping as follows: Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends, flange faces, and weld ends. Set valves in best position for handling. Set valves closed to prevent rattling.

G. Deliver and store valves and accessories in shipping containers with labeling in place in accordance with AWWA C500/C509

H. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

I. Seal valve ends to prevent entry of foreign materials into valve body

J. During loading, transporting and unloading, exercise care to prevent damage to material
1. Use nylon slings only
2. Do not drop pipe or fittings
3. Do not roll or skid against pipe already on ground
4. Repair any damage done to coating or lining
5. Handle per manufacturer's recommendations
6. Store rubber gaskets in cool dark location
7. Store all material on wood pallets or timbers

K. Adequately tag or otherwise mark all piping and fittings as to size

L. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or

other operations shall be repaired to the approval of and at no additional cost to the Owner

M. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner

1.10 EXISTING CONDITIONS

A. Field Measurements:
   1. Verify field measurements prior to fabrication
   2. Indicate field measurements on Shop Drawings

1.11 JOB CONDITIONS

A. All work which requires the interruption of active water or sewer service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the City of Idaho Springs and coordinated as specified in Division 1

B. Underground Obstructions
   1. Underground Obstructions known to Engineer are shown on Drawings
      a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
      b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
   2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
   3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
      a. Notify Engineer and Owner in case of a conflict
      b. In case of a conflict, the proposed work may be changed by Engineer
   4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

C. Verify existing system operation, pressures, and valve settings (open or closed) prior to construction

1.12 ENVIRONMENTAL REQUIREMENTS

A. Weather limitations: Do not install piping over frozen surfaces or in standing water

PART 2 PRODUCTS

2.1 GENERAL

A. Provide pipes and fittings of the following materials, joint types, sizes, and weight/class indicated on Drawings or as specified herein

B. Fittings: Furnish bends, ells, tees, wyes, couplings and other fittings of the same type and class of material having equal or superior physical and chemical properties as acceptable to the Engineer

C. All buried pipe shall be installed with tracer wire and metallic core identification tape

2.2 PVC PIPE – 4" TO 12" DIAMETER

A. The following piping shall be small diameter PVC pipe as indicated on Drawings and in the pipe schedule:

B. Manufacturers:
1. JM Eagle
2. Georg Fischer Piping Systems
3. North American Pipe Corporation
4. Diamond Plastics Corporation
5. Vinyltech Corporation
6. Or accepted substitution

C. Pipe: AWWA C900, DR 18 except as otherwise specified or indicated on the Drawings

D. Marking: Identification markings on pipe shall conform to AWWA C900

E. Fittings: Ductile iron compact fittings: ANSI A 21.53/AWWA C153
1. Working pressure rating: 350 psi rating
2. Joint: Mechanical joints with restraints
3. Coating:
   a. Exterior: AWWA C111, Asphalt coated
   b. Interior: AWWA C104 and C111, lined with double thickness cement seal coated
   c. Or interior and exterior: AWWA C116, fusion bonded epoxy coating

F. Joints: ASTM D3139, integral bell or mechanical joint
1. Push-on joints: pipe to pipe joints, except as otherwise specified or indicated on Drawings. Push on joints are not permitted on fittings or valves
   a. Integral bell type with elastomeric gaskets, ASTM F477 factory installed
   b. Suitable for buried service
   c. Gaskets:
      i) Material: Virgin SBR rubber suitable for potable water conforming to AWWA C111
      ii) Lubricant shall be suitable for potable water contact
2. Restraint device for PVC push on joint
   a. Restraint material: ASTM A536 , ductile iron
   b. A split ring shall be used behind the pipe bell. A serrated ring shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring
   c. 316 SS nuts, bolts, and washers torqued to requirements of manufacturer
   d. Pressure rating consistent with pipe pressure rating
   e. Restraint coatings shall be consistent with manufacturer's standard

f. Manufacturers:
   i) EBAA Iron Inc. "Series 1600"
   ii) Romac Industries "Series 611"
   iii) Or accepted substitution

3. Mechanical joint restraint
   a. Provide mechanical joint restraint for all ductile iron fittings connecting to PVC pipe
   b. Restraint devices for shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA A21.10/C110
   c. Pressure rating consistent with pipe pressure rating
   d. Restraint coatings shall be consistent with manufacturer's standard
   e. 316 SST hardware
   f. Manufacturer:
      i) EBAA Iron "MEGALUG 2000 PV"
      ii) Romac Industries "Roma-Grip"
      iii) Or accepted substitution

G. Couplings
   1. Mechanical couplings:
      a. Dresser Style 38
      b. Rockwell 411
      c. Or accepted substitution
   2. Insulated Mechanical Couplings:
      a. Dresser Style 39
      b. Or accepted substitution
   3. Transition Couplings:
      a. Rockwell 415
      b. Dresser Style 39
      c. Or accepted substitution
   4. Glands color coded: Black

2.3 PVC GRAVITY PIPE (NON-PRESSURE)

A. The following piping shall be non-pressure PVC pipe as indicated on the Drawings and in the pipe schedule

B. Manufacturers:
   1. CertainTeed
   2. Diamond Plastics Corp.
   3. JM Eagle Manufacturing Co.
   4. Or accepted substitution

C. Pipe and fittings:
   a. 4 inch to 12 inch, ASTM D3034, Type PSM, SDR 35
   b. Cell Classification: ASTM D1784
   c. Pipe length: 20 feet standard length

D. Joints:
   1. Shall be bell and spigot, push-on type with elastomeric gaskets conforming to ASTM D3212 and F477
   2. Designed to hold pipe in alignment, provide flexibility, separate the ends of pipe lengths, resist applied earth pressures, and provide fluid tightness
   3. Rubber rings: F477

2.4 COPPER TUBING – 3 INCHES OR LESS

A. Manufacturers:
   1. Mueller
   2. Or accepted substitution

B. Copper Tube: ASTM B88; Type K, soft-annealed temper with flared connections.
   1. Fittings: Wrought-copper solder-joint fittings, ANSI B16.22; soldered joints, pressure type. Compression fitting will not be accepted.

2.5 GATE VALVES – 3" TO 12" AND ACCESSORIES

A. Manufacturers:
   1. Mueller
   2. American AVK
   3. American Flow Control
   4. Clow
   5. Kennedy
   6. Or accepted substitution

B. AWWA C509, Iron body, bronze trim, two O-ring stem seals, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, extension stem, and extension valve box, pressure rating of 250 psi. For installation in horizontal or near horizontal pipe lines
   1. Non-adjustable elastomeric stem seals
      a. Adjustable packing glands are not permitted
   2. Direct operation of stem from above via 2-inch square nut
      a. No gear box provided
   3. Rotation: Counterclockwise to open with the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut

C. Rotation: Contractor to verify the operating direction with the jurisdictional water district or department
   1. Provide the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut.
   2. Contractor to confirm nut size with the jurisdictional water district or department

D. Valve stem material: ASTM B763, UNS alloy C99500 minimum yield strength of 40,000 psi
   1. Valve stem extensions: Provide valve stem extensions as necessary for proper valve operation with a 7 foot key with tee handle

2. Provide one (1) key to Owner prior to project closeout

E. Extension stems
1. Provide for buried valves with operating nuts more than 4.5 feet below grade
2. Non-rising stems
   a. Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
   b. Connected to the valve by a flexible socket coupling
   c. All other connections pinned
   d. Extend stem to within 6-inch of grade
   e. Provide spacers to center stem in valve box
   f. Provide wrench nut

F. Coating
1. AWWA C550 and NSF 61 certified
2. Minimum 8 mils dry film thickness
3. Fusion bonded epoxy applied to all ferrous metal surfaces after cleaning surfaces of grease, dirt and moisture, and performing near-white blast cleaning following SSPC-SP10
4. Do not coat fasteners or machined surfaces subject to contact and relative movement against other surfaces during operation of valve or other surfaces where such coating would compromise proper installation or functionality of valve

G. Valve boxes, depth as required for valve
1. Three piece cast iron (complying with ASTM A48, Class 20A) adjustable screw type, 5.25-inch diameter, minimum thickness of 3/16 inch
2. Box, cover, and base coated by dipping in asphalt varnish.
3. Cover marked with word, “WATER.”
4. Provide extension piece to permit 6-inch adjustment above finish grade
5. Manufacturers:
   a. Tyler Pipe Company "Series 6860 with #160 oval base"
   b. East Jordan Iron Works "8560 Series"
   c. Tyler Union "6860 Series"
   d. Or accepted substitution

2.6 ECCENTRIC PLUG VALVES

A. Provide plug valves as indicated in Valve Schedule below and on Drawings

B. Approved manufacturers:
1. DeZurik
2. Henry Pratt Company
3. Milliken
4. Val-Matic Valve and Manufacturing Corp.
5. Or accepted substitution

C. General
1. Quarter-turn non-lubricated eccentric plug valves

2. Resilient faced plug
3. Tight shut-off up to scheduled rating with pressure in reverse direction where scheduled
4. Valves with vane type seat rings are not acceptable
5. Valve ends to match connecting piping
   a. Buried: Mechanical joint, ANSI A21.11/AWWA C111
   b. Flanged: 125 lb, ANSI B16.1
   c. Screwed valve ends shall be to the NPT standard
   d. Grooved ends shall conform to AWWA C606 rigid joint specifications
6. Minimum Working Pressure Rating:
   a. 175 psi, 4 inch through 12 inch
7. Opening motion eccentric, lifting plug away from body seat
8. Valve alignment
   a. Valve shall be installed so that the plug is horizontal and rotates upward as the valve opens
   b. Valve shall be installed with seat on low pressure side of valve
9. Provided with fully adjustable plug position stops
10. Plugs shall be eccentric type with no backing ring or frame
11. Valve body cavity shall be smooth without protrusions or baffles
12. Valve body plainly marked to indicate seat end
13. Valve packing adjustment accessible without removing actuator from valve

D. Valve Materials
1. Plug and body: Cast iron, ASTM A126, Class B
2. Resilient plug facing or replaceable style body seats shall be synthetic rubber, neoprene, or Buna N compound suitable for use with water and wastewater applications
3. Seat rings shall be threaded, or welded of corrosion-resistant stainless steel (18-8), nickel, or Monel conforming to AWWA C504
4. Sprayed or plated mating seat surfaces are not acceptable
5. Bearings shall be replaceable. Sleeve type and thrust bearings in the upper and lower journals shall be corrosion-resistant stainless steel or bronze
6. Shaft seals shall be multiple O-ring, self-adjusting U-cup or chevron type packing conforming to AWWA C504
7. Pull-down packing is not acceptable
8. Shaft seals shall be field adjustable or replaceable without valve disassembly
9. Plug seat: Chloroprene (Neoprene)
10. Packing: Acrylonitrile Butadiene V-Type Cup
    a. Dual U-cup
11. Upper thrust bearing: TFE
12. Body seat: Welded-in overlay seat of no less than 90% nickel
13. Upper and lower trunnion bearings: Sleeve type, 18-8 stainless steel
14. Valves complete with epoxy coating on the interior and exterior, manufacturer's standard corrosion resistant coating shall be acceptable

E. Testing

1. Each valve shall be in accordance with AWWA C540 subjected to cycle life and pressure leak test (1,034 kPa) and a valve body hydrostatic test (2,068 kPa) by the manufacturer at their facilities prior to shipping
2. Valves shall be capable of drip-tight shut-off up to the full leak test rating
   a. Test and certify pressure capacity in the reverse direction

2.7 CLEANOUTS

A. Exposed metal cleanouts:
   1. Manufacturers:
      a. Smith, Jay R. Mfg. Co.
      b. Tyler Pipe; Wade Div
      c. Watts Drainage Products Inc.
      d. Zurn Plumbing Products Group
      e. Or accepted substitution
   2. Standard: ASME A112.36.2M for cast iron for cleanout test tee
   3. Size: Same as connected piping
   4. Body material: hub-and-spigot, cast-iron soi pipe T-branch as required to match connected piping
   5. Closure: Countersunk, brass, cast-iron, or plastic plug
   6. Closure plug size: same as or not more than one size smaller than cleanout size

2.8 YARD HYDRANT (NON-POTABLE)

A. Provide 1 inch water supply line to freeze proof yard hydrant with galvanized casing and brass mechanism as shown in Drawing details
   1. Provide with brass vacuum breaker/automatic below grade drain
   2. Yard hydrant shall be designed to be freeze proof

B. Manufacturer:
   1. Merrill Mfg. "Any Flow Series” Hi-Cap 1-inch
   2. Or accepted substitution

2.9 MANHOLES

A. Precast Concrete Units:
   1. Manufacturers:
      a. Rinker Materials
      b. Old Castle Precast
      c. Or accepted substitution
   2. Specification: ASTM C478
   3. Minimum wall thickness: greater of 6 inch or 1/12 of internal diameter
   4. Reinforced
   5. Grade rings as required

B. Due to the presence of water soluble sulfates in the soils, concrete shall meet the specifications for Class 2 sulfate exposure as defined in ACI 201.2R-10.

C. Precast Units or Cast-in-place as shown. Use concrete that will attain a 28-day compressive strength of not less than 4,000 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan. Sawcut in field only if no other option.

D. Cast-in-place Concrete Units: As shown on the drawings complying with the Pueblo West Metropolitan District and Colorado Department of Transportation drainage and design standards

E. Manhole Steps: Steel bar, 1/2 inch Grade 60, drop-front type, with polypropylene coating applied by manufacturer, Type MA Industries, Inc. "PS2-PF" or approved equal

2.10 SOURCE QUALITY CONTROL

A. Identification Marks: Clearly and permanently marked at not greater than 5 foot intervals with pipe diameter, PVC cell classification, manufacturer, plant, shift, ASTM, date designations and service designation

B. Testing per ASTM D3034
   1. Test products not manufactured in the U.S. at an acceptable laboratory in the U.S.

2.11 FABRICATION

A. Manhole Sections
   1. Precast concrete dimensions as shown on plans
   2. Minimum manhole inside diameter: 48 inch
   3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H20 loading
   4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
   5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly
   6. Access opening: Minimum 24 clear or as indicated on the Drawings
   7. Pipe connection: As indicated on Drawings
   8. Pipe knockout: As indicated on Drawings
   9. Base slab shall be poured monolithically with bottom riser section
   10. Manhole steps: 12 inch on center, vertical alignment above largest bench or open area

B. Grating and Metal Frame: As specified on drawings

2.12 MATERIALS

A. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Engineer for pipe stubouts

B. Cleanouts and Pressure Cleanouts: Provide as indicated on Drawings, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the following words associated with the following pipe:
   1. “SEWER” – sewer piping

2. “DRAIN” – drain piping

C. Reinforcement:
1. Reinforcing Steel: ASTM A615 Grade 60
2. Welded Wire Fabric: ASTM A185

D. Concrete: Refer to Division 3 specifications
1. Minimum compressive strength: 4000 psi at 28 days
2. Cement: ASTM C150, Portland Cement, Type II
3. Aggregates: ASTM C33, free of deleterious substances

E. Gaskets: ASTM C923
1. Mastic: FS SS-S-210A, "RAM-NEK" or accepted substitution
2. Rubber: Neoprene, 40+ 5 hardness when measured by ASTM D2240, Type A durometer

F. Boots: ASTM C923
1. Flexible rubber boots

G. Frames and Castings: ASTM A48 with asphalt varnish coating hot dip applied at foundry, 6 mils thick Class 30b

H. Manhole Rings and Covers
1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces
2. Covers to seat at all points on ring
3. Covers to be cast with "SANITARY" in 2" tall flush letters
4. Provide type as indicated on the drawings. Manhole ring frame shall be set in a bed of grout. The frame shall be surrounded with a cement grout in unpaved area, or a concrete collar in paved area.
5. Due to the presence of water soluble sulfates in the soils, concrete or grout used for manhole rings shall meet the specifications for Class 2 sulfate exposure as defined in ACI 201.2R-10.

I. Rock Subbase: 1-1/2 inch minus, well-graded gravel over compacted subgrade

J. Water: Clean and free of deleterious substances

K. Grout:
1. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days
2. Epoxy Grout: Three Component Epoxy Resin System
   a. Two liquid epoxy components
   b. One inert aggregate filtered component
   c. Each component furnished in separate package for mixing at job site
3. Manufacturers

a. Non-Shrink, Non-Metallic Grout
   i) Master Builders: Masterflow 928
   ii) Burke: Non-Ferrous Non-Shrink
   iii) M.R. Meadows: Sealtight 588
   iv) Sonneborn: Sonogrout G.P.
   v) Tamms: Tammsgrout 621
   vi) Sika: SikaGrout 212
   vii) Or accepted substitution
b. Epoxy Grout
   i) Burke: BurkEpoxy Anchoring Grout
   ii) L&M Inc.: Epogrout
   iii) Sika: Sikadur 42, Grout Pack
   iv) Or accepted substitution

2.13 CONCRETE MATERIALS

A. Follow requirements specified in Division 3 Specifications

2.14 SOIL MATERIALS

A. Furnish pipe bedding and cover as specified in Section 02300

2.15 ACCESSORIES

A. Concrete for Thrust Blocks: constructed of "Class B" Concrete as defined by Colorado Dept of Transporation (CDOT) standards, with maximum water to cement ratio of 0.63 by weight and 28-day compressive strength of 2500 psi minimum

B. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, and valves. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages
   1. Clamps, straps and washers: Steel, ASTM A506
   2. Rods: Steel, ASTM A575
   3. Rod Couplings: Malleable-iron, ASTM A197
   4. Bolts: Steel, ASTM A307
   5. Cast-Iron Washers: Gray-iron, ASTM A126

C. Pipe Accessories
   1. Underground Type Plastic Line Identification Marker
      a. Manufacturer's standard permanent, continuous-printed plastic tape with metallic core, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide colored (green/blue/yellow) tape with black printing reading "CAUTION SANITARY SEWAGE LINE OR WATER LINE BURIED BELOW." Provide identification markers of one of the following: Water or Sanitary Sewer
         i) Allen Systems, Inc.
         ii) Emed Co., Inc.
         iii) Seton Name Plate Corp.
         iv) Or accepted substitution

2. Tracer Wire for Buried Pipe
   a. Provide tracer wire for all PVC pipe
   b. All tracer wire shall be 12 AWG solid copper wire coated with 45 mil Type HMW - PE blue insulation compliant with ASTM D1351 specifically designed for direct burial in corrosive soil or water
   c. UL listed
3. Tracer Wire Test Stations
   a. 4-inch with locking lid
   b. Manufacturers:
      i) CP Test Services
      ii) Glenn Series "Glenn-4"
      iii) Or accepted substitution
   c. Test stations to be spaced at a maximum of 1,000 feet

D. Valve Accessories
1. Extension stems
   a. Provide where indicated on drawings, specified, or required for proper operation and for buried valves.
   b. Non-rising stems
      i) Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
      ii) Connected to the valve by a flexible socket coupling
      iii) All other connections pinned, keyed, or socket
   c. Stem guides
      i) Cast iron, bronze brushed, adjustable in two (2) directions
      ii) If extension stem length exceeds 10 feet or the weight exceeds 50 lbs., design top guide to carry the stem weight and provide a collar on the stem to bear against the thrust guide
      iii) Max spacing:
         Non-rising stems: 100 times stem O.D.
         Rising stems: 60 times stem O.D.
         Ten foot maximum
   d. Buried valves
      i) Extend stem to within 1.0 foot of grade.
      ii) Provide spaces to center stem in valve box
      iii) Provide wrench nut
2. Valve boxes
   a. Provide for all buried valves
   b. Boxes shall consist of a cast iron cover, lid, and base castings. No slip type boxes shall be allowed
   c. Type: Cast iron or ductile iron, extension sleeve (screw) type
   d. Minimum thickness: 3/16 inch at any point
   e. Coating: Bituminous varnish
   f. Cast appropriate name designation of service in cover.
   g. Shaft shall be ductile iron and minimum diameter of 5-1/4"
   h. An appropriate word designating the valve service type on the cover
   i. Manufacturer:

i) Neenah Foundry Company
ii) Tyler Company
iii) Mueller Company
iv) Or accepted substitution

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions under provisions of Division 1 specifications

B. Verify locations and inverts or tops of pipe are as indicated

C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation

D. Remove all defective pipe from site and replace

E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work.

F. Start installation only when conditions are satisfactory

3.2 PERFORMANCE - GENERAL

A. Perform work in a safe and proper manner with appropriate precautions against hazard

B. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities

C. Contain all construction activity on the designated site and within the limits of work. Cost of restoration of site will be the responsibility of the Contractor

D. Contractor to verify quantities to perform all earthwork required according to Drawings, including but not limited to, additional import or export required to handle compaction, pavement subgrade preparation, and pipe bedding

E. Contractor shall take precautions to limit the removal of or damage to existing pavements, multi-use paths sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted

3.3 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations shall be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work

B. Backfill shall be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

C. Any excavations improperly backfilled or where settlement occurs shall be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner

D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, shall be borne by the Contractor at no additional expense to the Owner

3.4 SITE PREPARATION

A. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris

B. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.

C. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted

3.5 DEWATERING

A. Comply with CDPHE Dewatering Requirements

B. Dewatering discharge to surface waterways requires CDPHE dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, if necessary

3.6 PREPARATION

A. Thoroughly clean pipe and fittings of foreign matter before installation. Remove scale and dirt, on inside and outside, before assembly

B. Ream pipe and tube ends and remove burrs

C. Prepare pipe connections to equipment with flanges or unions. Clean joint contact surfaces with wire brush is necessary, wipe clean, and keep clean until jointing is complete.

D. Cut ends of metallic pipe, recoat with manufacturer's coatings

E. Shape trench and place bedding as specified in Section 02300 and as shown on the drawings. Do not disturb trench bottom during excavation. Hand trim excavation for accurate placement of pipe to elevations indicated
   1. Dig bell or coupling holes
   2. Do not support pipe on blocks or mounds of earth

3. Provide uniform and continuous bearing and support for full length of pipe between bell holes
4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle
5. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent
6. Backfill in accordance with Section 02300

F. Alignment and Grade
1. Except as indicated on the Drawings, lay all pipe straight and at a uniform grade
2. Use batter boards to determine and check pipe subgrades
3. Other methods of maintaining alignment and grade may be acceptable if approved by the Engineer

3.7 PIPE INSTALLATION

A. Inspect pipe and accessories for defects before lowering into trench

B. Replace any defective, damaged or unsound pipe

C. Cutting Pipe
1. Cut pipe to measurement taken at the site, not from the drawings
2. Cut pipe neatly without damage to pipe or cement lining
3. Cut smooth, straight, and at right angles to pipe axis
4. Dress and bevel end of cut pipe to remove roughness and sharp corners
5. Cut pipe with saw, abrasive wheel or pipe cutter designed specifically for the pipe material

D. Group piping with other site piping work whenever practical

E. Install pipe to indicated elevations. Adjust to maintain minimum 4.5 feet depth of bury and maintain minimum grade for drainage and also allow for all air to be released at high points

F. Comply with City of Idaho Springs standards and specifications. Use the manufacturer's recommendations if the City of Idaho Springs standards do not specifically apply.

G. Install PVC Pipe in accordance with AWWA M23 and AWWA C605

H. Route pipe as indicated on plan and profile drawings

I. Install pipe to allow for expansion and contraction without stressing pipe or joints

J. Protect from lateral displacement by placing embedment evenly on both sides of pipe

K. Make changes in horizontal, vertical, and curved alignment shown on drawings by using joint deflections not more than half in the amount permissible by manufacturer and shown on drawings

L. Do not bend pipe

M. Deflect pipe at joints

N. Do not deflect PVC pipe at connection to ductile iron fittings

O. Slope pipe and position drain at low points

P. Protect from lateral displacement by placing embedment evenly on both sides of pipe as specified in Section 02300

Q. Do not lay pipe in water. Maintain groundwater level a minimum of 12 inches below pipe to be installed. Do not lay pipe under unsuitable weather or trench conditions

R. Lay pipe with bell ends facing the direction of laying except when Engineer authorizes reverse laying

S. Form and place concrete for thrust blocks at each elbow or change of direction of pipe

T. Install trace wire continuous over top of pipe. Tracer wire shall be Type THHN, AWG size #12, UL listed with a single copper conductor, PVC insulation, and nylon jacket. Test stations at post hydrants shall be CP Test Services, Glenn Series Glenn-4 with locking lid, or approved equal. Install pipeline marker strip (tape) in trench above all pipelines

U. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

V. Carefully lower pipe, fittings, and accessories into the trench with slings, ropes, and other suitable equipment to prevent damage. Do not dump or drop pipe or accessories into trench

W. Joint to form true and smooth line

X. Remove any pipe not making a good fit

Y. Begin pipe laying at the lowest point unless reverse laying is accepted by Engineer

Z. Utilize implements, tools and facilities as recommended by the manufacturer if required to remove debris

AA. During construction, close all open ends with watertight expandable type plugs
1. At the end of each day's operations
2. Whenever pipe ends are left unattended
3. Deposit adequate backfill on pipe to prevent flotation
4. Do not use wood, burlap or other similar temporary plugs

BB. Utility crossings
1. Whenever possible, lay water mains over sanitary and storm sewers to provide vertical separation of at least 18-inch between invert of water main and crown of sewer

2. If standard crossing detail is not available and above separation cannot be met, provide one continuous length of watertight sewer pipe 20' long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inch either side of joint or encase sewer pipe in 6-inch of concrete completely around pipe, for not less than 10' either side of water main
3. Water Mains Passing Under Sanitary Sewers: If vertical separation is less than 18-inch, provide structural support for sewer. Provide concrete encasement where water lines pass under sanitary sewer line. Reference detail shown on Drawings

CC. Maintain a minimum 10 feet of horizontal separation and 18 inches of vertical separation between water main and storm or sanitary sewer lines in accordance with the CDPHE
1. Provide concrete encasement if these clearances cannot be achieved and when water line is below sanitary sewer line

DD. Tracer wire and marker tape
1. Install tracer wire continuous over top of pipe
2. Install tracer wire test stations at maximum 500 LF of water line per City of Idaho Springs requirements. Locate test station at fire hydrants, gate valves, or special test station locations in a valve box
3. Terminate tracer wire following drawing details
4. Tape tracer wire to top of pipe using PVC tape every 4 feet along the pipe, and on each side of fitting
   a. Tape: minimum 2 inches wide and wrapping full circumference of pipe
5. Install identification /warning marker tape in fill area of trench above all water lines

EE. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

FF. Install access fittings to permit disinfection of water system, subject to approval by Engineer

GG. Backfill trench in accordance to specifications herein

HH. Protect pipe from floatation or movement until completely backfilled and put into service

II. Remove and re-lay any pipe which has floated

3.8 JOINTS

A. Make pipe joints carefully and neatly

B. Connect piping in accordance with manufacturer's recommendations

C. Push-on Joints
1. Lubricate joint surfaces immediately before completing the joint
2. Bevel spigot ends of field cut piping
3. Groove spigot ends of field cut restrained joint piping if required by joint system

D. Mechanical Joints

1. Thoroughly lubricate gaskets and install in accordance with manufacturer's instructions
2. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble
3. Do not over tighten bolts to compensate for poor installation
4. Carefully align holes in mechanical joints with restraint device to permit installation of the harness bolts
5. Install flange and mechanical joint pieces so the mechanical jointholes, as well as the flange holes, straddle the top centerline for horizontal piping, or the side centerline for vertical piping

3.9 PROTECTIVE COATING

A. Provide polyethylene wrap encasement on all buried ductile iron fittings, valves, and fire hydrant extensions
   1. Encase ductile iron fittings and valves in polyethylene per AWWA C105, Method A, secured with polyethylene compatible adhesive tape. Overlap polyethylene onto PVC pipe a minimum of 6 inches
   2. Before backfilling, inspect polyethylene for rips, punctures and other damage and repair following AWWA C105

B. Coat exposed ferrous metal surfaces of joints, couplings, and uncoated steel with primer and tape coating system after installation. Do not coat stainless steel or high strength low alloy steel nuts and bolts
   1. Surface Preparation: Clean surfaces of rust, scale, soil, mud, oil, grease, and other contaminants by hand or power tool following SSPC-SP2 or SP3 and other appropriate means as recommended by coating manufacturer Remove excess moisture and provide surface dryness as recommended by coating manufacturer
   2. Application: Apply primer in uniform manner to clean and dry surfaces following coating manufacturer's recommendations
      a. Fill complex and irregular surfaces with appropriate mastic or filler tape to eliminate bridging; then apply tape/wrap to primed and filled surfaces following coating manufacturer's recommendations.
      b. When coating restraining rods or strapping, apply tape wrap longitudinally
      c. Where metal being coated enters concrete, overlap coating onto concrete by minimum of 2 inches after placement of concrete
   3. Inspection: After field coating of specified items, conduct visual inspection to verify complete coverage has been accomplished.
      a. Repair damaged or incompletely coated surfaces following coating manufacturer's recommendations

C. Metal Surfaces not Protected by Poly Wrap
   1. Coat all steel clamp rods, bolts, and other metal accessories used in tapping saddles, anchorages, cut ends of pipe, follower rings and bolts or joint harnesses subject to submergence or contract with the earth and not concrete encased, but including pipe fittings and bolts in polyethylene tube protection
   2. Apply 2 coats of coal tar paint to clean, dry metal surfaces, allow first coat to dry before applying second coat

D. Metal Harness Rods
   1. Provide field applied primer and Polyken tape wrap

3.10 CONCRETE ENCASEMENT

A. Provide where indicated on the Drawings

B. Suitably support and block pipe and anchor against flotation

3.11 INSTALLATION – BURIED VALVES

A. Install valves and accessories in accordance with the manufacturer's recommendations and in accordance with referenced standards and specifications

B. Set valves on solid bearing

C. Center and plumb valve box over valve. Set box cover flush with finished grade. Evenly fill around box and thoroughly compact on all sides

D. Extend stem to within 6 inches of final grade. Provide spacers to center stem in valve box

E. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards

F. Provide an isolation or shutoff valve and union at the water connections to each fixture and unit of equipment, whether shown on the drawings or not

3.12 THRUST BLOCKS

A. Installation:
   1. Thrust blocks shall be constructed at bends and fittings that require support due to unbalanced line thrust. Care shall be taken to ensure that outlets, cover bolts, nuts, clamps, and other fittings are accessible. A bond breaker shall be placed between the pipe and the thrust block to aid in future removal. If a large thrust block is to be placed, it shall be separated into sections by a suitable material. Bearing surface areas are minimum areas to bear against the undisturbed trench wall. If the soil bearing capacity is insufficient to provide adequate support based on minimum bearing areas established by Drawing Details, then the minimum bearing area shall be increased to a size that shall ensure support restraint. In every instance, the thrust block shall bear against undisturbed earth
   2. Before placing concrete, equipment used in the mixing and transport shall be cleaned. Debris, water, or ice shall be removed from the area to be occupied by concrete. Concrete shall not be placed on frozen subgrade. Concrete shall be placed only in the presence of the Engineer unless inspection is waived prior to the placement
   3. Shall be in accordance with Geotechnical Report

B. Formwork for Thrust blocks:

1. Forming for concrete thrust blocks and anchors shall be done by bulkheading around the shape of the thrust block or anchor with wood, burlap sacks, or reinforced paper sacks that are filled with sand or earth. Sacks shall be constructed of a size easily handled when full and left in place in the trench. Wood forms shall be removed before backfilling.
2. Horizontal struts or braces required for trench shoring shall not remain in concrete thrust blocks. Prior to placing concrete, the forms and ditch bank will be inspected and approved by Engineer
3. When concrete is deposited against the ground without the use of forms, the ground shall be thoroughly moistened or other provisions made to prevent the ground from drawing water in from the concrete

C. Thrust block Curing Time:
   1. Newly placed concrete shall be allowed to set undisturbed for a minimum of 24 hours

D. Compaction of Fill Over Thrust blocks
   1. Backfill may be placed over thrust blocks once the surface has set sufficiently and they are able to resist the weight of the backfill. However, tamping or compacting shall not be allowed above the thrust block for a minimum of 24 hours after placement

E. Hydrostatic testing shall not be conducted until thrust blocks have fully cured, a minimum of 7 days

3.13 ABANDONMENT

A. Cap ends of main as shown. Place required concrete blocking as shown on drawing details

B. Where mains are to be abandoned and removed to a fitting or valve, cut and plug main at fitting or valve
   1. When shown on drawings, remove fire hydrants and valves, including lead joint tees when encountered; salvage and deliver removed fire hydrants and valves to the City of Idaho Springs
   2. Pipe, fittings, and other appurtenances that are removed, but are not required to be salvaged become property of Contractor
      a. Remove and dispose of offsite

3.14 MANHOLE PREPARATION

A. Verify items provided by other section of Work are properly sized and located

B. Verify that built-in items are in proper location, ready for roughing into Work

C. Verify excavation for manholes is correct

D. Excavation, Backfill, Subgrade Compaction: Refer to Section 02300 for requirements

E. Rock Subbase

1. Remove water and place 6-inch minimum depth
2. Vibrate for compaction
3. Level top to accept precast sections with uniform bearing all around
4. If material below vault is unsuitable, excavate as directed by the Engineer and backfill to grade with 1-1/2 inch minus rock and compact

3.15 PLACING MANHOLE

A. Place manhole sections plumb and level, trim to correct elevations

B. Clean ends of sections and place double mastic gasket

C. Fill inside and outside of joint completely with non-shrink grout and trowel smooth

D. Cure non-shrink grout using approved methods outlined in Division 3 Specifications.

E. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Engineer

F. Completed manholes shall be rigid and watertight

G. Coordinate with other sections of work to provide correct size, shape, and location

3.16 PREFORMED GASKETS

A. Remove and replace manhole sections which have chipped or cracked joints

B. Thoroughly clean section joints

C. Install gasket in conformance with manufacturer's recommendations

D. Only use primer furnished by gasket manufacturer

3.17 MANHOLE INVERT

A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench 1 inch per foot for drainage to invert.

B. Invert shape to conform to radius of pipe it connects

C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert

D. Construct in conformance with standard drawings

3.18 MANHOLE RINGS AND COVERS

A. Place rings in bed of non-shrink grout on top of manholes

B. Ensure no infiltration will enter manhole at this location

C. Carry non-shrink grout over flange of ring

D. Set top of ring flush with all surfaces subject to foot and vehicular traffic or as required by District

E. Set manhole ring and cover 1/4-inch to 1/2-inch below roadway surface

F. Use precast grade rings for height adjustment of manhole ring and cover

3.19 CONNECTION TO EXISTING MANHOLES

A. Maintain flow at all times

B. Prior approval of proposed method for maintaining flow must be obtained from Engineer

C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure

D. Make connection during low flow periodsgrout

3.20 GROUT

A. PREPARATION
1. Non-Shrink, Non-Metallic Grout, General Use
   a. Clean concrete surface to receive grout
   b. Saturate concrete with water for 24 hrs prior to grouting and remove excess water just prior to placing grout
   c. Cold weather conditions
      i) Warm concrete, substrate and base plate to 40 deg F, or above; store grout in warm area
      ii) Follow manufacturer's recommendations for cold weather application
   d. Hot weather conditions
      i) Use cold mixing water and cool base plate if possible; store grout in cool area
      ii) Follow manufacturer's recommendations for hot weather application
   e. Apply to clean, sound surface
   f. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer
2. Epoxy Grout: Apply only to clean, dry, sound surface
   a. Patching cavities in concrete including, but not limited to, tie holes, and structural and equipment support

B. APPLICATION
1. Non-Shrink, Non-Metallic Grout
   a. Mix in a mechanical mixer
   b. Use no more water than necessary to produce flowable grout
   c. Provide air vents where necessary to eliminate air pockets
   d. Place in accordance with manufacturer's instructions

e. Where exposed to view finish grout edges smooth
f. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound
g. Wet cure grout for 7 days, minimum
h. Maintain the temperature at a minimum of 40 deg F until grout reaches 3000 psi
i. After placement of grout, eliminate excessive external vibration

2. Epoxy Grout
   a. Mix and place in accordance with manufacturer's instructions
   b. Completely fill all cavities and spaces around dowels and anchors without voids
   c. Obtain manufacturer's technical assistance as required to insure proper placement

3.21 ERECTION TOLERANCES

A. Establish invert elevations and slopes as shown on Drawings

B. Respect pipe manufacturer’s tolerances of horizontal and vertical deflection

3.22 FIELD QUALITY CONTROL – PIPE

A. General
   1. Utilize pressures, media and pressure test durations as specified on Piping Schedules
   2. Isolate equipment which may be damaged by the specified pressure test conditions
   3. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify Engineer 24 hours prior to each test
   4. Completely assemble and test new piping systems prior to connection to existing pipe systems
   5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance
   6. Provide all necessary equipment and perform all work required in connection with the tests and inspections
   7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination

B. Low pressure air test
   a. Check pneumatic plugs for proper sealing
   b. Place plugs in line at each manhole and inflate to 25 PSIG
   c. Introduce low pressure air into sealed line segment until air pressure reaches 4 PSIG greater than ground water that may be over the pipe. Use test gauge conforming to ANSI B40.1 with 0 to 15 PSI scale and accuracy of 1 percent of full range
   d. Allow 2 minutes for air pressure to stabilize
   e. After stabilization period (3.5 PSIG minimum pressure in pipe) discontinue air supply to line segment
   f. Acceptable time for loss of 0.5 PSIG of air pressure in plastic pipe shall be:

	Minimum Time for 0.5 PSIG Loss in Plastic Pipe (minutes: seconds)								
Pipe Size	≤100 Feet	150 Feet	200 Feet	250 Feet	300 Feet	350 Feet	400 Feet	450 Feet	500 Feet
4 Inch	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53

	Minimum Time for 0.5 PSIG Loss in Plastic Pipe (minutes: seconds)								
Pipe Size	≤100 Feet	150 Feet	200 Feet	250 Feet	300 Feet	350 Feet	400 Feet	450 Feet	500 Feet
6 Inch	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34
8 Inch	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20
10 Inch	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:53
12 Inch	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	14:14
15 Inch	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16
18 Inch	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:03
21 Inch	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38
24 Inch	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	56:59
27 Inch	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07
30 Inch	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:02

NOTE: If there has been no (zero psi) drop after 1 hour of testing, the test section shall be accepted and the test completed

b. For pipe lengths not shown in the above table, use the two nearest pipe lengths to estimate the minimum time necessary for a 0.5 PSIG loss
c. For concrete pipe 24" and smaller refer to ASTM C-924 for acceptable test procedures and times
d. For concrete pipe 24" and larger refer to ASTM C-1103 for acceptable test procedures and times

C. Exfiltration/Infiltration Test
1. Perform an exfiltration test on each reach of sanitary service and sewer pipe between manholes or discharge
   a. Test the first reach prior to backfilling and before installing any of the remaining pipe
   b. Provide all necessary piping between the reach to be tested and the water supply, together with all required materials and equipment
   c. Methods used, scheduling, and duration of tests shall be acceptable to Engineer
   d. Air testing may be allowed: Submit complete information to Engineer for review describing the proposed test method including the method of testing manholes before beginning testing
2. Procedure
   a. Block off all manhole openings except those connecting with the reach under test
   b. Fill the line
      i) Average depth: 10 feet above invert except as required by manhole depth
      ii) Maximum depth at lower end: 25 feet above crown
      iii) Minimum depth at upper end: 5 feet above crown
   c. Add and measure water as required to maintain a constant level
      i) Maximum exfiltration/infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
      ii) Manholes considered section of 48-inch pipe
      iii) Maintain test for at least 2 hours or as long as necessary, in the inspector's opinion, to locate all leaks
3. Repair and retest any reach which exceeds the allowable exfiltration/infiltration

D. Infiltration
   1. At any time prior to expiration of the correction period, infiltration exceeds 0.039 gallons per inch of nominal diameter per 100 feet per hour, locate the leaks and make repairs

E. Mandrel Test
   1. No sooner than 30 days after placement and compaction of backfill, but prior to placement of permanent surface materials, clean and mandrel each line to detect obstructions (deflections, joint offsets, lateral pipe intrusions, etc.)
   2. Use a rigid mandrel with diameter of at least 95 percent of the pipes specified average inside diameter and a length of the mandrel circular portion at least equal to the nominal pipe diameter
      a. Where pipe fittings and valves do not allow mandrel test use other methods to confirm joint offsets and pipe being clean and free of obstructions
   3. Pull the mandrel through the pipe by hand
   4. Relay or replace all pipe exceeding the 5 percent deflection at no additional cost to the Owner
   5. Retest repaired sections
   6. Maximum allowable deflection at end of one year correction period, 7-1/2 percent of the base internal diameter tested in the same manner. Uncover and repair sections exceeding the allowable deflection

F. All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights.

G. Lamp Test
   1. Each section between manholes will be lamped by Contractor in the presence of engineer
   2. A true circle will be required in the lamp tests to indicate a properly constructed sewer line
   3. Repair any sections not passing the lamp test at Contractor's expense.

3.23 FIELD QUALITY CONTROL – MANHOLES

A. Test all manholes:
   1. Vacuum test:
      a. Plug all inlets and outlets in such a manner as to prevent displacement of plugs
      b. Install and operate vacuum tester head assembly in accordance with equipment specifications and manufacturer instructions
      c. Attach the vacuum pump assembly to the proper connection on the test head assembly. Ensure that vacuum inlet/outlet valve is closed
      d. Inflate sealing element to twice the pressure test to be used. Do not over inflate
      e. Start vacuum pump assembly engine and allow preset RPM to stabilize
      f. Open vacuum inlet/outlet valve and evacuate manhole to 5-inches Hg (mercury)
      g. Close vacuum inlet/outlet valve, disconnect vacuum pump and monitor vacuum. Record time for vacuum to drop from initial 5 inches Hg to 4 inches Hg.

h. Acceptance for 5 foot diameter manhole is when the time to drop from 5 inches Hg to 4 inches Hg meets or exceeds requirements as defined below:

Maximum Allowable Vacuum Drop		
Manhole Depth Rim to Invert	**Manhole Diameter in feet**	**Time for Vacuum to Drop 1 inch Hg**
10 feet or less	5	150 seconds
10 feet to 15 feet	5	180 seconds
15 feet to 25 feet	5	210 seconds

i. Adjust time to drop from 5 inches Hg to 4 inches Hg for other manhole diameters as follows:
   i) 4 foot diameter manhole: Subtract 30 seconds from time shown above
   ii) 6 foot diameter manhole: Add 30 seconds to time shown above
j. Repair all manholes that fail leakage test and retest until manhole passes test at no additional cost
k. If joint mastic or gasket is displaced during vacuum test, disassemble manhole and replace seal
l. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn, Retesting shall proceed until a satisfactory test is obtained.

2. All testing shall be witnessed by Engineer. Contractor shall provide a minimum of 48 hours notice to Engineer prior to testing.

3.24

3.25 CLEANING AND DRAINING

A. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected

B. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete

3.26 SITE PIPING SCHEDULE

A. Install pipes as scheduled in the pipe schedule provided below

Description	Size (inches)	Material	Type of Installation	Supplied By
Drain	8	PVC – SDR 35	Buried	Contractor
Sanitary Sewer Influent	12	PVC – SDR 35	Buried	Contractor
Sanitary Sewer Influent	18	PVC – SDR 35	Buried	Contractor
Sanitary Sewer Influent	24	PVC – SDR 35	Buried	Contractor

Description	Size (inches)	Material	Type of Installation	Supplied By
Service Water	6	PVC – C900	Buried	Contractor
Waste Activated Sludge	6	PVC – C900	Buried	Contractor
Waste Activated Sludge	2	PVC – C900	Buried	Contractor

3.27 VALVE SCHEDULE

A. Install valves as scheduled in the valve schedule provided below

B. The following abbrevations are used in the valve schedule:
   1. GV: Gate Valve
   2. PV: Plug Valve

Item No.	Type	Size (inches)	Area Location	Type of Installation	Valve End Connection
1	GV	6	Water service line	Direct Bury	MJ & MJ
2	PV	24	Sanitary Sewer Influent	Direct Bury	MJ & MJ
3	PV	18	Sanitary Sewer Influent	Direct Bury	MJ & MJ

END OF SECTION

SECTION 02676

DISINFECTION OF WATER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disinfection of potable water piping and hydrants

1.2 RELATED SECTIONS

A. Section 02616 – Site Piping

B. Section 15060 – Pipe and Pipe Fittings

C. Section 15100 – Valves, Cocks and Hydrants

1.3 REFERENCES

A. American Water Works Association (AWWA):
   1. B300 – Standard for Hypochlorites
   2. B301 – Standard for Liquid Chlorine
   3. C651 – Disinfecting Water Mains
   4. C652 – Disinfection of Water Storage Facilities
   5. C653 – Disinfection of Water Treatment Plants

B. National Sanitation Foundation (NSF):
   1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects

1.4 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700

B. Disinfection report; record:
   1. Type and form of disinfectant used
   2. Date and time of disinfectant injection start and time of completion
   3. Test locations
   4. Initial and 24 hour disinfectant residuals (quantity in treated water) in parts per million (ppm) or milligram per liter (mg/L) for each outlet tested
   5. Date and time of flushing start and completion
   6. Disinfectant residual after flushing in ppm for each outlet tested

C. Bacteriological (Bac-T) report; record:

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 24 hour disinfectant residuals in ppm for each outlet tested
6. Coliform bacteria test results for each outlet tested
7. Bacteriologist's signature and authority

1.6 QUALITY ASSURANCE

A. Perform work in accordance with AWWA C651, C652, C653, and the Colorado Department of Public Health and Environment (CDPHE)

1.7 REGULATORY REQUIREMENTS

A. Conform to AWWA C651, C652, C653, as appropriate, and CDPHE regulations for performing the work of this Section

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Calcium and sodium hypochlorite shall conform to AWWA B300 and B301

B. Store hypochlorite in a cool, dark place away from flammable materials

PART 3 EXECUTION

3.1 CLEANING

A. Verify that piping has been cleaned and inspected

B. Verify that piping has been successfully pressure tested and flushed

C. Perform scheduling and disinfection activity with start-up, testing, adjusting, demonstration procedures, including coordination with related systems

3.2 DISINFECTION

A. Provide and attach required equipment to perform the work of this Section

B. Tablet, continuous, or slug disinfection may be followed in accordance with AWWA C651

C. The preferred method is continuous disinfection, summarized as follows:

1. Inject treatment disinfectant, free chlorine in liquid form into piping system to obtain 50 to 80 ppm residual
2. Bleed water from outlets to ensure distribution and test for disinfectant residual
3. Maintain disinfectant in system for 24 hours
4. If final disinfectant residual tests less than 25 ppm, repeat treatment
5. Flush, circulate and clean until residual equal to that of incoming potable water or 1.0 mg/L is achieved

D. Replace permanent system devices removed for disinfection

3.3 FINAL FLUSHING

A. Maintain a flushing velocity of 2.5 feet per second in piping

B. Collect chlorinated water for proper disposal and/or dechlorinate to less than 0.1 ppm free chlorine prior to discharge in accordance with State, County, and local regulations

C. City of Idaho Springs to provide flushing water

D. Contractor to pay for flushing water

3.4 DISINFECTION FIELD QUALITY CONTROL

A. After final flush, and before main or equipment is placed in service, collect water samples from representative points along the main or from the equipment and field test for chlorine residual

B. Chlorine residual shall be within 50 percent of the chlorine residual prevailing in the source

C. If initial disinfection fails to provide satisfactory samples, repeat disinfection until satisfactory samples have been obtained

3.5 DISINFECTION TESTING AND ACCEPTANCE

A. The Contractor will perform Bac-T sampling and testing after pipes have been disinfected and flushed as specified herein

B. If any portion of the piping or equipment fails Bacteriological testing, the Contractor is responsible for repeating disinfection procedures until passing Bac-T test is obtained

C. Contractor shall provide and pay for services of a certified laboratory to complete Bac-T testing

D. Submit test reports per Section 01700

3.6 FINAL ACCEPTANCE

A. Comply with City standards and specifications for placing water line in service

B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
   1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete

C. Drain all test water from the new pipe system prior to placing in service

D. Provide water tap locations (x, y, z) on the Drawings

E. Provide operation and maintenance manuals for backflow preventer

F. Provide final reports to Engineer for:
   1. Bac-T results
   2. Residual chlorine tests
   3. Hydrostatic tests for each section or pipe
   4. Tracer wire continuity test

END OF SECTION

SECTION 02740

FLEXIBLE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Full depth and/or composite hot bituminous pavement (asphalt) over prepared subgrade

B. Overlay, patch and/or pavement rehabilitation applications for streets, parking lots and other miscellaneous asphalt pavement

1.2 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02300 – Earthwork

C. Section 02750 – Rigid Paving

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T 230: Standard Method of Test of Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures

B. American Society for Testing and Materials (ASTM):
   1. C29: Unit Weight and Voids in Aggregate
   2. C88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   3. C117: Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
   4. C128: Specific Gravity Test and Absorption of Fine Aggregate
   5. C131: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
   6. C136: Sieve or Screen Analysis of Fine and Coarse Aggregates
   7. D70: Specific Gravity of Semi-Solid Bituminous Materials
   8. D2726: Bulk Specific Gravity of Compacted Bituminous Mixtures
   9. D2041: Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
   10. D4462: Viscosity of Asphalts (Bitumens)
   11. D2172: Quantities Extraction of Bitumens from Bituminous Paving Mixtures
   12. D2419: Sand Equivalent Value of Soils and Fine Aggregate
   13. D290: Bituminous Mixing Plant Inspection
   14. D6373: Performance Graded Asphalt Binder
   15. D692: Course Aggregate for Bituminous Paving
   16. D1073: Fine Aggregate for Bituminous Paving Mixtures
   17. D1241: Materials for Soil-Aggregate Subbase, Base and Surface Courses

18. D2026: Cutback Asphalt (Slow-Curing Type)
19. D2027: Cutback Asphalt (Medium-Curing Type)
20. D2028: Cutback Asphalt (Rapid-Curing Type)
21. D2950: Density of Bituminous Concrete in Place by Nuclear Methods

C. Surface Preparation Standards (SSPC):
   1. SP-2: Superior Performing Asphalt Pavement System (Superpave) Level 1 Mix Design

D. Colorado Department of Transportation

E. Colorado Asphalt Pavement Association

F. City of Idaho Springs construction specifications, standards and details.

1.4 SUBMITTALS

A. Submit under provisions of Division One Specifications

B. Record of Work: Maintain record of time and date of placement, temperature, and weather conditions, retain until completion and furnish copy to engineer.

C. Proposed Design Job Mix Formula for each mixture required by the contract. The mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design.

D. Test Reports: Proposed Design Job Mix testing shall be performed in a materials laboratory under the direct supervision of; and shall be stamped and signed by a Professional Engineer licensed in the State of Colorado practicing in this field. In addition, the General Contractor shall submit as part of the Proposed Design Job Mix, documents to verify the following:
   1. Source of materials
   2. Gradation, specific gravity, source and description of individual aggregates and the final blend
   3. Aggregate physical properties
   4. Source and Grade of the Performance Graded Binder (PG Binder)
   5. Proposed Design Job Mix – aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content
   6. Required mixing and compaction temperatures
   7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
   8. Sampling and testing of asphalt concrete mixtures for quality control during paving operations
      a. Uncompacted asphalt concrete mix
         i) Asphalt cement content: ASTM D2172 (AASHTO T164)
         ii) Maximum Specific Gravity: ASTM D2041 (AASHTO T209)
      b. Compacted asphalt concrete mix
         i) Bulk density: ASTM D1188 (AASHTO T166)

c. Perform at least one test for each day's paving but not less than one test per each 4000 sf of each lift.

1.5 QUALITY ASSURANCE

A. Materials and installation shall conform to applicable portions of Colorado Department of Transportation (CDOT) and City of Idaho Springs construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of City of Idaho Springs and CDOT construction specifications, standards and details for the construction of concrete, curbs, gutters, sidewalks, driveways, roadways, street paving, and other public right-of-way Improvements.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Transport mixture from mix plant in trucks with tight, clean, smooth, non-sticking compartments. Thinly coat hauling compartments with lime-water mixture, paraffin oil or other approved release agent to prevent sticking. Petroleum distillates such as kerosene or fuel oil are not approved release agents. Elevate and drain compartment of excess solution before loading mix.

C. Cover to protect from weather and prevent loss of heat

D. Provide insulated truck beds during temperature below 50 degrees F on long distance deliveries

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not apply when underlying surface is muddy, frozen or wet

B. Weather conditions permit pavement to be properly placed and compacted

C. The hot mix asphalt will be placed only when both the air and surface temperatures are equal to or exceed the temperatures specified in the table below:

CDOT Table 401-3: Placement Temperature Limitations in F

Compacted Layer Thickness (Inches)	Minimum Air and Surface Temp. (Degrees F and rising)	
	Top Layer	Other Layers
1½ or less	60	50

>1½ to 3	50	40
3 to 4	45	35

Note: Air temperature shall be taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Pavement shall be asphalt of the plant hot mix type. Materials and construction shall comply with Section 403 and 702 of the CDOT Standards and Specifications for Road and Bridge Construction.

B. Tack Coat:
   1. SS-1 or CSS-1h
   2. AASHTO M208 or M140

C. Asphaltic Cement:
   1. Superpave Performance Graded (PG) binder of PG64-22 or PG58-28 Table 702-1 of CDOT standard section 702
   2. Will not be acidic modified or alkaline modified
   3. Will not contain any used oils that have not been refined
   4. Modifiers will not be carcinogenic

D. Aggregate for Asphaltic Concrete, General
   1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D692
   2. Sand, stone, or slag screening: ASTM D1073
   3. Percent wear: ASTM C131, less than 45 for aggregates retained in #10 sieve

E. Base Course Aggregates for Asphaltic Concrete
   1. Uncrushed gravel may be used in mixture if it meets design criteria specified
   2. Provide uniform quality combined aggregates with a minimum sand equivalent value of 40
   3. Provide aggregate in gradations for courses to comply with Class S and SG, Colorado Department of Transportation, ASTM C136
   4. A maximum of 20% Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.
      a. RAP shall not be permitted in any road mixes
      b. RAP shall not be allowed in polymer modified mixes or in the permanent final lift of asphalt

F. Surface Course Aggregates for Asphaltic Concrete
   1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions
   2. Provide uniform quality combined aggregate with a minimum sand equivalent value of 50

3. Provide aggregate in gradations for courses to comply with Class SX, Colorado Department of Transportation, ASTM C136.

G. Hydrated Lime for Aggregate:
   1. May be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment will conform to ASTM C207, Type N. Residue retained on a No. 200 sieve will not exceed 10% when determined in accordance with ASTM C110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.

H. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Traffic Control Devices
   1. Signs.
      a. Comply with City of Idaho Springs standards and specifications for signs within the public right-of-way.
      b. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by the City of Idaho Springs. Private property or nonstandard signs will be maintained by the owner. Submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements. All signs shall be 3M-engineer grade reflective sheeting or accepted substitute.
      c. Traffic/Parking Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick. Facing shall be specified reflective sheeting with standard sign colors based on standard graphics and as shown on the plans.
   2. Sign Posts.
      a. For large signs greater than 12”W x 18”H and for multiple signs of any size mounted on the same post: sign posts shall be two (2) inch by two (2) inch galvanized telespar tube.
      b. For regular single signs 12”W x 18”H or smaller: sign posts shall be one and one-half (1-1/2) inch by one and one-half (1-1/2) inch galvanized telespar tube.
      c. Galvanized telespar tube shall have 0.120-inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, all sides over full length, ten (10) feet in length (min).
   3. Sign Post Anchor Bases (Stubs). All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4” by 2-1/4” anchor for large posts and 1-3/4” by 1-3/4” anchor for regular posts. Bases shall be embedded a minimum of 36” below finished grade and shall extend 3” above finished grade.
   4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are

present which will not properly compact at sign base, install a 6” diameter by 36” deep concrete footing around signs post anchor base for all signs in landscaped areas.

5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.

B. Pavement Marking. Specified pavement marking materials shall be used at locations as identified below.
   1. Comply with City of Idaho Springs and CDOT standards and specifications for pavement marking within the public right-of-way.
   2. FS TT-P-1952, Type I Alkyd, white, blue, yellow and red color paint meeting requirements of CDOT Standard Specification 708. Verify colors and extent of painting prior to painting. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on internal pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on internal drive, road or street pavements.
   3. Furnish paint with a no-pick-up maximum drying time of 20 minutes, when tested according to ASTM D711 using a wet film thickness of 0.015-inch when tested and applied at 77 degrees F.

2.3 MIXES/SOURCE QUALITY CONTROL

A. Determine full depth design mix based upon aggregates furnished
   1. Test mix by independent laboratory at Contractor's expense
   2. Grade dependent on temperature during placement
   3. Submit mix designs under provisions of Division One specifications for review and acceptance by Engineer

B. Submit mix design giving unit weight and to meet following requirements prior to placement of asphalt:

Property	S(75)	SX(75)
Air Voids in Mix, % (N Design)	3.5-4.5	3.5-4.5
Initial Gyrations	7	7
Design Gyrations	75	75
Hveem Stability	28 min	28 min
Voids Filled w/ Asphalt	65-80	65-80

Establish a single percentage passing each sieve size, a single percent of asphalt and a mix temperature. Maintain job mixes within following percentages of design mix:

Aggregates:	
¾” and larger	± 6%
#4 to #8	± 5%

#30	± 4%
#200	± 2%
Asphalt Content Tolerance	± 0.3%
Discharge Mix temp	± 20˚ F

PART 3 EXECUTION

3.1 EXAMINATION

A. Establish and maintain required lines and elevations. Provide grade and location stakes under this section as required for asphaltic concrete paving work.

B. Operate heavy, rubber-tired front loader over subgrade of paved areas. Where soft spots occur, remove loose materials and replace with Class 6 road base aggregate complying with CDOT standards compacted to level of subgrade.

3.2 PREPARATION

A. Prepare subgrade under provisions of Section 02300

B. Loose and Foreign Material
   1. Remove loose and foreign material from compacted subgrade surface immediately before application of paving. Clean surface with mechanical sweeper, blowers, or hand brooms, until surfaces are free from dust

C. Weed Control
   1. If weeds or vegetation exist at or on the subgrade, apply “Round-up” at rates following manufacturer’s instructions. Apply “Round-up” three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow “Round-up” to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
   2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to “Round-up” and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
   3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of

soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.

4. Do not apply within 20 feet of trees or shrubs

D. Tack Coat
   1. Apply in similar manner as prime coat, except as modified
   2. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphaltic concrete or portland cement concrete and surfaces
   3. Apply at rate of 0.05 to 0.15 gallons per square yard of surface
   4. Apply tack coat by brush to contact surfaces of curbs, gutters, catch basins, and other structures projecting into or abutting asphaltic concrete pavement
   5. Allow surfaces to dry until material is at condition of tackiness to receive pavement
   6. Where asphaltic concrete will adhere to surface, tack coat may be eliminated by Engineer

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
   1. Mill to minimum depth of 1 ½-inches, or as indicated on the plans.
   2. Mill to a uniform finished surface free of gouges, grooves, and ridges of more than ¼ inch depth.
   3. Control rate of milling to prevent tearing of existing asphalt course.
   4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
   5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
   6. Transport milled hot-mix asphalt to asphalt recycling facility.
   7. Keep milled pavement surface free of loose material and dust.

3.4 RING/FRAME ADJUSTMENTS

A. Set ring/frames of subsurface structures to final grade as a part of this work.

B. Placing Ring/Frames
   1. Surround ring/frames set to elevation with a ring of compacted asphalt concrete base prior to paving
   2. Place asphalt concrete mixture up to 1-inch below top of ring/frame, slope to grade, and compact by hand tamping

C. Adjust frames to proper position to meet paving

D. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations

E. Set ring/frames to grade, flush with surface of adjacent pavement

3.5 PREPARING THE MIXTURE

A. Comply with ASTM D995 for material storage, control, and mixing and for plant equipment and operation

B. Stockpile
   1. Keep each component of the various sized combined aggregates in separate stockpiles
   2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation

C. Heating
   1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
   2. Use lowest possible temperature to suite temperature viscosity characteristics of asphalt
   3. Do not exceed 350 degrees F

D. Aggregate
   1. Heat-dry aggregates to acceptable moisture content
   2. Deliver to mixer at recommended temperature to suite penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture
   3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements

E. Mix aggregate and asphalt cement to achieve 90-95 percent coated particles for base mixtures and 85-90 percent coated particles for surface mixture, per ASTM D2489

3.6 EQUIPMENT

A. Bituminous Pavers:
   1. Self-propelled, spreads without tearing surfaces, equipped with an activated screed assembly, heated if necessary, controls pavement edges to true lines without use of stationary forms and capable of spreading and finishing the asphalt plant mix material in widths applicable to the typical sections and thicknesses shown in the contract documents.
   2. Pavers used for roadway shoulders, recreational paths and similar construction will be capable of spreading and finishing the courses of asphalt plant mix material in width shown in the contract documents.
   3. Pavers will be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor will be constructed to operate from either or both sides of the paver and will be capable of working with the following devices:
      a. Ski-type device at least 30 feet in length
      b. Short ski or short shoe
      c. At least 5,000 feet of control line and stakes

4. The controls will be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent.
5. Manual operation will be permitted:
   a. For constructing irregularly shaped or minor areas
   b. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. However, if specified surface tolerances cannot be achieved, paving operations will be suspended until satisfactory correction, repairs of equipment replacements are made.

B. Rolling Equipment
   1. Steel-wheel roller: Self-propelled, contact pressure of 250 to 350 psi per inch of width of roller wheel, equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking
   2. Pneumatic-tired rollers: Self-propelled, contact pressure under each tire of 85 to 110 psi, wheels spaced so that one pass will accomplish one complete coverage equal to rolling width of machine, oscillating wheels. Remove and replace immediately tires picking up fines

C. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools

3.7 PLACING THE MIX

A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine

B. Complete placement over full width of section on each day's run

C. Spread mixture at minimum temperature specified by CDOT Table 401-5 for the specific binder used in the asphalt mix:
   1. PG 64-22: 320 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
   2. PG 58-28: 275 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
   3. The maximum mix discharge temperature will not exceed the minimum discharge temperature by more than 30 F.
   4. Delivered mix temperature will be measured behind the paver screed
   5. Hot asphalt mixture will be produced at the lowest temperature with the specified temperature range:
      a. producing a workable mix and provides for uniform coating of aggregates, in accordance with AASHTO T195
      b. allowing the required compaction to be achieved

D. Inaccessible and small areas may be placed by hand

E. Conform to the grade, cross section, finish thickness, and density indicated.

F. Lift Thickness
   1. Place in multiple lifts. Place asphalt in lifts such that each compacted lift thickness is no less than 2.0” thick and no greater than 3.0” thick. Top lift to be 2” thick.
   2. Typical Lift Thickness Sequencing:

Final Asphalt Section Required (inches)	No. of Lifts	Thickness of each Lift (inches) from bottom to top lift
2”	1	2
3”	1	3
4”	2	2-2
5”	2	3-2
6”	3	2-2-2
7”	3	3-2-2
8”	3	3-3-2
9”	4	3-2-2-2
10”	4	3-3-2-2
>10	Review with Engineer	

G. Paver Placing
   1. Unless otherwise directed, being placing along centerline of areas in crowned section and at high side on one-way slope and in direction of traffic flow
   2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips
   3. Complete base courses before placing surface courses
   4. Place mixture in continuous operation as practicable

H. Hand Placing
   1. Spread, tamp, and finish mixing using hand tools in areas where machine spreading is not possible as acceptable to Engineer
   2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature

I. Joints
   1. Construct transverse joint at right angles to centerline when operations are suspended long enough for mixture to chill
   2. Construct joints to have same texture, density, and smoothness as adjacent sections of asphalt concrete course
   3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat
   4. Offset transverse joints in succeeding courses not less than 24 inches
   5. Cut back edge of existing pavement or previously placed course to expose an even, vertical surface for full course thickness
   6. Offset longitudinal joints in succeeding courses not less than 6 inches
   7. When the edges of longitudinal joints are irregular, honeycombed or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness

8. Wearing course constructed in even number of strips; place 1 longitudinal joint on centerline of road
9. Wearing course constructed in odd number of strips; place the centerline of 1 strip on centerline of road

J. Gutter: Finish surface high adjacent to concrete gutter so when compacted surface is slightly higher than edge of curb and flashing

3.8 COMPACTING THE MIX

A. All paving will be compacted to 94 +/- 2% of Maximum Theoretical (RICE) density, CP-51 or AASHTO T209: Maximum Specific Gravity of Bituminous Paving Mixtures, as determined by ASTM D 2950. RICE values will be used in calculating Relative Compaction according to CP-44 or AASHTO T166.

B. Provide pneumatic and steel-wheel type rollers to obtain the required pavement density, surface texture and rideability

C. Begin rolling operations when the mixture will bear weight of roller without excessive displacement and complete as quickly as possible after placement occurs.

D. Compaction operations will be continuous until the required density is achieved or the density requirements are not met and the mix temperature falls below 185˚ F or there is obvious surface distress or breakage. Minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on the asphalt binder supplier documentation kept on file at the jobsite.

E. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set

F. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers

G. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs

H. Do not roll centers of sections first under any circumstances

I. Breakdown Rolling
1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge
2. Operate rollers as close as possible to paver without causing pavement displacement
3. Check crown, grade, and smoothness after breakdown rolling
4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling

J. Second Rolling

1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction
2. Continue second rolling until mixture has been thoroughly compacted

K. Finish Rolling
1. Perform finish rolling while mixture is still warm enough for removal of roller marks by combination of steel and pneumatic rollers
2. Continue rolling until roller marks are eliminated and course has attained specified density, and required surface texture and surface tolerances
3. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness

L. Patching
1. Remove and replace defective areas
2. Cut-out and fill with fresh, hot asphaltic concrete
3. Remove deficient areas for full depth of course
4. Cut sides perpendicular and parallel to direction of traffic with edges vertical
5. Apply tack coat to exposed surfaces before placing new asphaltic concrete mixture
6. Compact by rolling to specified surface density and smoothness

3.9 JOINING TO EXISTING WORK

A. Cut sides vertically and apply tack coat to exposed asphalt surfaces before placing new pavement. Meet existing thickness of surface and base courses, but not less than specified for new work.

B. All joins shall be compacted to 92.0% +/- 2.0% of RICE, taken fully on each side of joint, every 200 lineal feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T166.

3.10 FIELD QUALITY CONTROL

A. The City of Idaho Springs will engage a certified testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction in accordance with Division One Specifications.

B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency at least two business days advance notification to schedule tests.

C. Testing Agency will test in-place pavement for density and thickness.

D. Asphalt density testing:
1. Every one-hundred fifty (150) lineal feet per driving lane.
2. Every 2,000 square feet of parking lot

3. Densities shall be between ninety-two percent (92%) and ninety-six percent (96%) of the RICE unit weight

E. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections

F. The Contractor will core the pavement as required by the testing agency for field density tests in accordance with AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with ASTM D 2950.
   1. Testing agency will take not less than 4-inch diameter pavement specimens
   2. At the testing agency's discretion, cores may be required at the beginning of placement of each pavement layer or change of mixture materials or gradation.
   3. Untested areas during placement will require cores to be taken to verify compaction
   4. Contractor to repair holes from test specimens

G. For each completed course or from locations directed by the testing agency, and at a minimum, a representative asphalt pavement sample shall be taken from the first one thousand (1,000) tons, and all mix properties shall be verified. The percent voids filled with asphalt cement, Hveem stability, and Lottman shall be verified at a minimum of every ten-thousand (10,000) tons. Asphalt testing shall comply with ASTM D1559. Two copies of all test reports shall be submitted directly to the Engineer.

H. Acceptable density of in-place course materials is between 92 and 96 percent of the recorded laboratory RICE unit weight. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements

I. Thickness: Variations from drawings
   1. Base course: 1/4-inch +
   2. Remove and replace paving less than minimum thickness

J. Grade Tolerance: ±0.1 feet

K. Surface Smoothness
   1. Test using a 10-foot straight edge applied parallel to direction of drainage
   2. Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact
   3. Do not permit pockets or depressions where water may pool
   4. Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to Engineer

L. Inspection: The work of this section is subject to the inspection and approval of the engineer and/or owner. The following inspections are required:
   1. Protection of adjacent property
   2. Staking and establishment of elevations
   3. Establishment and compaction of subgrade
   4. Placement and compaction of bituminous base course and wearing surface
   5. Final inspection

6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

3.11 CLEANING

A. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of Engineer

3.12 PROTECTION OF FINISHED WORK

A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and in no case sooner than 6 hours

B. Provide barricades and warning devices as required to protect pavement and the general public

3.13 WARRANTY

A. Provide installer's 2-year written warranty endorsed by the contractor warranting the pavement from creeping, shoring, cracking, softening, settling, ponding and other defects due to improper placing or defective materials. Replace defective materials upon notification by the owner in accordance with the requirements of the original work.

3.14 SCHEDULE OF MIX PLACEMENT:

A. Refer to Drawings for asphalt thickness and subgrade requirements.

END OF SECTION

SECTION 02750

RIGID PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.2 RELATED SECTIONS

A. Section 01020 – Geotechnical Report

B. Section 02300 – Earthwork

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. M171 – Sheet Materials for Curing Concrete

B. American Concrete Institute (ACI):
   1. 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
   2. 301 – Specifications for Structural Concrete for buildings
   3. 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
   4. 305/305R – Hot Weather Concreting
   5. 306/306R – Cold Weather Concreting
   6. 308 – Standard Practice for Curing Concrete

C. American Society for Testing and Materials (ASTM):
   1. A1064 – Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete
   2. A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   3. C31 – Making and Curing Concrete Test Specimens in the Field
   4. C33 – Concrete Aggregates
   5. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens
   6. C94 – Ready Mix Concrete
   7. C143 – Test Method of Slump of Hydraulic Cement Concrete
   8. C150 – Portland Cement
   9. C260 – Air-Entraining Admixtures for Concrete
   10. C309/AASHTO M148 – Liquid Membrane-Forming Compounds for Curing Concrete
   11. C494 – Chemical Admixtures for Concrete

12. C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
13. C979 – Pigments for Integrally Colored Concrete
14. C1116 – Fiber Reinforced Concrete
15. D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)
16. D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
17. D1752 – Preformed Sponge Rubber Cork Expansion and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
18. D6690 – Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements

D. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

E. Colorado Department of Transportation

F. City of Idaho Springs construction specifications, standards and details.

1.4 SUBMITTALS

A. Provide under provisions of Division One Specifications

B. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds
1. Existing data on proposed design mixes, certified and complete
2. Submit reports of field quality control testing

1.5 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, Conform materials and installation to applicable portions of Colorado Department of Transportation (CDOT), and the City of Idaho Springs construction specifications, standards and details.

1.6 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of City of Idaho Springs and CDOT construction specifications, standards and details for the construction of concrete, curbs, gutters, sidewalks, driveways, roadways, street paving, and other public right-of-way Improvements.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

C. Obtain cementitious materials and aggregate from same source for all work

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover

C. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight

D. Prepare a delivery ticket for each load of ready-mixed concrete

E. Contractor shall submit tickets for all concrete delivered to site:
   1. Quantity delivered
   2. Actual quantity of each material in batch
   3. Outdoor temp in the shade
   4. Time at which cement was added
   5. Numerical sequence of the delivery
   6. Quantity of water that can be added in the field based on mix design
   7. Free moisture in fine and coarse aggregate in percent by weight
   8. Temperature of batch

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen

B. Protect concrete from rapid loss of moisture during hot water placement

PART 2 PRODUCTS

2.1 MATERIALS

A. Form Materials
   1. Form Materials: Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
   2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
   3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete
   4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise

B. Reinforcement
   1. Where reinforcement is specified herein or indicated on the plans:
      a. Bars: ASTM A615, Grade 60

b. Reinforcing Welded Wire Fabric (WWF): ASTM A1064, steel, 16 gage minimum
   i) Furnish in flat sheets
c. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish
d. Fibrous reinforcement: Collated, fibrillated, polypropelyne fibers, tensile strength 70,000 psi
   i) ASTM C1116
   ii) Use 1.5 lbs. Per cubic yard minimum
   iii) Fibermesh or accepted substitution

C. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.2 ACCESSORIES

A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane

B. Joint Sealers: Polyurethane base, elastomeric, self leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions

C. Sheet Materials: AASHTO M171, 4 mil

D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethelene foam; Texmastic “vinylex 3600,” Sonneborn “Sonoflex F,” or accepted substitutions

2.3 CONCRETE MIX

A. Comply with ASTM C94

B. Maximum Coarse Aggregate Size: 1-inch

C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete

D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.44

E. Slump: 4-inch maximum
   1. May be increased to 4.5 inches for hand work, acceptable to Engineer
   2. As low as possible consistent with proper handling and thorough compaction

F. Volumetric Air Content: 4.5%±1% after placement for 1-inch aggregate
   1. Vary air content with maximum size aggregate, ASTM C94, Table 3.

G. Strength: Compressive strength as determined by ASTM C39, 4,500 psi minimum at 28 days

H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded

I. Adjust mix as required to meet specifications

J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 25 percent Class C or Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:
   1. The loss on ignition shall not exceed 3.0 percent
   2. The CaO in Class F fly ash shall not exceed 18 percent

K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification
   1. Include a water reducing admixture
   2. Calcium chloride content shall not exceed 0.05% of the cement content by weight

L. Coloring
   1. ASTM C979 pure mineral pigments, specially formulated for concrete coloring as manufactured by Davis Colors, L.M. Scofield Co., Tamm's or acceptable substitution.
   2. Colors: Match any concrete being removed and replaced

2.4 SOURCE QUALITY CONTROL AND TESTS

A. Provide under provisions of Division One Specifications

B. Submit proposed mix design to Engineer for review prior to commencement of work

C. Tests on cement and aggregates will be performed to ensure conformance with specified requirements

D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads

B. Verify gradients and elevations of base are correct

C. Check completed formwork for grade and alignment to the following tolerances:
   1. Top of forms not more than 1/8-inch in 10 feet
   2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.2 PREPARATION

A. Subgrade
   1. Prepare subgrade in accordance with Section 02300
   2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete

3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Section 02300
4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high
5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete
6. Weed Control
   a. If weeds or vegetation exist at or on the subgrade, apply "Round-up" at rates following manufacturer's instructions. Apply "Round-up" three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow "Round-up" to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
   b. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
   c. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.
   d. Do not apply within 20 feet of trees or shrubs

B. Frame Adjustment
   1. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement for concrete collars
   2. Set frames of structures in full grout bed to provide bearing. Set to final grade
   3. Form construction joints and blockouts as indicated on drawings

3.3 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete
   1. Transporting of mixed concrete shall conform to ACI 305R

2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling
3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer
5. Provide delivery ticket and comply with delivery requirements of this section

B. Forming
1. Place and secure forms to correct location, dimension, profile, and gradient
2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement
3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete
4. Oil forms prior to concrete placement
5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement
6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the drawings
7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face
8. Backfill behind forms as required to prevent water from entering subgrade

C. Reinforcement
1. Add fiber reinforcement to mix at plant prior to delivery to jobsite
2. Place bar or WWF reinforcement at mid-height of slabs-on-grade or as shown on the drawings
   a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire
   b. Support with metal chairs, brick or stone is unacceptable
3. Hold all tie and marginal dowels in proper position by sufficient supports or pins
4. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip
5. Interrupt reinforcement at expansion joints
6. Place dowels to achieve pavement and curb alignment as detailed.
7. Provide doweled joints inch at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement
8. Grease dowels on one side of joints with caps on greased end

D. Placing concrete
1. Place concrete in accordance with ACI 301
2. Lightly moisten subgrade or base course immediately before placing concrete.
3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed
4. during concrete placement
5. Deposit concrete near final position. Minimize segregation and damage to subgrade

6. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials
7. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs
8. Do not place concrete in forms that has begun to set
9. Do not place more concrete in one day than can be finished before dark the same day
10. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified
11. Walks: Construct sidewalks with a minimum thickness of 4-inch. Tool edges to rounded profile and finish as specified or as shown on the drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated

E. Cold weather concreting
1. Conform to ACI 306/306R, except as modified herein
2. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

3. Do not place heated concrete which is warmer than 80 degrees F
4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place
5. Do not allow concrete to cool suddenly

F. Hot weather concreting
1. Conform to ACI 305/305R, except as modified herein
2. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection
3. Do not allow concrete temperature to exceed 70 deg F at placement
4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture
5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4

G. Joints
1. Provide concrete joints per CDOT Standard Details
2. Sidewalk and pavement
   a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut

b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 100 feet.
c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length

3. Curb and Gutter
   a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.
   b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.
   c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.
4. Place expansion joint filler between paving components and buildings or other appurtenances at temperatures above 50 deg F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
5. Provide keyed joints as indicated in details.

H. Finishing
1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish
4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted
5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.
6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic
7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface
9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.
10. Direction of Texturing:
    a. Curb and Gutter: At right angles to the curb line
    b. Sidewalk: At right angles to centerline of sidewalk.

11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Engineer.

I. Joint sealing
   1. Seal joints and clean concrete prior to opening to traffic.
   2. Seal all expansion joints.
   3. Separate concrete from other structures with 3/4-inch thick joint filler.
   4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
   5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.

J. Curing and protection
   1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury
   2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions
   3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved

3.4 FIELD QUALITY CONTROL

A. Comply with Division One Specifications - Quality Assurance: Field inspections and testing

B. It is the Contractor’s responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide testing agency at least two business days advance notification to schedule tests.

C. Tolerances
   1. Division One Specifications - Quality Assurance: Tolerances
   2. Maximum Variation of Surface Grade: 1/4- inch in 10 ft
   3. Maximum Variation from True Alignment: 3/8-inch in 10 ft

D. Take cylinders and perform slump and air entrainment tests as required by Division One Specifications in accordance with ACI 301. Unit weight and mix temperature will also be taken

E. The first three loads will be tested for slump and air content. If any one test fails to meet requirements, that load will be rejected and tests will continue on each load until three consecutive loads meet requirements. Thereafter, five concrete test cylinders will be taken for every 75 cu yds or less cu yds of concrete placed each day

F. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents

G. One slump and air entrainment test will be taken for each set of test cylinders taken

H. Cylinders will be tested as follows: 2 at 7 days, 2 at 28 days and one at a later date, if necessary, as directed by the Engineer

I. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken

J. Thickness of fresh concrete may be checked by Owner at random. Coring will be conducted in accordance with City of Idaho Springs requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for portland cement concrete paving as specified in the following table.

CONCRETE PAVEMENT DEFICIENCY	
Deficiency in Thickness (Determined by Cores) INCHES	**Proportional Part of Contract Price Allowed**
0.00 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

Note: When thickness of pavement is deficient by more than one inch, and judgment of the Engineer is that area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

K. Failure of Test Cylinders or Coring Results: Engineer may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness

3.5 SCHEDULE OF CONCRETE

A. See plans for concrete thicknesses and subgrade preparation and adhere to Geotechnical Report recommendations

3.6 SCHEDULE OF CONCRETE REINFORCEMENT

A. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk and pavement

B. Rebar reinforcement required for all cross pans. See plans for rebar sizes and installation pattern.

C. Dumpster locations as shown on plans

END OF SECTION

SECTION 02920

SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil preparation

B. Fertilization

C. Seeding methods

D. Areas to be reseeded

E. Seed Mix

F. Maintenance

G. Seed protection and slope stabilization

1.2 RELATED SECTIONS

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 02300 – Earthwork

C. Section 02370 – Erosion and Sedimentation Control

D. Section 02930 – Sodding

1.3 REFERENCES

A. Federal Specification (FS) O-F-241 - Fertilizers, Mixed, Commercial

B. American Association of Nurserymen - Standardized Plant Names

C. Association of Official Seed Analysts (AOSA)

D. Colorado Department of Agriculture (CDA) Seed Act

E. Colorado Department of Transportation (CDOT) Construction Specifications

1.4 SUBMITTALS

A. Submit under Division One Specifications for products related to seeding work including but not limited to seed mixes, mulches, composts, tackifiers, fertilizers and herbicides.

B. Product Data:
   1. Certified Live Seed analyses not more than 6 months old by a recognized laboratory of seed testing for grass mixtures including percent of live seed (PLS), germination, all crop seeds in excess of 1 percent, inerts and weeds
   2. Manufactures guaranteed chemical analysis, name, trade name, trademark and conformance to state and local laws of all fertilizers and herbicides

1.5 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging

B. Provide a certificate of the PLS test of the grass seed intended for the project, certifying that the seed furnished is from a lot that has been tested by a recognized laboratory within the last 6 months

C. All brands furnished shall be free from such noxious seeds as Russian or Canadian Thistle, Coarse Fescue, European Birdweed, Johnson Grass, Leafy Spurge, field bindweed, kochia, or any state-listed or City of Idaho Springs or CDOT listed noxious weed species

D. Any materials that have become wet, moldy or otherwise damaged in transit or in storage will not be used

1.6 QUALIFICATIONS

A. Applicator: Company specializing in performing work of this section with landscaping license from State of Colorado
   1. Experienced with type, elevation, topography and scale of work specified
   2. Adequate equipment and personnel to perform work

1.7 REGULATORY REQUIREMENTS

A. Comply with codes and ordinances of local regulatory agencies for seeding mixtures, seeding practices, fertilizer, and herbicide composition and regulations of the City of Idaho Springs, Clear Creek County, and the State of Colorado

B. Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division One specifications

B. All materials and products will remain in original manufacturers shipping bags or containers until they are used. All material or products will be stored in a manner to prevent them from coming into contact with water or other contaminating substance and in a manner that product effectiveness will not be impaired

C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable

D. Commercial fertilizer: mixed in original bags or containers of the manufacturer, showing weight, chemical analysis and manufacturer name. Store in such a manner such that product effectiveness will not be impaired

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not prepare or seed frozen soils

B. Perform seeding and planting only after preceding work establishing final ground surface is completed

C. Conduct minimum of two (2) soil tests to confirm fertilizer type and application rates

1.10 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition

1.11 WARRANTY

A. All plant material and work accomplished under this section shall be guaranteed to provide a uniform stand of grass acceptable to the Owner at the end of a one (1) year time period from the completion of the Seeding and Erosion Control work

PART 2 PRODUCTS

2.1 SEED

A. In conformance with State and Federal regulations and subject to the testing provisions of the Associate of Official Seed Analysts (AOSA)

B. Seed Suppliers: Licensed Seed Dealer with Colorado Department of Agriculture

C. Provide the latest crop available in accordance with Colorado Department of Agriculture Seed Laws, Chapter 35, Article 27

D. Compensate for percentage of purity and germination by furnishing sufficient additional seed to equal the specified pure live seed product. The formula for determining the quantity of pure live seed (PLS) is as follows:

Pounds of Seed (Bulk) x Purity x Germination = Pounds of Pure Live Seed (PLS)

2.2 SEED MIX

A. Native seed mix shall be used and shall adhere to county and state regulations

B. Recommended permanent seed mixes per table below:

1. Permanent Upland Area Seed Mix (UDFCD Table A-2. recommended for sandy soil)

Common Name	Scientific Name	Growth Season	Growth Form	% Mix	Lbs/Ac (PLS[1])
Grasses					
Switchgrass	*Panicum virgatum*	Warm	Sod/Bunch	15	2.3
Prairie sandreed	*Calamovilfa longifolia*	Warm	Sod	10	2.2
Sideoats grama	*Bouteloua curtipendula*	Warm	Sod	10	3.1
Blue grama	*Bouteloua gracilis*	Warm	Sod	10	0.7
Indian ricegrass	*Oryzopsis hymenoides*	Cool	Bunch	10	4.3
Western wheatgrass	*Pascopyrum smithii*	Cool	Sod	10	5.5
Little bluestem	*Schizachyrium scoparium*	Warm	Bunch	10	2.3
Sand dropseed	*Sporobolus cryptandrus*	Warm	Bunch	10	0.1
Green needlegrass	*Stipa viridula*	Cool	Bunch	10	3.3
Herbaceous/Wildflowers					
Pasture sage	*Artemisia frigida*			1	0.1
Blanket flower	*Gaillardia aristata*			2	0.9
Tansy aster	*Maceranthera tanacetifolia*			2	0.2
TOTAL PLS POUNDS/ACRE				**100**	**25**

[1]PLS = Pure Live Seed – If broadcast seeding, double the rate

2.3 SOIL MATERIALS

A. Select onsite topsoil: Earth material of loose friable clay loam reasonably free of admixtures of subsoil, refuse stumps, roots, rocks, brush, weeds or other material which can be detrimental to the proper development of site revegetation

2.4 ACCESSORIES

A. Soil Additives (Fertilizer)
   1. Dry fertilizers: Primary element composition by weight of 6-10-5
      a. Nitrogen (N) six (6%) percent of which fifty (50%) per-cent inorganic, phosphoric acid (P_2O_5) ten (10%) percent, and potash (K_2O) five (5%) percent
   2. Commercial fertilizer: Primary element composition by weight of 18-46-0
      a. Nitrogen, eighteen (18%) percent, of which fifty (50%) percent is organic, and phosphoric acid (P_20_5), forty-six (46%) percent
      b. These elements may be organic, inorganic, or a combination and shall be available according to the methods adopted by the Association of Official Chemists
   3. Dry, pelletized or granular, uniform in composition and a free flowing product. Do not use material which has caked, segregated, exceeded the expiration date of application, or be otherwise damaged
   4. Thoroughly mixed by the manufacturer. Clearly identify the contents of each container. Do not use materials and containers previously opened, exceeding the expiration date for application or otherwise damaged

B. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of grass

C. Mulching Material: Hydromulch with tackifier as specified in CDOT Construction Specifications Section 213

PART 3 EXECUTION

3.1 GENERAL

A. Seed all areas disturbed by construction, including all areas along the roadside ditches

B. Pattern for seeding and fertilization as required by field conditions. In no case shall revegetation occur within 30 days of the application of any chemical weed control substance

C. Engineer to review grading prior to seeding

3.2 SOIL PREPARATION

A. Uniformly place and spread topsoil removed during grubbing and stored on site. Provide minimum thickness of 4 inches to meet finished grade. Key topsoil to the underlying and surrounding material by the use of harrows, rollers or other equipment suitable for the purpose

B. Apply water to the topsoil for compaction purposes in a fine spray by nozzles in such a manner that it will not wash or erode the newly placed soil

C. Exercise care during soil preparation on all embankments so as not to disturb established ground cover. Areas disturbed during the soil preparation will be fertilized and seeded at the discretion of the Engineer in accordance with these documents

3.3 FERTILIZATION

A. Do not proceed with fertilization in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen and untillable ground or conditions detrimental to the effectiveness of the application

B. Apply fertilizer in a manner to assure uniform distribution, light watering is acceptable for dispersion

C. In cases where work progress is stopped due to the above conditions, fertilization will begin again, when appropriate conditions exist. The application will begin again with a reasonable overlapping of the previously applied area

3.4 SEEDING METHODS

A. All seeding shall be installed either by hydroseeding or drilling method.

B. Do not proceed with seeding in adverse weather and unsuitable ground conditions. Examples of these respective conditions may be wind, precipitation, frozen or untillable ground or conditions detrimental to the effectiveness of the application. All seeding shall be performed between either March 1st to May 30th of the calendar year of construction unless indicated otherwise by Engineer

C. Hydroseeding:
   1. Apply seeded slurry with hydraulic seed at a rate of //160 lbs// live seed per 1,000 square feet, evenly in two intersecting directions
   2. Do not hydroseed areas in excess of that which can be mulched on same day
   3. Immediately following seeding apply mulch to a thickness of 1/8 inch
   4. Apply water with a fine sprat immediately after each area has been mulched. Saturate to four (4) inches of soil

D. Drilling:
   1. Accomplish seeding by means of an approved power drawn drill, followed by drag chains. The grass drill should be equipped with a satisfactory feeding mechanism, agitation, and double disk furrow openers. Equip drills with depth bands set to maintain a planting depth of approximately 3 to 2 inch and shall be set to space rows not more than 7 inches apart
   2. If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the Engineer will require immediate resowing of seed in such areas at the Contractor's expense. The seeding mixture shown in the Materials Section applies at a pure live seed rate per acre
   3. Immediately following seeding apply straw mulch at a rate of one (1) ton per acre
   4. Apply water with a fine spray immediately after each area has been mulched. Saturate to four (4) inches of soil depth
   5. Provide additional watering weekly until revegitation seed has germinated

3.5 AREAS TO BE RESEEDED

A. Seed all disturbed areas that are damaged or disturbed by the Contractor's activities during the entire project scope

B. Additional areas as requested by the Owner and approved by the Engineer

3.6 MAINTENANCE

A. Fertilize the seeded areas once a uniform stand of grass has been established

B. Maintain seeded areas until there is an acceptable uniform plant growth. Reseed areas that are not producing a uniform plant growth within five (5) weeks following seeding. Acceptable uniform plant growth shall be defined as that time when the scattered bare spots, not greater than 1 square foot in area, do not exceed three percent (3%) of the seeded area

C. Maintenance period - 1 year

D. Areas that are seeded late in the fall planting season which are not producing acceptable uniform plant growth, as described above, shall be reseeded during the following spring planting season. If such a condition exists, and the Contractor has diligently, in the opinion of the Engineer, pursued the performance of his work, the Owner at his option, may extend the contract completion date and reduce contract retainage. Retainage may be reduced to less than five percent (5%) of the total contract amount, but shall be at least two (2) times the estimated cost of obtaining the required growth in the indicated areas, plus areas which are susceptible to damage by winter kill, washout or other causes

E. Contractor shall control perennial weeds, thistle, spotted and napweed, spurge and other weeds during the maintenance period

3.7 SEED PROTECTION AND SLOPE STABILIZATION

A. Cover seeded slopes with erosion control fabric where grade is 4 to 1 or greater and where indicated on the Drawings and/or Section 02300 and Section 02730. Cover seed with mulch in all other areas

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric until seed germination. If seed is washed out before germination, fertilize, reseed and restore affected areas

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete

B. Reinforcing steel

C. Forms

D. Concrete accessories

1.2 RELATED SECTIONS

A. 03600 - Grout

1.3 REFERENCE STANDARDS AND GUIDES

A. Comply with the following except as modified by supplementary requirements of this Project Specification.

B. American Concrete Institute – ACI:
1. 117 – Standard Specifications for Tolerances for Concrete Construction and Materials
2. 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
3. 301 – Specifications for Structural Concrete
4. 304 – Guide for Measuring, Mixing, Transporting and Placing Concrete
5. 305 – Hot Weather Concreting
6. 306 – Cold Weather Concreting
7. 308.1 – Guide to Curing Concrete
8. 309 – Guide for Consolidation of Concrete
9. 315 – Details and Detailing of Concrete Reinforcement
10. 318 – Building Code Requirements for Structural Concrete
11. 347 – Guide to Formwork for Concrete
12. 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary

C. American Standards and Testing Materials (ASTM)
1. A615 – Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
2. C31 – Practice for Making and Curing Concrete Test Specimens in the Field
3. C33 – Concrete Aggregates
4. C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
5. C94 – Specification for Ready-Mixed Concrete

6. C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete
7. C150 – Specification for Portland Cement
8. C173 or C231 – Test Methods for Air Content of Freshly Mixed Concrete
9. C260 – Air Entraining Admixtures for Concrete
10. C309 – Liquid Membrane-Forming Compounds for Curing Concrete
11. C452 – Standard Test Method for Potential Expansion of Portland-Cement Mortars Exposed to Sulfate
12. C494 – Chemical Admixtures for Concrete
13. C618 – Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral admixture in Portland Cement Concrete
14. D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

D. Concrete Reinforcing Steel Institute (CRSI)
1. DA4 – Manual of Standard Practice
2. P1 – Placing Reinforcing Bars

E. National Institute of Standards and Technology (NIST)
1. PS 1 – Structural Plywood

1.4 PERFORMANCE TOLERANCES

A. Confirm to ACI 117, ACI 301, ACI 347 and ACI 350 as modified herein. In case of conflict, ACI 117 governs. ACI 350 governs where ACI 117 does not apply.

1.5 SUBMITTALS

A. Submit under provisions of Division 1 specifications

B. Shop Drawings: Reinforcing bar lists, fabrication and placement drawings
1. Indicated bar sizes, spacing, locations, and quantities of reinforcing steel. Bending and cutting schedules shall be included in all shop drawings.
2. Indicate pertinent dimensions, materials, bracing, arrangement of joints and ties, and exact location of openings, framing, and special conditions affecting work
3. All shop drawings shall be original drawings produced by the supplier and shall not be reproductions of the Contract Documents

C. Product Data: Provide sufficient information on products specified to verify compliance with specifications. Provide data on
1. Joint devices
2. Attachment accessories
3. Admixtures and mixes
4. Curing Compounds
5. Sealers
6. Waterstops
   a. Product data for all waterstops to be used
   b. Installation procedures to be followed, showing compliance with manufacturer's recommendations

D. Test Reports
   1. Submit reports of tentative concrete mix designs and testing prior to placing any concrete, including
      a. Slump range on which the design is based
      b. Total gal of water per cu yd
      c. Brand, type, composition, and quantity of cement with manufacturer and plant location identified
      d. Brand, type, composition and quantity of fly ash
      e. Specific gravity and gradation of each aggregate
      f. Ratio of fine to total aggregates
      g. Surface-dry weight of each aggregate per cu yd
      h. Brand, type ASTM designation, active chemical ingredients and quantity of each admixture
      i. Air content and tolerance
      j. Water/cementitious material ratio and tolerance
      k. Compressive strength based at 7- and 28-day compression tests
      l. Submit reports of field quality control testing
      m. Time of initial set
   2. Submit suppliers certified fly ash test reports for each shipment delivered to concrete supplier
      a. Physical and chemical characteristics
      b. Certification of compliance with the specifications
      c. Signed by Contractor and concrete supplier
   3. Existing data on proposed design mixes are acceptable if certified and complete

E. Construction Joint Locations: Submit all proposed construction joint locations in slabs and walls to Engineer two (2) weeks prior to placing any concrete.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301 and ACI 350. Maintain one copy of each document on site.

B. Follow recommendations of ACI 305 when concreting in hot weather.

C. Follow recommendations of ACI 306 when concreting in cold weather.

D. Acquire cement and aggregate from same source for all work

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division 1 Specifications

B. Cement and fly ash: Store in moisture proof enclosures, do not use if caked or lumpy

C. Aggregate: Store to prevent segregation and inclusion of foreign materials, do not use the bottom 6-inch of piles in contact with the ground

D. Reinforcing steel

1. Store on supports 6” minimum off of ground, which will keep it from contact with ground and protected from oil or other materials detrimental to steel or bonding capability. Cover to prevent unacceptable surface corrosion and contamination.
2. Tag bundles of reinforcing bars and wire spirals with metal tag showing specification, grade, size, quantity and suitable identification to permit checking, sorting and placing.

E. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight

F. Prepare a delivery ticket for each load of ready-mixed concrete

G. Truck operator shall hand ticket to Geotechnical Engineer or Third Party Inspector at the time of delivery with ticket to show:
1. Quantity delivered
2. Actual quantity of each material in batch
3. Outdoor temp in the shade
4. Time at which cement was added
5. Numerical sequence of the delivery
6. Quantity of water that can be added in the field based on mix design
7. Free moisture in fine and coarse aggregate in percent by weight
8. Temperature of batch

PART 2 PRODUCTS

2.1 FORMS

A. Prefabricated: Symons "Steel-Ply" or accepted substitution

B. Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better

C. Lumber: Straight, uniform width and thickness; free from knots, offsets, holes, dents, and other surface defects

D. Chamfer strips: Clear, white pine, surface against concrete planed

E. Form coating: Colorless biodegradable oil or water based release agent that will not stain concrete and is VOC compliant. Acceptable products: Nox-Crete "Nox-Crete Form Coating", L & M "Debond", or accepted substitution

F. Form Coating where exposed to potable water: Meets NSF Standard 61, Dayton Superior “Clean Strip J1EF”, Hill and Griffith Company “Grifcote LV-50-Plus”

G. Form ties: Removable end, permanently embedded body types with waterstops not requiring auxiliary spreaders, with cones on both ends, embedded portion 1-inch minimum back from concrete face. If not provided with threaded ends, constructed for breaking off ends without damage to concrete.

2.2 REINFORCING STEEL

A. Bars: ASTM A615, Grade 60

B. Beam Stirrups and column ties: ASTM A615, grade 40

C. Bar supports: CRSI Class 1, fabricated from galvanized wire having PVC coated legs

D. Tie wire: 16 ½ gage or heavier, black annealed wire

E. Form and fabricate reinforcing steel in accordance with ACI 315 and 318 and CRSI DA4 except as specified or indicated on Drawings, free from rust, scale and contaminants which will reduce bond.

F. Dowel Adhesive: Hilti “HIT-RE 500 V3”, Powers “PE 1000+”, Simpson “SET-XP”, or accepted substitution.

2.3 CONCRETE

A. Cement: ASTM C150, Type I/II modified cement tested to meet type V for sulfate resistance per ASTM C150 Table 4 and ASTM C452. Cement should have a tricalcium aluminate content of not more than 8 percent.

B. Fly ash: ASTM C618, Class F

C. Fine aggregate: Clean, natural sand, ASTM C33; no manufactured or artificial sand

D. Coarse aggregate: Crushed rock, natural gravel, or other inert granular material, ASTM C33 except clay and shale particles no more than 1%.
   1. Alkali Silica Reactivity: Aggregate shall be considered non-reactive with a documented satisfactory service record for a minimum ten year period used in concrete with similar cementitious material or with an alkali (Na_2O eq.) content in concrete equal or higher than that in the proposed mixture. In the absence of service record the aggregate shall be tested and will be considered non-reactive if it complies with a) or b)
      a. ASTM C1260 14-day expansion less than or equal to 0.1%, or
      b. ASTM C1293 1-year expansion less than or equal to 0.040%

E. Water: Clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances that may be deleterious to concrete or steel.

F. Admixtures
   1. Air entraining agent: ASTM C260; Grace "Darex AEA", Master Builders "MB-VR", Sika Chemical "AEA", or accepted substitution
   2. Chemical Admixtures: ASTM C494, non-corrosive and chloride free.

2.4 WATERSTOPS

A. Hydrophilic Waterstop

1. 3/4” inch wide by 3/8 inch thick, Adeka “MC-2010MN”, Hydrotite CJ-10202K, Kryton “Krytonite Swelling Waterstop”, or accepted substitution
2. Waterstop shall be treated to not expand when in contact with fresh concrete.

2.5 ACCESSORIES

A. Membrane Forming Curing Compound: ASTM C309, L&M Construction Materials “Dress & Seal WB30”, BASF "MasterKure CC 200WB”, Euclid “Super Diamond Clear VOX”, Dayton Superior “Cure & Seal 1315 EF”, or accepted substitution.

B. Curing Compound for surfaces in contact with potable water: Meets NSF Standard 61, Dayton Superior “Clear Cure VOC J7WB”, Atlas Tech Products “Atlas Quantum-Cure NSF”, W.R. Meadows “VOCOMP-25”.

C. Floor Sealer: L&M Construction Materials “ Dress and Seal WB30”, BASF “MasterKure CC 200WB” , Euclid “Super Diamond Clear VOX”, Dayton Superior “Cure & Seal 1315 EF”, or accepted substitution.

D. Epoxy Bonding Agent: ASTM C881, Sika “Sikadur 32 Hi-Mod”, Dayton Superior “Sure Bond J58”, L&M Construction Materials “Epobond”, Dayton Superior “Sure Bond J58”, or accepted substitution. Use when joining new to existing concrete.

E. Non-Epoxy Bonding Agent: ASTM C1059 Type II, Larson Products “Weld-Crete”, BASF “MasterEmaco A 660”, L&M Construction Materials “Everbond”, Dayton Superior “Acrylic Bonding Agent J40”, or accepted substitution. Use when joining new to existing concrete when bonding agent cannot be placed immediately prior to placement of new concrete.

F. Patching Mortar: Sika “Sikatop”, L&M Construction Materials “Durapatch VOH”, or accepted substitution.

G. Vapor Barrier: Polyethylene film minimum 6 mils thick.

H. Premolded Joint Filler: ASTM D1751, ASTM D1752 Type I, II, or III.

I. Use the following to control plastic shrinkage cracking Micro Fiber Reinforcement: 1/2 inch to 3/4 inch collated fibrillated polypropylene fibers, ASTM C1116 Type III. Manufacturers: W.R. Grace, Fibermesh, Euclid Chemical Co., or accepted substitution.

2.6 CONCRETE MIX DESIGN

A. Concrete Mix: Measure and combine cement, aggregate, water, and admixtures in accordance with ASTM C94 and ACI 211.1.
   1. Cement: When used in exposed concrete shall be one brand from one source. Do not mix different cements in same element of Work.
   2. Water-Cement Ratio (if fly ash used, water-cement plus fly ash ratio): 0.45 maximum for 4000 psi or 4500 psi concrete, 0.52 maximum for 3000 psi concrete.
   3. Air-Entrainment: Air-entrain concrete exposed to exterior or exposed to liquids. See Table below for requirements.

4. Chemical Admixtures: Use is optional to aid concrete properties and allow for efficient placement. Manner of use and amount shall be in accordance with manufacturer's written recommendations and as approved by Engineer. Do not use admixtures that increase early shrinkage or negatively affect finishing.
5. Fly Ash: Use is optional unless otherwise noted. Combine fly ash with cement at a rate of 1 pound fly ash for each pound reduction of cement. Amount of fly ash shall not be less than 15% or more than 25% of weight of cement plus fly ash. When fly ash used, minimum amount of cement designated may be proportionately reduced.
6. Concrete for fillets in tanks shall be fiber reinforced.
   a. Dosage Rate: use the following of for micro fiber reinforcement 1-1/2 pounds per cubic yard minimum.
   b. Use in strict accordance with manufacturer's written recommendation and ASTM C94.
7. Use no admixtures other than specified, unless approved by Engineer.

B. Class of Concrete:
1. Furnish in accordance with table. Cement contents listed are minimum values and shall be increased as required to attain other specified characteristics.
2. Slumps listed are maximum, except when high range water reducer is used. Maximum slump when high-range water reducer is used, 10 inches.
3. Chloride ion content shall not exceed values listed in ACI 318, Table 4.3.1.

Use	28-Day Compressive Strength (psi)	Coarse Aggregate (size no.)	Minimum Cement Content (bags/cu yd)	Air Content (%)
Base Slabs	4000	67	6.0	2±1.5
Frost Walls	4500	67	6.5	6±1.5
Walls	4500	67	6.5	6±1.5
Interior Slabs	4000	67	6.0	3±1.5
Exterior Slabs	4500	67	6.5	6±1.5
Concrete Fillets	3000	67	4.75	6±1.5
Interior Equipment Pads	3000	67	4.75	2±1.5

2.7 FABRICATION

A. Reinforcing Steel: Accurately formed, fabricated in accordance with ACI 315 and 318 and CRSI DA4 except as specified or indicated on drawings, free from rust, scale and contaminants which will reduce bond

2.8 SOURCE QUALITY CONTROL

A. Test the proposed concrete mix for each size and gradation of aggregates and each consistency intended for use in the project

B. Aggregates

1. Sample and test according to ASTM C33
2. Determine bulk specific gravity in accordance with ASTM C127 and C128

C. Fly Ash: Supplier's chemical composition and physical analysis test

D. Initial set test
1. In accordance with ASTM C403
2. Test at 70 degrees F and 90 degrees ambient
3. Test at 70 degrees F on mix including specific plasticizing and entraining admixtures
4. Test at 90 degrees F on mix including specified retarding and air entraining admixtures
5. Fly ash: Supplier's chemical composition and physical analysis test

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions in field or under provisions of Division 1 Specifications

B. Verify requirements for concrete cover over reinforcement

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions

B. Subgrade and bedding shall be compacted and free of frost. If placement occurs at temperatures below freezing, provide temporary heat and protection to remove frost. Do not place concrete on frozen material.

C. Provide mud slabs where noted, where necessary, and when required by the Engineer to obtain a dry and stable working platform for placement of concrete. Unless otherwise approved by Engineer, 2 inch thick mud slabs shall be provided between free-draining fill and concrete as detailed.

D. Remove standing water, ice, mud, and foreign matter before placing concrete

E. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels with dowel adhesive system.

3.3 FORMS

A. Formwork design, detailing, and installation shall be Contractor’s responsibility and shall conform to ACI 347R.

B. Type of forms used is Contractor's option, except as otherwise indicated or shown. Plywood and other wood forms shall have smooth level surfaces treated with form oil or sealer to produce clean release of concrete from forms.
   1. Where wall remain exposed use plywood, prefabricated metal or wood forms; do not use boards. Lay forms out in a uniform pattern with the long dimension of the form placed vertically and joints aligned.
   2. Form ties shall be plastic cone snap ties. Cone shall be min ¾ inch diameter by 1 inch deep. Ties for liquid holding structures or dry structures below grade shall have integral waterstop. Taper tie through-bolt form ties may be used as an alternate to plastic cone snap ties; conform to details shown. Do not use wire ties on exposed concrete.
   3. Provide ¾ inch chamfer on external corners of exposed concrete walls, beams, columns, equipment bases and exposed edges of construction joints. Do not chamfer edges flush with pre-engineered metal building walls.

C. Coat plywood and wood forms with non-staining form release agent. Apply release agent before reinforcement is placed.

D. Clean, patch, and repair form material before reuse.

E. Formwork shall prevent leakage of mortar, shall not deflect under weight of concrete and workmen, and shall withstand fluid pressure of concrete. Maximum deviation from a true plane: 1/8 inch within 6 feet

F. Brace or tie forms to maintain desired position, shape, and alignment during and after concrete placement

G. Design to produce hardened concrete to the shape, lines, and dimensions indicated on the drawings

H. Plywood or lined forms are not required for surface normally submerged or not normally exposed to view

I. Other type of forms may be used for surfaces not restricted to plywood or lined forms as backing for form lining

J. Flat segmental forms, 2 foot maximum width, may be used for curved surfaces 25 feet minimum diameter

K. Provide polyethylene film to protect concrete from water loss when placing concrete against gravel or crushed rock not containing 25 percent minimum material passing a No. 4 sieve, lap joint 4 inches

L. When placing concrete against rock, remove all loose pieces of rock and clean exposed surface with high pressure hose

M. Size and space wailers, studs, internal ties and other form supports so proper working stresses are not exceeded

N. Locations to be finished to a specified elevation, slope, or contour, bring form to true line and grade and provide a wooden guide strip at the proper location in the forms for finishing the top surface with a screed or template

O. At horizontal construction joints in walls, stop the forms on one side not more than 2 feet above the joint

P. Provide temporary opening at the bottom of columns and wall forms and wherever necessary for cleaning and inspection

Q. Install form ties on exposed surfaces in uniformly spaced vertical and horizontal rows

R. Do not remove or disturb until concrete has attained sufficient strength to safely support all dead and live loads

S. Leave shoring beneath beams and slabs in place and reinforce as required for construction equipment and materials

T. Maintain forms in place for a minimum of 40 hours for length of curing time in accordance with ACI 306/306R when temperature is 45 deg F and below

U. Remove forms carefully to prevent surface gouging, corner or edge breakage and other damage

3.4 REINFORCING STEEL

A. Accurately position reinforcing steel on supports, spacers, hangers, or other reinforcing steel at maximum intervals of 4 feet on center

B. Secure with wire ties or suitable clips. Tie 50 percent of all reinforcement and reinforcement at intersections for wall and floor construction

C. Except at contact splices, minimum clear distances between bars, the greater of
   1. Nominal diameter of bars
   2. 1.5 times max size of coarse aggregate

D. Splices
   1. As specified or indicated on the drawings
   2. Splices at other locations will be acceptable, if approved by the Engineer
   3. Do not weld or tack weld reinforcing steel
   4. Remove and replace steel upon which any unauthorized welding has been performed

3.5 EMBEDMENTS

A. Accurately position and securely anchor in forms, anchor bolts, steel shapes, conduit, sleeves, masonry anchorages, and other materials to be embedded in concrete

B. Cast pipe and other embedded items into concrete as placement progresses. Do not provide blockouts.

C. Do not place ducts, conduit, and pipes in slabs on grade. Place minimum 4 inches below slab

D. Place items constructed of dissimilar metals to avoid physical contact with reinforcing. Secure item and reinforcing to ensure they will not shift and come into contact during concrete placement. Contact between reinforcing steel and other metal, other than bare, coated, or plated carbon steel not permitted.

E. The following restrictions shall be adhered to, unless otherwise noted
   1. No duct, conduit, pipe, or fitting placed vertically shall be larger in cross-sectional area than 4% oc column into which it is placed.
   2. Duct, conduit, pipe, and fittings, when placed within slabs or walls
      a. Shall not be larger than 1/3 thickness of slab or wall
      b. Shall be placed within the middle 1/3 of slab or wall where possible
      c. Shall not be placed closer than 3 outside diameters clear from each other when parallel
      d. Shall cross each other at right angles
      e. Shall be secured to prevent shifting of “floating” during concrete placement
      f. Multiple conduits shall not cross each other at the same location
      g. Except for conduits that must run up a column, keep conduits a minimum of 2 to 3 feet away from columns
      h. Where conditions require conduit to be tied to the inside face of the reinforcing mat, the conduit shall be galvanized steel or PVC, shall be placed 3 outside diameter clear away from the parallel reinforcement bar.
   3. Reinforcing steel shall be in place before embedded items placed and reinforcing cut or removed shall be replaced with additional reinforcing as indicated.
   4. Do not pass sleeves through columns or beams without Engineer’s approval.

F. Anchor bolts
   1. Unless installed in pipe sleeves, provide sufficient threads on anchor bolts to permit a nut on the concrete side of the form or template
   2. Install a second nut on the other side of the form or template
   3. Adjust the nuts to hold the bolt rigidly in the proper position

G. Clean embedments before installation

3.6 TRANSPORTING MIXED CONCRETE

A. Transporting of mixed concrete shall conform to ACI 304R.

B. Maximum delivery time from batch plant is 90 minutes

C. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

D. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be

incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.

E. Notify Special Inspector of any water added to the concrete mixture

F. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer

G. Provide delivery ticket to Special Inspector or Owner and comply with delivery requirements of this section

3.7 PLACING CONCRETE

A. Place concrete in accordance with ACI 304, ACI 301, and ACI 318

B. Schedule and attend pre-pour meeting with Owner at least 7 days before first pour to review requirements of this specification

C. Notify Engineer and Owner not less than 48 hours in advance of the times and places at which contractor intends to place concrete

D. Predetermine limits at each pour and place all concrete within limits of pour in one continuous operation

E. Construction joint locations shall be approved by the Engineer

F. Rigidly secure forms, reinforcing steel, embedment, and anchor bolts in proper position

G. Remove all mud, water, ice, snow, frozen material, and debris from space to be occupied by concrete

H. Clean surfaces encrusted with dried concrete from previous concrete operations

I. Convey to the point of final deposit by methods which will prevent separation or loss of ingredients

J. Place concrete in final position without being moved laterally more than 5 feet

K. Place concrete in horizontal layers not more than 2 feet of depth to allow for proper consolidation

L. Place subsequent layer while the preceding layer is still plastic

M. Top finish concrete when thoroughly settled

N. Remove all laitance, debris, and surplus water from the tops of the forms by screeding, scraping or other effective means

O. Overfill the forms for walls whose tops will be exposed to the weather and screed off the excess after the concrete has settled

P. Provide vertical construction joints as required to comply with these requirements

Q. Limit portions of columns and walls poured monolithically with floor or roof slabs to 6 feet of vertical height

R. Allow concrete in walls and columns to settle at least 2 hours before concrete is placed in structural systems to be supported by the walls and columns

S. Clean concrete spatter and other foreign substances from surfaces not in contact with concrete.

3.8 BONDING TO HARDENED CONCRETE

A. Place new concrete on rough, clean, damp faces of existing concrete

B. Roughen concrete to be bonded to future concrete to 1/4 inch amplitude

C. Remove surface mortar of smooth surfaces to expose aggregate

D. Clean hardened concrete of all foreign substances, including curing compound, washed with clean water, and keep saturated for 24 hrs preceding placement of fresh concrete

E. Apply epoxy bonding agent for bonding to hardened concrete

3.9 CONSOLIDATION

A. Thoroughly consolidate concrete during and immediately after placement

B. Work concrete around all reinforcements and embedments and into the corners of the forms

C. Use mechanical vibrators which will maintain 9,000 cycles per minutes when immersed in the concrete, 1 ½ hp motor minimum

3.10 COLD WEATHER CONCRETING

A. Conform to ACI 306, except as modified herein

B. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

C. Do not place heated concrete which is warmer than 80 degrees F

D. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place

E. Do not allow concrete to cool suddenly

3.11 HOT WEATHER CONCRETING

A. Conform to ACI 305, except as modified herein

B. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing

C. Do not allow concrete temperature to exceed 80 deg F at placement

D. Prevent plastic shrinkage cracking due to rapid evaporation of moisture

E. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.5

3.12 CONSTRUCTION JOINTS

A. Unless otherwise noted, construction joints shown are optional. Joints not shown on Drawings shall be approved by Engineer. Locate to miss splices in reinforcement.

B. Limit size on concrete pours. Maximum length of wall and slab pours shall not exceed 60 feet.

C. Before concrete placed, construction joints shall be cleaned, laitance removed, and surface wetted. Remove standing water.

D. Locate construction joints in floors within middle third of span. Construction joints in floors supported by walls may be located at center of wall.

E. Construction joints in beams shall be offset minimum distance of 2 times width of intersecting beam.

F. Locate vertical joints in walls a minimum of one-half wall height from corners or other intersecting walls or at midpoint between corners or intersecting walls. Locate horizontal joints in walls within the middle third of wall height.

G. Beams, haunches, drop panels, and capitals shall be placed monolithically as part of slab system, unless detailed otherwise.

H. Construction joints shall have keys or roughened surfaces. Where roughened surfaces are used, surface shall have amplitude of ¼ inch minimum.

I. Make control joints in slabs on grade of preformed control joint strips set flush with finished surface, by construction joint, by tooled joint, or cut ¼ inch wide joints with diamond saw within 12 hours after placement.
   1. Cut alternate reinforcing bars or wires crossing joint.
   2. Control joints shall be minimum ¼ depth of slab.
   3. Fill construction joint, tooled joint, and sawed control joints with epoxy joint filler.

4. Unless otherwise indicated, spacing of control joints shall not exceed 15 feet in each direction.

J. Install premolded joint filler where noted in accordance with manufacturer's recommendations. Joint filler shall be compatible with sealant and suitable for intended purpose.

K. Install construction joints in slabs perpendicular to the planes of their surfaces

3.13 WATERTIGHT JOINTS

A. Provide waterstop in construction joints at the following locations:
1. Walls and slabs separating dry interior from earth or liquid.
2. Exterior walls and slabs of liquid holding tanks.
3. Slabs above occupied areas
4. Other locations shown on Drawings.

B. Hydrophilic Waterstops
1. Follow all manufacturer's recommendations and instructions for installation.
2. Provide a smooth even surface to ensure good bond between waterstop and substrate.
3. Locate waterstops in center of construction joints.
4. Splice waterstops in accordance with manufacturer's recommendations.
5. Prior to application of waterstop remove all dust, oil, or other contaminants from the concrete surface prior to adhering the waterstop.
6. Secure waterstop sufficiently to substrate to prohibit movement of waterstop during placement of fresh concrete.

3.14 FINISHING SLABS AND FLATWORK

A. Slab Finishes:

Description	Concrete Finish
Submerged and Buried Slabs	Float
Sealer Applied Floors and Slabs	3 Trowelings
Exterior Exposed Slabs	Float and Broom Finish
Exterior Stairs and Walks	Float and Broom Finish

B. After placement, screed concrete with straightedges, power strike-offs or vibrating screeds.

C. After screeding, bull float or darby surfaces to eliminate ridges and to fill in voids left by screeding.

D. Float:
1. Use magnesium or aluminum hand floats or power floats with slip on float shoes.
2. Float finish shall result in uniform smooth granular texture.

E. Trowel:
1. Use steel trowels.

2. Use power or hand troweling.
3. Final troweling shall be by hand and continue until concrete surface consolidated to uniform, smooth, dense surface free of trowel marks and irregularities.

F. Broom Finish: Use fine, soft-bristled broom and broom at right angles to direction of traffic to give nonskid finish approved by Engineer.

G. Floor Sealer:
1. Apply in accordance with manufacturer's written instructions.
2. Apply first coat after final troweling, surface water glaze has dissipated, and when surface is hard enough to sustain foot traffic on same day as pour.
3. When floor has been water cured, apply first coat after curing has been completed. Apply within one day of floor being dry enough for application.
4. Apply second coat after Work completed and ready for occupancy.

H. Tolerances:
1. Concrete slabs shall be within 3/16 inch of 10 foot straightedge in all directions except where slabs are dished for drains. Deviations from elevation indicated shall not exceed 3/4 inch.
2. Pitch floor to floor drains minimum 1/8 inch per foot or as shown. Pitch bottom of slab or beam to match top slope to maintain thickness or depth indicated. As an alternate, bottom of slab or beam may be placed level provided that min thickness or depth is maintained.

3.15 FINISHING FORMED SURFACES

A. Remove fins and other surface projections from all formed surfaces except exterior surfaces that will be in contact with earth backfill and are not specified to be dampproofed

B. Use a power grinder, if necessary, to remove projections and provide a flush surface

C. Remove fins and fill all tie holes on surfaces exposed to view
1. Clean, dry and fill plastic cone snap tie holes with Patching Mortar. Fill taper tie through-bolt form tie holes with Non-Shrink Grout.
2. Finish flush to match the texture of adjacent concrete

D. Grout smooth all exposed surfaces under provisions of Chapter 10, ACI 301 where indicated otherwise.
1. Grout clean surfaces exposed to view to produce a smooth uniform surface free of marks, voids, surface glaze and cement dust
2. Use non-shrink grout mix with bonding agent. Dampen surface and apply with cork or rubber float

3.16 CURING AND PROTECTION

A. Protect concrete from frost and keep moist for min curing period of 7 days after placement in accordance with ACI 308.
1. Formed Surfaces:

a. Wet cure by spraying surfaces as frequently as drying conditions may require to keep concrete surfaces moist.
b. Surfaces may be cured by leaving forms in-place. For vertical surfaces, apply water to run down inside of forms, if necessary, to keep concrete moist.
c. After forms are removed, wet cure for remainder of curing period or apply curing compound.
d. Do not use curing compound where mortar, grout, concrete, or other coatings or adhesives will be applied.

B. Flatwork:
1. Cure using curing compound or wet cure.
2. Do not use curing compound where mortar, grout, concrete, or other coatings or adhesives will be applied.

C. Curing Compound:
1. Apply curing compound at uniform rate sufficient to comply with requirements for water retention as specified and as measured in accordance with ASTM C156.
2. Cover areas subjected to direct sunlight with ambient temperature expected to exceed 80°F with white pigmented compound, other surfaces may be covered with fugitive dye compound.

D. Water curing
1. Begin water saturation as quickly as possible after initial set
2. Regulate water application to provide complete surface coverage with minimum runoff
3. Interrupt the application of water to walls for grout cleaning only over the area being cleaned at the time and do not permit the surface to become dry during such an interruption

E. Protect from damaging mechanical disturbances, load stresses, heavy shock, and excessive vibration.

F. Protect finished concrete surfaces from damage caused by construction equipment, materials, and methods, and from rain or running water.

G. Do not load self-supporting structures to overstress concrete.

3.17 REMOVAL OF FORMING AND SHORING

A. Do not remove forming or shoring until member supported has acquired sufficient strength to safely support own weight and any imposed loads. Forming shall remain in place for at least min time recommended by ACI 347R. In addition, forming for horizontal members shall remain in place minimum 7 days. In no case shall forming for horizontal members be removed before concrete has reached 70% of specified design strength.

B. Reshore areas as required to carry additional imposed loads.

3.18 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. General:
   1. Prior to starting repair work, obtain Engineer's approval of proposed repair techniques and materials.
   2. Method of repair shall not adversely affect the appearance of the finished structure.
   3. Develop repair techniques on portion of as-cast surface selected by Engineer. Surface of repair remaining exposed to view shall match color and texture of adjacent surfaces.
   4. Prepare surfaces, apply and install materials, and cure as recommended by material manufacturers.

C. Defective Areas:
   1. Remove honeycombing, stone packets, spalls, and other defective concrete down to sound concrete. If chipping required, make edges perpendicular to surface. Do not feather edges.
   2. Fill defective area with patching mortar

D. Leaks or wet spots:
   1. Inject, patch and repair areas where leaks or wet spots have occurred inside dry structures.
   2. Inject, patch and repair areas where leaks or wet spots have occurred in wet wells, basins, tanks, and other structures which are to hold water and exceed the allowable leakage rate specified in this section.

3.19 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301 under provisions of Section 01400

B. Owner's geotechnical consultant provide field and compressive strength tests to determine compliance of concrete materials in accordance with the specifications except as indicated otherwise under provisions of Section 01400

C. The Owner shall pay for compressive strength tests to determine compliance of concrete material in accordance with the specifications

D. Concrete Field Tests
   1. Tests by ACI certified technician
   2. Concrete Test Samples: Samples for acceptance tests on concrete shall be obtained in accordance with ASTM C172 at the point of placement or discharge.
   3. Provide all equipment, supplies, and the services of one or more employees, as required
   4. The test frequencies specified are minimum. Additional tests may be performed as required by the job conditions

E. Slump: Provide a sample from each truck load in accordance with ASTM C143 if requested by Engineer and when making test cylinders

F. Air Content: Provide a sample from each truck load if requested by Engineer and when making test cylinders

G. Compression Tests
   1. Provide one set of 6 cylinders each day when up to 50 cu yds have been placed
   2. Make one additional set of 6 cylinders for each additional 50 cu yds or each major pour placed in one day
   3. Test two cylinders in each set at 7 days
   4. Test two cylinders in each set at 28 days
   5. The other two cylinders to be used as directed by Engineer at any time
   6. Engineer will evaluate in accordance with ACI 214 and 318
   7. Make, cure, store, and deliver cylinders in accordance with ASTM C31
   8. Test in accordance with ASTM C39
   9. Mark or tag each set of test cylinders with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders was placed, the delivery truck or batch number, the air content, and the slump

H. Storage Facilities for Concrete Test Cylinders
   1. Including water necessary, a specially prepared box with high-low thermometer and thermostatically controlled heating devices in accordance with ASTM C31

I. Failure of Test Cylinder Results: Evaluation of concrete structures where laboratory-cured cylinders fail to meet 28-day concrete strength requirements of the contract documents will be subject to, but not limited to, the following measures.
   1. Upon failure of 28-day test cylinder results, the Engineer may require the Contractor, at his expense, to obtain and test at least three 4-inch diameter cored samples from area in question
   2. Concrete will be considered adequate if average of three core tests is at least 85 percent of, and if no single core is less than 75 percent of, the specified 28-day strength. Where concrete durability is a concern due to freeze thaw or sulfate exposure the Engineer may reject concrete that passes ACI 318 core testing criteria for strength, but fails to meet acceptance criteria for cylinder testing.
   3. In the event an area is found to be structurally unsound, the Engineer may order removal and replacement of concrete as required. The cost of the core tests and removal and replacement of defective concrete shall be borne by the Contractor
   4. Fill all core holes as specified for repairing defective concrete
   5. Additional measures may be required at the direction of the Engineer in accordance with ACI 350

3.20 LEAKAGE TESTING OF WATER HOLDING STRUCTURES

A. Structures shall be subjected to leakage tests after concrete has obtained specified design strength, and before backfilling or other Work which will cover faces of walls is begun

B. Tanks laterally restrained or supported by cross-walls, beams or slabs shall not be tested until such restraining or supporting construction is placed and has obtained its specified design strength

C. Fill structure with water to elevation given in the Table 1. After structure has been full for 24 hrs, it will be assumed for purposes of test that absorption of moisture by concrete in structure is complete. Measure change in water level after 24 hours have elapsed.

D. Fill container with water and place next to or in structure being tested. Locate container so it experiences environmental conditions as close as possible to those experienced by structure. Container shall be used as an indicator to measure loss of water due to evaporation. Level of water in container shall be measured and recorded over same period as structure.

E. If drop in water level, adjusted for evaporation in 24-hr period, exceeds 1/32 of an inch leakage shall be considered excessive

F. During test period, examine structure and mark visible leaks or damp spots

G. Damp spots on the exterior wall faces or footings shall be qualified as leaks. All leaks shall be repaired.

H. Drain structure to 2-ft minimum below leaks and damp spots and repair. Method of repair shall be Contractor's option, subject to requirements of these Contract Documents and review by Engineer.

I. If leakage was determined to be excessive, refill structure to specified level and retest

J. Continue this process until drop in water level in 24-hr period is less than 1/32 of an inch

K. Repairs and additional tests shall be made by Contractor, in acceptable manner, at no additional cost to Owner

TABLE 1
LEAKAGE TEST ELEVATIONS

Structure No. and Name	Test Elevation
Digesters	7400.00
Headworks	7383.00

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Patching cavities in concrete

B. Other grouting specified or indicated on Drawings

1.2 RELATED SECTIONS

A. Section 03300 – Concrete

1.3 REFERENCES

A. ASTM C109 – Test Method for Compressive Strength of Hydraulic Cement Mortar

B. ASTM C157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete

C. ASTM C191 – Time of Setting of Hydraulic Cement by Vicat Needle

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Product Data: Provide manufacturer's catalog sheet for material indicating test data and physical properties

1.5 QUALITY ASSURANCE

A. Conform to applicable industry standard, Corps of Engineers, Specification CRD-C 621 - Specification for non-shrink grout

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Non-Shrink, Non-Metallic Grout
   1. Master Builders - Masterflow 928
   2. M.R. Meadows - Sealtight 588
   3. Sonneborn - Sonogrout 10K
   4. Euclid - Tammsgrout Supreme
   5. Sika - SikaGrout 212
   6. Or accepted substitution

B. Epoxy Grout
   1. L&M Inc. - Epogrout
   2. Sika - Sikadur 42, Grout Pack
   3. Or accepted substitution

2.2 MATERIALS

A. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days

B. Epoxy Grout: Three Component Epoxy Resin System
   1. Two liquid epoxy components
   2. One inert aggregate filtered component
   3. Each component furnished in separate package for mixing at job site

C. Water: Clean and free from deleterious substances

PART 3 EXECUTION

3.1 PREPARATION

A. Non-Shrink, Non-Metallic Grout
   1. Clean concrete surface to receive grout
   2. Saturate concrete with water for 24 hrs prior to grouting and remove excess water just prior to placing grout
   3. Cold weather conditions
      a. Warm concrete, substrate and base plate to 40 deg F, or above; store grout in warm area
      b. Follow manufacturer's recommendations for cold weather application
   4. Hot weather conditions
      a. Use cold mixing water and cool base plate if possible; store grout in cool area
      b. Follow manufacturer's recommendations for hot weather application
   5. Apply to clean, sound surface
   6. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer

B. Epoxy Grout: Apply only to clean, dry, sound surface

3.2 APPLICATION

A. Non-Shrink, Non-Metallic Grout
   1. Mix in a mechanical mixer
   2. Use no more water than necessary to produce flowable grout
   3. Provide air vents where necessary to eliminate air pockets
   4. Place in accordance with manufacturer's instructions
   5. Where exposed to view finish grout edges smooth

6. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound
7. Wet cure grout for 7 days, minimum
8. Maintain the temperature at a minimum of 40 deg F until grout reaches 3000 psi
9. After placement of grout, eliminate excessive external vibration

B. Epoxy Grout
1. Mix and place in accordance with manufacturer's instructions
2. Completely fill all cavities and spaces around dowels and anchors without voids
3. Obtain manufacturer's technical assistance as required to insure proper placement

3.3 SCHEDULE

A. Non-Shrink, Non-Metallic Grout: General Use
1. Grouting of manhole covers, pipe inlets, and precast manholes and vaults

B. Epoxy Grout
1. Patching cavities in concrete including, but not limited to, tie holes, and structural and equipment support

END OF SECTION

SECTION 04810

UNIT MASONRY ASSEMBLIES

GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

A. Product Data for each different masonry unit, accessory, and other manufactured product specified.

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
   1. Exposed CMUs.
   2. Pigmented or colored-aggregate mortar. Make samples using same sand and mortar ingredients to be used on Project.
   3. Accessories embedded in masonry.

D. Qualification Data: For testing agency.

E. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For exposed units, include test report for efflorescence according to ASTM C 67.
   2. Cementitious materials. Include brand, type and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
   6. Joint reinforcement.
   7. Anchors, ties, and metal accessories.

F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 01039 Coordination and Meetings

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place
   2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface
   2. Protect sills, ledges, and projections from mortar droppings
   3. Protect surfaces of door frames, as well as similar products with painted and integral finishes, from mortar droppings
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions
   2. Provide square-edged units for outside corners unless otherwise indicated

C. Structural CMUs: ASTM C 90
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi
   2. Density Classification: Lightweight
   3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions
   4. ASTM C 90 requires at least four units for sample, representing the range of color and texture permitted

2.3 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated

B. Hydrated Lime: ASTM C 207, Type S

C. Self-Consolidating Grout (SCG): ASTN C 476-02, course masonry grout.

D. Ready-Mixed Mortar: Cementitious material, water, and aggregate complying with requirements specified in the Article; combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.
   1. Mortar color to match adjacent building mortar.

E. Aggregate for Mortar: ASTM C 144
   1. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve
   2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color

F. Aggregate for Grout: ASTM C 404

G. Water: Potable

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M
   1. All Walls: Hot-dip galvanized**,** carbon steel
   2. Wire Size for Side Rods: 9 gauge.
   3. Wire Size for Cross Rods: 9 gauge.
   4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   5. Provide in lengths of not less than 10 feet with prefabricated corner and tee units

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
   1. Products: Subject to compliance with requirements, provide one of the following:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.
e. Acceptable Substitution.

2.7 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Diedrich Technologies, Inc.
      b. EaCo Chem, Inc.
      c. ProSoCo, Inc.

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. For reinforced masonry, use portland cement-lime mortar.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type S.
   3. For mortar parge coats, use Type N.
   4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type S.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10 feet, or 1/2-inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet, 1/2-inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10 feet, 1/8-inch in 20 feet or 1/2-inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10 feet, 1/4-inch in 20 feet or 1/2-inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10 feet, 3/8-inch in 20 feet, or 1/2-inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4-inch in 10 feet, or 1/2-inch maximum.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   3. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.8 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 2 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.10 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer’s approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.11 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 02300 Earthwork.
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05400

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTIONAL INCLUDES

A. Section Includes:
   1. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

D. Qualification Data: For testing agency.

E. Welding certificates.

F. Product Certificates: For each type of code-compliance certification for studs and tracks.
G. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips

7. Miscellaneous structural clips and accessories.

H. Evaluation Reports: For nonstandard cold-formed steel framing from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 PRODUCTS

1.5 MANUFACTURERS

A. ClarkDietrich

B. Or Equal

1.6 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Deflection Limits: Design framing systems to withstand 5psf lateral load without deflections greater than the following:
a. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load

2. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing,

sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F

3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of 1 inch.

4. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

B. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
   1. Floor and Roof Systems: AISI S210.
   2. Wall Studs: AISI S211.
   3. Headers: AISI S212.
   4. Lateral Design: AISI S213.

1.7 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
   1. Grade: ST33H
   2. Coating: G60

B. Steel Sheet for Vertical Deflection Clips: ASTM A653, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 33
   2. Coating: G60

1.8 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch
   2. Flange Width: 2 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch
   2. Flange Width: 1-1/2 inches
   3. Designation: 600T150-54

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch
2. Flange Width: 1 plus the design gap for one-story structures

1.9 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

1.10 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.

1.11 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

1.12 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch

PART 3 EXECUTION

1.13 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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.

1.14 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

1.15 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

1.16 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated on Drawings

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at 96-inch centers

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

1.17 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

1.18 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

1.19 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Provide miscellaneous metal work shown on the Drawings, as specified herein, and as needed for a complete and proper installation.

B. Section Includes:
   1. Concrete anchors
   2. Stairs
   3. Alternating Tread Stairs
   4. Plank grating
   5. Grating support frames
   6. Aluminum handrail
   7. Ladders
   8. Floor Access hatches
   9. Miscellaneous items

1.2 RELATED SECTIONS

A. Section 09900 – Coatings

1.3 DEFINITIONS

A. Submerged: At or below level 1 foot 6 inches above maximum water level in water holding structures

1.4 REFERENCES AND STANDARDS

A. AISC: American Institute of Steel Construction

B. AA: Aluminum Association

C. AWS: American Welding Society

D. ASTM: American Society for Testing and Materials

E. AISI: American Iron and Steel Institute

F. OSHA: Occupational Safety and Health Administration

1.5 SUBMITTALS

A. Shop Drawings:
   1. Indicate materials, sizes, connections, anchors, and finishes.

B. Product Data
   1. Manufacturer's catalog sheets and premanufactured items.

C. Miscellaneous Submittals:
   1. Floor access hatch warranty.

D. Submit in accordance with Section 01340.

1.6 QUALITY ASSURANCE

A. Perform shop and/or field welding required in connection with the work of this Section by certified welders in strict accordance with pertinent recommendation of AWS.

B. Conform to AISC and AA standards.

PART 2 GENERAL

2.1 MATERIALS

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, and roughness.

B. Comply with following standards, as pertinent.
   1. Steel Shapes unless noted otherwise below: ASTM A36
      a. W-Shapes: A992
      b. Steel Plates and Bars: A572
   2. Square or rectangular tubing: ASTM A500, Grade C.
   3. Round tubing: ASTM A500, Grade C.
   4. Pipe: ASTM A53, Grade B
   5. Stainless Steel:
      a. Exterior and submerged uses: AISI, Type 316
      b. Interior uses: AISI, Type 304 or Type 316
   6. Aluminum shapes and plates: Alloy 6061-T6 or 6063-T6
   7. Floor Plate: Checkered surface aluminum plate.
   8. Connection Bolts:
      a. For steel members: ASTM A325
      b. For wood members: ASTM A307, galvanized
      c. For aluminum and galvanized steel members: Stainless steel
   9. Cast-in-place anchor bolts:
      a. ½ inch minimum diameter
      b. Nonsubmerged: ASTM A307, galvanized
      c. Submerged: Stainless steel

10. Malleable Iron: ASTM A47
11. Cast Iron: ASTM A48, Class 35B
12. Ductile Iron: ASTM A536, Grade 65-45-12
13. Cast Aluminum: ASTM B26

2.2 CONCRETE ANCHORS

A. Expansion Anchors:
   1. Manufacturers:
      a. Kwik Bolt 3 or Kwik Bolt TZ by Hilti
      b. Power-Stud+ SD1 or SD2 by Powers Fasteners
      c. Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Co., Inc.
      d. Red Head Trubolt+ or Trubolt Wedge Anchor by ITW Commercial Construction
   2. Usage: In concrete
      a. 316 Stainless Steel
      b. Do not use when submerged or subjected to dynamic loads.

B. Adhesive Anchors:
   1. Manufacturers:
      a. HIT RE-500-V3 or HIT-HY 200-A by Hilti Corp.
      b. AC100+ Gold or PE 1000+ by Powers Fasteners
      c. AT or SET-XP Epoxy Adhesive System by Simpson Strong-Tie Co., Inc.
      d. Red Head Epcon S7, A7, G5 or C6 Adhesives by ITW Commercial Construction
   2. Epoxy adhesive with 316 Stainless steel stud assembly.
   3. Usage:
      a. In concrete, submerged
      b. In masonry, provide screen tube inserts
      c. Do not use in overhead applications

C. Adjustable anchors:
   1. Manufacturers:
      a. Deco
      b. Unisorb
   2. Usage: In concrete, for hanging monorail beams and supports from concrete ceilings

D. Screw Anchors:
   1. Manufacturers”
      a. Kwik-Con II or Kwik HUS / HUS-EZ by Hilti Corp.
      b. Wedge-Bolt+ or Tapper+ by Powers Fasteners
      c. Titen or Titen HD by Simpson Strong-Tie CO., Inc.
      d. Red Head Tapcon or Large Tapcon (LDT) anchors by ITW Commercial Construction
   2. Stainless steel concrete/Masonry screw with hex head.
   3. Usage:
      a. In concrete, only where noted
      b. In masonry, only where noted

2.3 FINISHES

A. Primer: Conform to the requirements of Section 09900.

B. Galvanizing Repair Paint: High zinc-dust content paint complying with MIL-P-21035

2.4 FABRICATION

A. Except as otherwise shown on the Drawings or the approved Shop Drawings, use materials of size, thickness, and type required to produce reasonable strength and durability in the work of this Section.

B. Provide clips, lugs, brackets, straps, plates, bolts, nuts, washers, and similar items, as required for fabrication and erection.

C. Fabricate with accurate angles and surfaces which are true to the required lines and levels, with projecting corners clipped, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

D. Weld shop connection and bolt or weld field connections.

E. Use AISC standard 2-angle web connections or single plate framing connections capable of supporting min of 50% or total uniform load capacity of member.

F. Connections shall consist of minimum two ¾ inch diameter bolts or welds developing minimum of 10,000 pounds capacity.

G. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the item. Conform to Section 09900.
   1. Do not coat ferrous metal surfaces embedded in concrete.
   2. Coating of cast iron or ductile iron floor access hatches and pressure relief valves not required.
   3. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.
   4. Coat aluminum surfaces in contact with concrete in accordance with AA and Section 09900. Under no circumstances shall aluminum contact dissimilar metal.

H. Galvanizing:
   1. Galvanize after fabrication.
   2. Galvanize by hot-dip process conforming to ASTM A123 and AHDGA specifications.

2.5 STAIRS

A. Construct stairs and platforms of steel channel stringers and framing members to support uniform live load of 100 pounds per square foor or a moving concentrated load of 1000 pounds, whichever produces the greatest stress.

B. Close exposed ends of stringers with plates, continuously welded to main member

C. Provide aluminum bar grating treads and landing platforms.

D. Hot-dip galvanize after fabrication

2.6 ALUMINUM PLANK GRATING

A. Manufacturers:
   1. Interstate Gratings
   2. Barnett Bates
   3. Brown-Campbell Company
   4. Ohio Gratings
   5. Grating Pacific
   6. AMICO

B. Provide shop-fabricated grating and accessories such as frames, support angles, and fasteners.

C. Grating shall be aluminum alloy 6061-T6 or 6063-T6 unpunched panels with raised longitudinal ridges for skid resistance.

D. Provide fastening devices to firmly anchor grating and treads to supports. Sections designated as removable shall not be attached to supports.
   1. Minimum of 4 per panel.
   2. Shall allow for repeated removal.
   3. Minimum 1/4 inch bolts or self tapping screws.
   4. 316 stainless steel.

E. Provide trim banding or load carrying banding on edges and cutouts welded to grating.

F. Panels shall bear on supports a minimum of 1-1/2 inches.

G. Bolt or nest individual sections together to form larger panels.

H. Minimum width of panels shall be 16 inches except for locations requiring a single piece.

I. Max width of panels shall be 48 inches.

J. Grating Support angles and framing
   1. Provide aluminum support angles embedded in concrete. Angles shall be ¼ inch thick, inside depth shall be equal depth of grating, inside length shall equal depth of grating, but not less than 1-1/4 inch. Provide 1 inch by ¼ inch by 8 inch long strap anchors or 3/8 inch diameter by 6 inch long headed anchor studs welded to back of angles at 18 inches on center.
   2. Provide aluminum angles, channels, and beams as noted bolted to concrete or masonry with concrete anchors as noted.
   3. Galvanize steel members supporting aluminum grating.

2.7 ALUMINUM HANDRAIL

A. Handrail and railing shall meet requirements of OSHA and local building code

B. Provide end products of one manufacturer to achieve standardization of appearance

C. Materials:
   1. Rails, posts, and formed elbows: 1-1/2 inch diameter schedule 40 aluminum pipe (1.90 inch outside diameter, 0.145 inch wall thickness) allow 6063-T6
   2. Fittings:
      a. Riveted type fabricated from material similar to rails and posts
      b. Connections shall be continuous type to permit sliding of hands.
      c. Fittins for open railing extensions shall be welded construction and welded to posts to comply with OSHA loading requirements. Welds shall be ground smooth and finished to match adjacent finish.
      d. Base plates and side mounted flanges shall be aluminum or stainless steel.
   3. Toe Plate shall be ¼ inch by 4 inch flat aluminum plate or manufacturer's standard z-type toe plate, alloy 6063-T6
   4. Mechanical fasteners shall be stainless steel.

D. Finishes:
   1. Clear satin anodized finish
      a. Extruded components: 0.7 mil
      b. Cast components: 0.4 mil

E. Fabrication
   1. Use materials of size thickness, and type required to produce required strength and durability.
   2. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.
   3. Form connections and changes in direction by using prefabricated fittings or radius bends.
   4. Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces
   5. Remove burrs from exposed cut edges
   6. Close pipe ends using prefabricated fittings
   7. Fabricate joints of exterior units to exclude water or provide weep holes where water may accumulate
   8. Provide base flange or side mounted base plate.
   9. Coat surfaces to be in contact with concrete with bituminous paint

2.8 LADDERS

A. Ladders shall conform to OSHA and local building code safety requirements

B. Construct from steel members
   1. Stringers: 3-1/2 inch by 3/8 inch bar

2. Rungs: 1 inch diameter deformed reinforcing rod.
3. Other materials shall be minimum ¼ inch thick
4. Weld rungs to stringers
5. Fabricate brackets for fastening ladders to wall, weld to ladder.

2.9 FLOOR ACCESS HATCHES

A. Prefabricated Standard Type:
   1. Manufacturers”
      a. Bilco type J or JD
      b. Halliday type S1S or S2S
      c. Nystrom N Series
   2. Provide access hatches and frames of material, type, and size as shown on Drawings.
   3. Equip hatches with safety grates.
   4. Door leaves shall be ¼ inch minimum diamond pattern plate with reinforcing on underside to withstand live load of 150 pounds per square foor with max deflection of 1/150 of span
   5. Frames shall be ¼ inch minimum thick with strap anchors around perimeter
   6. Equip hatches with stainless steel hinges bolted to underside and pivot on torsion bars that counterbalance leaf for easy operation
   7. Equip hatches with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing
   8. Provide 316 stainless steel snap lock mounted on underside of lead with removable top side handle and socket recessed in cover.
   9. Hardware shall be stainless steel
   10. Factory finish on aluminum surfaces with be mill finish with bituminous coating applied to surfaces in contact with concrete
   11. Manufacturer shall warranty in writing against defects in material and workmanship for 5 years.

2.10 SAFETY GRATE

A. Where noted on Drawings provide retractable safety grate across access hatch openings

B. Metal Grating Type
   1. Bilco Fall Protection Grating, Halliday Retro-Grate, or Nystrom Safety Grating
   2. Aluminum construction with safety orange powder coat
   3. Spring loaded lifting handle
   4. Stainless steel hold open arm with aluminum latch
   5. Stainless steel hardware throughout
   6. Load rated at 300 pounds per square foot

2.11 MISCELLANEOUS ITEMS

A. Fabricate miscellaneous framing, supports, and items of structural shapes, plates, bars, and tubing or sizes and arrangements indicated and as required.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:
   1. Set work accurately into position, plumb, level, true and free from rack.
   2. Tolerance: 1/8 inch in 10 feet
   3. Anchor firmly into position
   4. Where field welding is required, comply with AWS recommended procedures for appearance and quality of weld and for methods to be used in correction welding work.
   5. Grind exposed welds smooth, and touchup shop prime coats.
   6. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for proper installation. Drill field holes for bolts, for not burn holes.
   7. Perform cutting, drilling, and fitting as required for proper installation. Drill field holes for bolts, do not burn holes.
   8. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint the exposed areas with same material used for shop priming.

B. Concrete Anchors:
   1. Do not install until concrete or masonry has reached design strength.
   2. Do not install closer than 6 bolt diameters to edge of concrete of masonry, or closer than 12 bolt diameters to another anchor unless noted otherwise
   3. Minimum embedment shall be 8 bolt diameters unless noted otherwise
   4. Install in accordance with manufacturer’s recommendations.

3.3 ALUMINUM HANDRAIL AND RAILING

A. Assemble and install in accordance with manufacturer’s written instructions.

B. Set posts plumb and align in each direction to within 1/8 inch in 10 feet

C. Provide expansion joints in rails and toe plate at 30 feet maximum on center. Locate within 12 inches of post

D. Support handrail on brackets having 2 inch clearance between handrail and wall spaced not more that 5 feet on center and within 12 inches of each end of rail. Return handrail ends to within ½ inch of wall.

E. Locate swing gates as shown.

F. Provide toe plate except on stairs where concrete curb provided, and on top of walls that project above grade where foot traffic is not feasible.

G. Bolt to top of concrete or stair stringers. Bolt to side of platform framing.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces, removing dirt, dust, and other foreign matter.

B. Prepare surfaces for finished painting as specified in Section 09900

C. Field repair of damaged galvanized coatings:
   1. Repair surfaces damaged during shipping, erection, or construction operations.
   2. Use zinc rich paint
   3. Prepare surfaces and apply in accordance with ASTM A780, Annex A2.

END OF SECTION

SECTION 07110

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Bituminous type dampproofing of select concrete surfaces for channels, tanks and sumps in contact with process wastewater

1.2 RELATED SECTIONS

A. Section 03300 – Concrete

B. Section 09900 – Painting

1.3 SUBMITTALS

A. Submit under provisions of Section 01340

B. Product Data: Provide data, certificates, and material safety data sheets on dampproofing product. Label submittal with type and intended use.

C. Manufacturer's Instructions: Indicate special surface preparation procedure, substitute conditions requiring special attention

D. Maintenance Data: Include in Materials and Finishes Manual under provisions of Section 01730

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Coal Tar Epoxy Dampproofing – Hi Build
   1. Sherwin Williams – Hi-Mil Sher-tar Epoxy, B67 series
   2. Tnemec – 46H-413 Hi Build Tnemec-Tar
   3. Porter 7080 Tarset Maxi-Build II
   4. W.R. Meadows Sealtight Sealmastic Emulsion Type III
   5. Or accepted substitution

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surface substrate conditions are ready to receive work as instructed by the product manufacturer

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application

C. Test shop applied primer for compatibility with subsequent cover materials

D. Do not proceed with surface preparation or coating application until conditions are suitable

3.2 PREPARATION

A. Apply dampproofing and coal tar epoxy to clean, dry surfaces
   1. Remove dirt, dust, sand, grit, mud, oil, grease, and other foreign matter
   2. Protect surfaces not to be coated from contamination, discoloration, or other damage with drop cloths or other suitable methods

B. Do no add any adulterants or unauthorized thinners

C. Thoroughly mix each time paint is withdrawn from container

D. Keep containers closed tightly except while paint is withdrawn

E. Thinning only permitted to obtain recommended coverage at lower application temperatures

3.3 APPLICATION – GENERAL

A. Apply products in accordance with manufacturer's recommendations

B. Do not apply initial coating until moisture content of surface is within moisture limitations of coating manufacturer

C. Apply paint with suitable brushes, rollers, or spraying equipment
   1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved
   2. Keep brushes, rollers, and spraying equipment clean, dry, free from contaminants and suitable for the finish required

D. Comply with recommendation of product manufacturer for drying time between succeeding coats

E. Finish coats shall be smooth, free of brush marks, streaks, laps or pile-up of paint, and skipped or missed areas

F. Make edges of coating adjoining other materials or colors clean and sharp with no overlapping

G. Do not permit coating to get on top of concrete walls or on exposed wall surfaces above specified limits

H. Do not use Benzol or other volatile toxic solvents for thinning coating

I. Provide adequate forced ventilation when applying coating in enclosed spaces to:
   1. Remove all vapors from solvents as rapidly as produced
   2. Insure that workers are adequately protected

J. Inspection
   1. Do not apply additional coats until completed coat has been inspected by the Engineer
   2. Only inspected coats of paint will be considered in determining number of coats applied

3.4 APPLICATION – COAL TAR EPOXY DAMPPROOFING

A. Apply in two coats with brush

B. Apply when temperatures are 45 degrees F and rising

C. Total dry film thickness: 20 mils
   1. Primer: 10 mils
   2. Finish: 10 mils

3.5 SCHEDULE

A. Coal Tar Epoxy Dampproofing: Exposed Surfaces
   1. All concrete surfaces in contact with wastewater. Apply from 1'-0" below minimum liquid level up to top of tank
      a. Include floors or channel for inverts in buildings
   2. All concrete surfaces in contact with wastewater
      a. Include floors and sumps
   3. Exterior concrete of the building in contact with groundwater
   4. Exposed wall surfaces forming a part of an interior vault or dry pit
      a. Include walls in contact with wastewater and groundwater

END OF SECTION

SECTION 07210

BUILDING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES
1. Board insulation at perimeter concrete foundation walls.

1.2 REFERENCES

A. ASTM: American Society for Testing and Materials

1.3 PERFORMANCE REQUIREMENTS

A. Materials of this section shall provide continuity of thermal barrier at building enclosure elements.

1.4 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance criteria, and limitations.

B. Manufacturer's installation instructions.

C. Submit in accordance with section 01340.

1.5 ENVIRONMENTAL CONDITIONS

A. Do not install insulation adhesives when temperatures or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 EXTRUDED POLYSTYRENE BOARD

A. Rigid, closed-cell, extruded, polystyrene insulation with integral high density skins.

B. Minimum thermal resistance "R" per inch: 5.0.

C. Minimum compressive strength:
1. 25 pounds per square inch for perimeter wall and cavity wall insulation.
2. 100 pounds per square inch for sandwich slab insulation.

D. Maximum water absorption by volume in accordance with ASTM C272: 0.1%.

E. Manufacturer's recommended adhesive for insulation application.

F. Minimum thickness: 2 inches unless otherwise noted. Reduce thickness of cavity wall insulation at concrete beams and columns to 1 ½ inches.

G. Acceptable Manufacturers:
   1. Dow.
   2. Owens Corning.
   3. Tenneco.
   4. Pactiv.

PART 3 EXECUTION

3.1 INSTALLATION / EXTRUDED POLYSTYRENE BOARD

A. Extruded polystyrene insulation to be installed where shown on the drawings, in accordance with manufacturer’s instructions.

B. Place boards in method to maximize contact bedding. Stagger side and end joints with edges butted tightly.

C. Cut and fit boards tightly around penetrations and other openings as required.

D. Perimeter insulation shall be set in adhesive applied to foundation wall in accordance with manufacturer’s recommendations.

E. Cavity wall insulation shall be set in adhesive applied to exterior face of interior wythe in accordance with manufacturer's recommendations. Fit courses of insulation between wall ties between wythes.

F. Where thickness exceeds 2 inches, install first layer of insulation as specified herein. Stagger side and end joints of finish layer.

END OF SECTION

SECTION 07920

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Preparation of joint substrates and installation of joint sealants, joint backer materials and accessories needed to ensure a complete and durable weathertight seal at locations indicated.

1.2 REFERENCES

A. ASTM: American Society for Testing and Materials

B. NSF: National Sanitation Foundation

C. USDA: United States Department of Agriculture

1.3 SUBMITTALS

A. Product Data:
   1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   2. Manufacturer's recommended installation procedures.
   3. Catalog illustrations in sufficient detail to show installation and interface of the Work of this Section with the Work of adjacent trades.
   4. Standard color card showing full range of colors available for each product exposed to view.

B. Miscellaneous:
   1. Written documentation of applicator's qualifications, including reference projects of similar scope and complexity, with current phone contacts of engineers and owners for verification.
   2. Certification from sealant manufacturers that their products are suitable for the use indicated and comply with specification requirements.

C. Submit in accordance with Section 01340.

1.4 QUALITY ASSURANCE

A. Applicator shall be approved by sealant manufacturer and shall have at least three years' experience in installing materials of types specified and shall have successfully completed at least three projects of similar scope and complexity.

B. Obtain joint sealants from single manufacturer for each different product required to ensure compatibility.

1. Provide joint sealants, joint fillers and accessory joint materials that are compatible with one another and with joint substrates under Project conditions.
2. Provide joint sealants, joint fillers and related joint materials that are nonstaining to visible joint surfaces and surrounding substrate surfaces.
3. Manufacturer shall instruct applicator in procedures for intersecting sealants.

C. Perform Work in accordance with ASTM C-1193 guidelines except where more stringent requirements are indicated or specified.

D. Schedule applications of waterproofing, water repellents, and preservative finishes after sealant installation unless sealant manufacturer approves otherwise in writing. Ensure that installed sealant is allowed to cure sufficiently prior to subsequent applications.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver the materials to Site in the manufacturer's unopened containers with all labels intact and legible at time of use.

B. Maintain the products in a dry condition during delivery, storage, handling, installation, and concealment.

1.6 SUBSTRATE CONDITIONS

A. Surfaces shall be broom clean, dry, sound, and free of voids, bugholes, rockpockets, honeycombs, protrusions, excessive roughness, foreign matter, frost, ice, and other contaminants which may inhibit application or performance of the sealant system.

B. Provide joints properly dimensioned to receive the approved sealant system.

1.7 WARRANTY

A. Furnish written warranties against adhesive and cohesive failure of the sealant and against infiltration of water and air through the sealed joint for a period of 3 years from date of substantial completion.
1. Manufacturer's standard warranty covering materials.
2. Installing Subcontractor's standard warranty covering workmanship.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Tremco.

B. Sonneborn.

C. Pecora.

D. Polyspec.

E. Or Equal.

2.2 SEALANTS

A. The sealant products listed are set as a standard of quality. Sealants of other manufacturers shall meet or exceed the characteristics of the products listed.

B. Provide colors selected by Engineer from manufacturer's standard color range.

C. Sealant Type B:
   1. For interior and exterior joints in vertical surfaces and non-traffic horizontal surfaces; such as:
      a. Control and expansion joints in concrete unit or brick masonry.
      b. Metal panel joints.
      c. Joints around frames of doors, windows, louvers, and other similar openings.
      d. Under metal thresholds.
      e. Joints in sheet metal flashings.
      f. Trim or finish joints.
   2. Single-component or multi-component, non-sag polyurethane sealant having 25% joint movement capability that is suitable for continuous immersion in water; comply with ASTM C920, Type S or M, Grade NS, Class 25.
   3. Acceptable Sealants:
      a. Tremco - Vulkem 116.
      b. Tremco – Dymeric 240/240FC

D. Sealant Type C:
   1. For interior and exterior joints in horizontal and sloped traffic surfaces; such as control, expansion, and isolation joints in concrete pavement and sidewalks.
   2. Single-component or multi-component polyurethane sealant having a Shore A hardness of not less than 25 or more than 50 and 25% joint movement capability that is suitable for continuous immersion in water; comply with ASTM C920, Type S or M, Grade P or NS, Class 25.
   3. Acceptable Sealants:
      a. Tremco - Vulkem 45/245.

E. Sealant Type I:
   1. Interior and exterior joints, excluding expansion joints, in concrete tanks containing domestic wastewater.
   2. Polysulfide sealant having a Shore A hardness of not less than 25 or more than 50 and 25% joint movement capability that is suitable for continuous immersion in water; comply with ASTM C920, Type S or M, Grade NS, Class 25.
   3. Joints shall be primed.
   4. Acceptable Primer:
      a. As recommended by sealant manufacturer.
   5. Acceptable Sealants:
      a. Pecora – Synthacalk GC2+
      b. Polyspec – Thiokol 2235M

2.3 ACCESSORIES

A. Joint Cleaner: As recommended by sealant manufacturer for substrates indicated.

B. Joint Primer: As recommended by sealant manufacturer for substrates, conditions and exposures indicated.

C. Bond Breaker: Polyethylene tape or other adhesive faced tape as recommended by sealant manufacturer to prevent sealant contact where it would be detrimental to sealant performance.

D. Joint Backer: Polyethylene foam rod or other compatible non-waxing, non-extruding, non-staining resilient material in dimension 25% to 50% wider than joint width as recommended by sealant manufacturer for substrates, conditions and exposures indicated.

E. Masking Tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces that is suitable for masking.

F. Premolded Joint Filler: Conform to requirements of Section 03300.

2.4 2.04 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the sealant manufacturer as compatible, subject to the approval of the Engineer.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which Work of this Section will be performed.
   1. Verify conformance with manufacturer's requirements.
   2. Report unsatisfactory conditions in writing to Engineer.
   3. Correct conditions detrimental to timely and proper completion of the Work.
   4. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Prepare surfaces to receive sealants in accordance with sealant manufacturer's instructions and recommendations except where more stringent requirements are indicated.

B. Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer whether primers are required or not.
   1. Remove all traces of previous sealant and joint backer by mechanical methods, such as by cutting, grinding and wire brushing, in manner not damaging to surrounding surfaces.
   2. Remove paints from joint surfaces except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.

3. Remove wax, oil, grease, dirt, film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.
4. Remove dust by blowing clean with oil-free, compressed air.

C. Provide joint backer material to depth required by sealant manufacturer for proper joint design.
1. Fit securely by compressing backer material 25% to 50% so no displacement occurs during tooling.
2. Avoid stretching or twisting joint backer.

D. Provide bond-breaker where indicated or recommended by sealant manufacturer, adhering strictly to the manufacturer's installation requirements.

E. Prime joint substrates where required.
1. Use and apply primer according to sealant manufacturer's recommendations.
2. Confine primers to sealant bond surfaces; do not allow spillage or migration onto adjoining surfaces.

F. Taping:
1. Use masking tape where required to prevent sealant or primer contact with adjoining surfaces that would be permanently stained or otherwise damaged by such contact or the cleaning methods required for removal.
2. Apply tape so as not to shift readily and remove tape immediately after tooling without disturbing joint seal.

G. Premolded Joint Fillers:
1. Where expansion joints having premolded joint fillers are scheduled to be sealed, provide a reservoir to accept the sealant such as by a molded breakaway joint cap or a removable block out.
2. Joint fillers that may contact the sealant should not be impregnated with oil, bitumen, non-curing polymers or similar contaminants.

3.3 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the Work of this Section.

B. Provide the approved sealant system where shown on the Drawings, and in strict accordance with the manufacturer's recommendations as approved by Engineer.

C. Install sealants immediately after joint preparation.

D. Mix and apply multi-component sealants in accordance with manufacturer's printed instructions.

E. Install sealants to fill joints completely from the back, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.

F. Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

G. Tool sealants in manner that forces sealant against back of joint, ensures firm, full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities.
   1. Dry tooling is preferred; tooling liquids that are non-staining, non-damaging to adjacent surfaces and approved by sealant manufacturer may be used if necessary when care is taken to ensure that the liquid does not contact joint surfaces before the sealant.
   2. Provide concave tooled joints unless otherwise indicated to provide flush tooling or recessed tooling.
   3. Provide recessed tooled joints where the outer face of substrate is irregular.

H. Remove sealant from adjacent surfaces in accordance with sealant and substrate manufacturer's recommendations as work progresses.

I. Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants, immediately, so that they are without contamination or damage at time of Substantial Completion.

END OF SECTION

SECTION 08100

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES
1. Steel doors
2. Steel door frames
3. Steel window frames

1.2 RELATED SECTIONS

A. Section 08710 – Door Hardware

1.3 REFERENCES

A. ANSI: American National Standards Institute

B. NFPA: National Fire Protection Association

C. ASTM: American Society for Testing and Materials

D. DHI: The Door and Hardware Institute

E. SDI: Steel Door Institute

1.4 SUBMITTALS

A. Product Data: For each type of door and frame indicated, include designation, type, level and model, material description, core description, construction details, label compliance, and finishes.

B. Shop Drawings:
1. Elevations of each door and frame design.
2. Details of doors including vertical and horizontal edge details.
3. Frame details for each frame type including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, accessories, joints, and connections.
7. Coordination of glazing frames and stops with glass and glazing requirements.

C. Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

D. Submit in accordance with Section 01340

1.5 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A250.8, unless more stringent requirements are indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Amweld Building Products, Inc.

B. Ceco Door Products

C. Curries Company

D. Kewanee Corporation

E. Steelcraft

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A568 or A569

B. Cold-Rolled Steel Sheets: ASTM A366

C. Metallic-Coated Steel Sheets: ASTM A 653, an A60 zinc-iron-alloy (galvannealed) coating,

2.3 DOORS

A. General: Provide doors of sizes, thicknesses, and designs indicated.

B. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 Full Flush.

C. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level:
   1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 Full Flush.

2.4 FRAMES

A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Frames of 0.053-inch thick steel sheet for:
   1. Level 2 steel doors.

C. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

D. Supports and Anchors:
   1. Fabricated from not less than 0.042-inch thick, electrolytic zinc-coated or metallic-coated steel sheet.
   2. Wall Anchors in Masonry Construction: 0.177-inch diameter, steel wire complying with ASTM A510 may be used in place of steel sheet.

E. Inserts, Bolts, and Fasteners: Manufacturer’s standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A153, Class C or D as applicable.

2.5 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Exterior Construction: For exterior locations and elsewhere as indicated, fabricate doors and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

C. Interior Construction: For interior locations, fabricate doors and frames from cold-rolled steel sheet or metallic-coated steel sheet.

D. Core Construction: Expanded polystyrene foam continuously bonded to steel skin.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.

F. Single-Acting, Door-Edge Profile: Square edge.

G. Tolerances: Comply with SDI 117.

H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

I. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

J. Hardware Preparation:
   1. Prepare doors and frames to receive mortised and concealed hardware according to door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
   2. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.

K. Frame Construction:
   1. Fabricate frames to shape shown.
   2. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
   3. Provide temporary spreader bars.

L. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.

M. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

N. Glazing Stops: Manufacturer's standard, formed from 0.032-inch thick steel sheet.
   1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
   2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

O. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.6 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

B. Final Finish: Conform to Section 09900. Color as elected by Owner

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames:
   1. Comply with provisions in SDI 105, unless otherwise indicated.
   2. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
   3. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
   4. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
   5. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
   6. Install fire-rated frames according to NFPA 80.
   7. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.

C. Door Installation:
   1. Comply with ANSI A250.8 unless otherwise indicated.
   2. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8.
   3. Install Fire-Rated doors within clearances specified in NFPA 80.
   4. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 08331

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Electrically operated door assemblies including insulated door curtains, guides, counterbalance mechanism, hardware, operators, and installation accessories.

1.2 REFERENCES

A. NEMA: National Electrical Manufacturer’s Association

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
1. Wind Loading: Design and reinforce overhead coiling doors to withstand 20 pounds per square foot wind loading pressure unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead coiling door.

B. Shop Drawings: Submit Shop Drawings for special components and installations not fully dimensioned or detailed on manufacturer's data sheets.

C. Miscellaneous:
1. Provide setting drawings, templates, instructions, and directions for installation of anchorage devices.

D. Operation and Maintenance (O&M) Data:

E. Submit in accordance with Section 01340.

1.5 QUALITY ASSURANCE

A. Furnish overhead coiling door as complete unit produced by one manufacturer, including hardware, accessories, mounting, and installation components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Cookson Company

B. Overhead Door Corporation

C. Cornell Iron Works

D. Or accepted substitution

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtain:
   1. Fabricate overhead coiling door curtain of interlocking insulated slats.
   2. Design to withstand required wind loading of continuous length for width of door without splices.
   3. Unless otherwise indicated, provide slats of material gauge recommended by door manufacturer for size and type of door required, and as follows.

      a. Galvanized Steel Door Curtain Slats: Furnish with powder coated finish.
         i) Furnish manufacturer's standard double wall, "S"-configuration, flat slats with foamed in place urethane insulation.

B. Endlocks:
   1. Malleable iron castings, galvanize after fabrication, and secure to curtain slats with galvanized rivets.
   2. Provide locks on alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar:
   1. Consists of two angles, each not less than 1-1/2 inch by 1-1/2 inch by 1/8 inch thick, galvanized or stainless steel, or aluminum extrusions to suit type of curtain slats.
   2. Provide replaceable gasket of flexible vinyl or neoprene between angles as weather seal and cushion bumper.

D. Automatic Reversing Control:
   1. Furnish each door with an electric operator with an automatic safety switch, extending full width of door bottom and located within neoprene or rubber astragal mounted to bottom door rail. Contact with switch will immediately reverse downward door travel.

E. Curtain Jamb Guides:
   1. Fabricate curtain jamb guides of steel angles or channels and angles with sufficient depth and strength to support curtain loading.
   2. Build-up units with minimum 3/16 inch thick steel sections, galvanize after fabrication.
   3. Slot bolt holes for track adjustment.
   4. Secure continuous wall angle to wall framing by 3/8 inch minimum bolts at not more than 30 inch on center, unless closer spacing recommended by door manufacturer.
   5. Extend wall angles above door opening head to support coil brackets, unless otherwise shown.
   6. Place anchor bolts on exterior wall guides so they are concealed when door is in closed position.

7. Provide removable stops on guides to prevent over-travel of curtain and continuous bar for holding windlocks, if any.

F. Weather Seals:
1. Provide vinyl or neoprene weatherstripping for exterior exposed doors.
2. At door heads, use 1/8 inch thick continuous sheet secured to inside of curtain coil hood.
3. At door jambs, use 1/8 inch thick continuous strip secured to exterior side of jamb guide.

2.3 COUNTERBALANCING MECHANISM

A. Counterbalance doors by means of adjustable steel helical torsion spring, mounted around steel shaft, mounted in spring barrel, and connected to door curtain with required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel:
1. Fabricate spring barrel of hot-formed structural quality carbon steel, welded or seamless pipe, of sufficient dia and wall thickness to support roll-up of curtain without distortion of slats and limit barrel deflection to not more than 0.03 inches per foot of span under full load.

C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast steel barrel plugs to secure ends of springs to barrel and shaft.

D. Torsion Rod for Counterbalance Shaft:
1. Fabricate of case-hardened steel or required size to hold fixed spring ends and carry torsional load.

E. Brackets:
1. Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate with bell mouth guide groove for curtain.

F. Hood:
1. Form to entirely enclose coiled curtain and operating mechanism at opening head, and act as weather seal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets required to prevent sag.
2. Fabricate aluminum hoods for aluminum doors of Alloy 3003 aluminum sheet not less than 0.032 inches thick, mill finish.

2.4 PAINTING

A. Shop clean and prime ferrous metal and galvanized surfaces, exposed and unexposed, except faying and lubricated surfaces, with door manufacturer's standard rust-inhibitive primer.

B. Door Curtain Finish: Powder coat by manufacturer, color selected by Owner from full range of manufacturer’s options.

C. Finish paint other door components in accordance with Section 09960.

2.5 MANUAL DOOR OPERATORS

A. Provide manual operators except where electric door operators indicated. Provide chain hoist manual operator unit.

B. Manual Operation:
   1. Design counterbalance mechanism so required pull for door operation does not exceed 25 pounds.
   2. Adjust operating mechanism so curtain can be easily stopped at any point in its travel and remain in position until movement reactivated.
   3. Provide galvanized steel lifting handle and slide bolt lock on inside bottom bar.

2.6 ELECTRIC DOOR OPERATORS

A. The door shall be operated at a speed of 2/3 foot per second by an electric motor with gear reducer in oil bath.

B. The motor operator shall include a geared limit switch an electrically interlocked emergency chain operator.

C. The motor starter shall be housed in a NEMA 4x housing and include a magnetic reversing starter size O, a 24 volt control transformer, and complete terminal strip to facilitate field wiring.

D. The motor operator shall be activated by a 3 button push-button station in a NEMA 4x enclosure.

E. The motor shall be sized as required by the door, 115 volt single phase, 1 horsepower maximum or as required by site power. Contractor to coordinate.

F. The motor operator shall be mounted to the door bracket as shown.

G. All motor operator components shall be U.L. listed.

2.7 INSERTS AND ANCHORAGES

A. Furnish inserts and anchoring devices which must be set in concrete or built into masonry for installation of units.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports in accordance with Shop Drawings, manufacturer's instructions, and as specified herein.

3.2 ADJUSTING

A. Upon completion of installation, including Work by other trades, lubricate, test, and adjust doors to operate easily, free from warp, twist of distortion, and fitting weathertight for entire perimeter.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Hardware for steel doors.

1.2 RELATED SECTIONS

A. Section 08100 Steel Doors and Frames

1.3 REFERENCES

A. NEMA: National Electrical Manufacture's Association

1.4 QUALITY ASSURANCE

A. Manufacturers: Companies specializing in manufacturing door hardware with minimum three years experience.

1.5 SUBMITTALS

A. Shop Drawings.

B. Product Data.

C. Submit in accordance with Section 01340.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify package with door opening code to match hardware schedule.

B. Protect hardware from theft by cataloging and storing in secure area.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Locksets.
   1. Privacy Lockset x lever action x stainless steel x US 32D x removable core x Box Strike.
      a. L9040 x 03 Schlage
      b. 8802 x CRE Yale

c. ML2020 x LSM Corbin Russwin
d. 4840 x William Hager

2. Office Lockset x lever action x stainless steel x US 32D x removable core x Box Strike.
   a. L9050 x 03 Schlage
   b. 8807 x CRE Yale
   c. ML2051 x LSM Corbin Russwin
   d. 3850 x William Hager
3. Storeroom Lockset x lever action x stainless steel x US 32D x removable core x Box Strike.
   a. L9080 x 03 Schlage
   b. 8805 x CRE Yale
   c. ML2057 x LSM Corbin Russwin
   d. 3880 x William Hager
4. Passage Set x lever action x stainless steel x US 32D x removable core x Box Strike.
   a. L9010 x 03 Schlage
   b. 8801 x CRE Yale
   c. ML2010 x LSM Corbin Russwin
   d. 3810 x William Hager
5. Entrance Lockset x lever action x stainless steel x US 32D x removable core x Box Strike.
   a. L9453 x 03 Schlage
   b. 8847 x CRE Yale
   c. ML2048 x LSM Corbin Russwin
   d. 3853 x William Hager
6. Dummy Trim Lockset x lever action x stainless steel x US 32D. Do not provide lever on inside face.
   a. L9176 x 03 Schlage
   b. CRE Yale
   c. LSM Corbin Russwin
   d. 3827 x William Hager

B. Exit Devices: Rim type x stainless steel x US 32D. Provide compatible F08 heavy duty exit device trim for exterior doors and compatible passage type exit device trim for interior doors.
   1. Single doors:
      a. ED5200 Corbin Russwin
      b. 8300 Adams Rite

C. Hinges x 4-1/2 x 4-1/2 x US 32D.
   a. BB 1191 Hager
   b. FBB 191 Stanley
   c. BB 4101 Lawrence

D. Continuous gear hinge, full length of door, color to match door.

E. Closers x delayed action x AL - size as recommended by manufacturer. Install closers on room side, using parallel arms where necessary.

a. DC6000 Series — Corbin Russwin
b. 4010 / 4110 Smoothee Series — LCN
c. 7500 Series — Norton
d. 5100 Series — Hager

HO - indicates hold open

F. Kick Plates – 10 inch x 2 inch LDW x US 32D x 16GA.
1. Brookline
2. Ives
3. Hiawatha
4. Rockwood

G. Thresholds - set in sealant 5 inch x 1/2 inch Clear Anodized Aluminum Thermally Broken Saddle x frame width.
1. S282A x AL — Reese
2. 252 x 3AFG x AL — Pemko
3. 8425 x AL — National Guard
4. 421S x AL — Hager

H. Door Bottom - Mill Aluminum with thermoplastic rubber.
1. DB594AU — Reese
2. 222APK — Pemko
3. 15NA — National Guard
4. 779SNMIL — Hager

I. Weatherstrip – Clear Anodized Aluminum.
1. DS 69C — Reese
2. 110 NA — National Guard
3. 332 CR — Pemko
4. 873SNMIL — Hager

J. Wall Stops x Concealed Fasteners.
1. 406/407 x convex — Ives
2. 406 — Rockwood

K. Flush Bolts with Dustproof Strike long enough to pass through threshold.
1. FB458 x 26D — Ives
2. 0600 x 26D — Baldwin
3. 555 x 26D — Rockwood
4. 282D x 26D — Hager

L. Overhead Stop – Hold Open.
1. 70H x 26D — Glynn Johnson

M. Astragals x Full Height Door - Clear Anodized Aluminum with thermoplastic rubber.
1. Doors with one active leaf:
a. 158NA — National Guard
b. 355CS — Pemko

2.2 KEYING

A. Key in accordance with schedule provided by Owner.

B. Supply 5 keys for each lock.

C. Cylinder locks on doors to match existing master keying.

2.3 FINISHES

A. Manufacturer responsible for surface preparation and priming. Finish coating of doors either in plant or field. System shall comply with Section 09960, refer to Schedule. Coordinate finish color with Engineer.

B. Finishes are US 32 satin stainless steel unless otherwise noted. Closer finishes may be paint.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions.

B. Use the templates provided by hardware item manufacturer.

3.3 HARDWARE SCHEDULE

A. Set No. 1.
1-1/2 PR Butts
1 Exit Device
1 Closer
2 Kickplates
1 Wall Stop or Floor Stop

B. Set No. 2.
1-1/2 PR Butts x NRP
1 Entrance Lockset
1 Closer x 110 degrees x HO
1 Kickplate
1 Weatherstripping
1 Door Bottom
1 Threshold

C. Set No. 3.
   1-1/2 PR Butts x NRP
   1 Exit Device
   1 Closer x 110 degrees x HO
   1 Kickplate
   1 Weatherstrip
   1 Door Bottom
   1 Threshold

END OF SECTION

SECTION 08800

GLASS AND GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Exterior windows.
   2. Exterior and Interior doors.
   3. Interior windows.

1.2 REFERENCES

A. ASTM: American Society for Testing and Materials

B. ANSI: American National Standards Institute

1.3 QUALITY ASSURANCE

A. Safety Glass: Comply with ANSI Z97.1, with label on each piece.

B. Safety Glazing Materials Act.

1.4 SUBMITTALS

A. Manufacturer's Data, Glass:
   1. Manufacturer's specifications and installation instructions for each type of glass required.
   2. Include test data substantiating that glass complies with specified requirements.

B. Manufacturer's Data, Glazing Materials:
   1. Manufacturer's specifications and installation instructions for each type of glazing sealant and compound, gasket and associated miscellaneous material. Include manufacturer's published data, or letter of certification, or certified test laboratory report indicating that each material complies with the project specifications and is suitable for the applications shown.

C. Samples, Glass:
   1. Submit 3, samples of each type of glass specified.
   2. Insulating glass samples need not be hermetically sealed, but edge construction shall be included.

1.5 JOB CONDITIONS

A. Weather Conditions: Do not proceed with installation of liquid sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.

1.6 GUARANTEES

A. Insulating Glass: Provide manufacturer's ten year warranty against seal separation.

PART 2 PRODUCTS

2.1 GLASS TYPES

A. Type G2: 1/4 inch thick, clear tempered float glass.

B. Type G5: 1 inch thick overall insulating glass units, with makeup of 1/4 inch annealed float outboard glass, 1/2 inch thick dead air space, and 1/4 inch clear annealed float inboard glass with clear pyrolitic low-emissivity coating on #3 surface within unit.

2.2 GLAZING SEALANTS/COMPOUNDS

A. Preformed Butyl Rubber Glazing Sealant:
   1. Tape or ribbon (coiled on release paper) of polymerized butyl, of mixture of butyl and polyisobutylene, compounded with inert fillers and pigments, solvent based with minimum of 95% solids, with thread of fabric reinforcement, tack-free within 24 hours, paintable, non-staining.
   2. Provide combination tape and encased continuous rubber shim, of approximately 50 durometer hardness.
   3. Any caulkings or window sealants which come in contact with the insulating glass sealants are to be compatible.

2.3 GLAZING GASKETS

A. Provide glazing gaskets recommended by manufacturer.

B. Molded Neoprene Glazing Gaskets:
   1. Molded or extruded neoprene gaskets or profile and hardness shown for watertight construction; comply with ASTM D2000 designation 2BC 415 to 3BC 620, black.

C. Polyvinyl Chloride Glazing Gaskets:
   1. Extruded, flexible PVC gaskets of the profile and hardness shown; when not shown, for watertight construction comply with ASTM D2287.

D. Vinyl Foam Glazing Tape:
   1. Closed cell, flexible, self adhesive, non-extruding, polyvinyl chloride foam tape; recommended by manufacturer for exterior, exposed, watertight, installation of glass, with only nominal pressure in the glazing channel, comply with ASTM D1667.

2.4 MISCELLANEOUS GLAZING MATERIALS

A. Setting Blocks: Neoprene, 70-90 durometer hardness, with proven compatibility with sealants used.

B. Spacers: Neoprene 40-50 durometer hardness, with proven compatibility with sealants used.

C. Compressible Filler Rod: Closed cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 510 pounds per square inch compression strength for 25% deflection.

D. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing will be performed, and notify the Architect/Engineer in writing of all conditions detrimental to the proper and timely completion of the work. Do not proceed with the glazing until unsatisfactory conditions have been corrected in a manner acceptable to the Architect.

3.2 JOB REQUIREMENTS

A. Provide watertight and airtight installation of each piece of glass. Each installation shall withstand normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

B. Protect glass from edge damage at all times during handling, installation and operation of the building.

C. Glazing channel dimensions shown provide for a minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. Be responsible for correct glass size for each opening, within the tolerances and dimensions established.

D. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturer's technical representative direct otherwise.

E. Comply with "Glazing Manual" by Flat Glass Marketing Associating except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.

F. Inspect each piece of glass immediately before installation, and eliminate all which have observable edge damage or face imperfections.

G. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other pieces.

3.3 PREPARATION FOR GLAZING

A. Clean the glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

3.4 GLAZING

A. Comply with ANSI Standard Z97.1-1975 Safety Glazing Code.

B. Install setting blocks of proper size at quarter points of sill rabbet. Set blocks in thin course of the heelbead compound.

C. Glazing shall be set with equal bearing for entire width.

D. Provide spacers inside and out, and of proper size and spacing, for all glass sizes larger than 50 united inches, except where gaskets are used for glazing. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

E. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in the channels at the heel of jambs and bead (do not leave voids in the sill channels) except as otherwise indicated, depending on light size, thickness and type of glass, and complying with manufacturer's recommendations.

F. Do not attempt to cut, seam, nip or abrade glass which is chemically strengthened, tempered, or heat strengthened.

G. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

H. Tool exposed surfaces of glazing liquids and compounds to provide a substantial "wash" away from the glass. Install pressurized tapes and gaskets to protrude slightly out of the channel to eliminate dirt and moisture pockets.

I. Clean and trim excess glazing materials from the glass and stops or frames promptly after installation, and eliminate stains and discolorations.

J. Where wedge shaped gaskets are driven into one side of the channel to pressurize the sealant or gasket on the opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to dynamic movement. Anchor gasket to stop with matching ribs, or by proven adhesive, including embedment of gasket tail in cured heel bead.

3.5 CURE, PROTECTION AND CLEANING

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

B. Protect exterior glass from breakage immediately upon installation by attachment of crossed streamers to framing held away from glass. Do not apply markers of any type to surfaces of glass.

C. Remove and replace glass which is broken, chipped, cracked, abraded, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

D. Maintain glass in a reasonably clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by washoff) to the deterioration of glazing materials and other work.

E. Wash and polish glass on both faces not more than four days prior to acceptance of the work in each area. Comply with glass manufacturer's recommendations. Washing shall be done by professional firm.

END OF SECTION

SECTION 09900

COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Coating of surfaces as noted on the Drawings and as specified herein, including:
   1. New surfaces described in Finish Schedules and notes on Drawings.
   2. Interior masonry wall surfaces.
   3. Exposed interior and exterior ferrous metal, ductile iron, or cast iron piping, regardless of factory-applied finish.
   4. Exposed interior and exterior structural steel surfaces.
   5. Exterior and interior equipment, pumps, valves, motors, etc. and all appurtenances.
   6. Color-coded equipment and piping above ceilings.
   7. Concrete tank and channel surfaces only where noted on drawings.
   8. Copper piping and galvanized steel piping and conduit mounted to painted surfaces.
   9. Exposed interior and exterior galvanized steel conduit and supports.
   10. Steel doors and frames.
   11. Existing surfaces remodeled or damaged during construction which presently have a finish. Refinish surrounding areas as required so touch-up not visible from 6 ft away.
   12. Existing surfaces exposed by removals where adjacent surface has a finish. Finish areas as required so touch-up not visible from 6 feet away.

B. Labeling and directional arrows on piping, equipment, valves, and ducts whether coated or not coated is specified in Section 01080.

C. Do not coat the following unless specifically noted otherwise:
   1. Factory-finished electrical motor control panels (MCC), main instrument panels (MIP), flow indicators, and related equipment.
   2. Moving parts of operating units, electrical parts, linkages, sensing devices, and motor shafts.
   3. Buried equipment and piping.
   4. Surfaces above ceilings.
   5. Factory-finished trim.
   6. Stainless steel, chrome plate, copper, bronze, galvanized surfaces, and similar finished materials.
   7. Aluminum ductwork or aluminum faced insulation.
   8. Aluminum louvers and trim.
   9. Concrete tanks.
   10. Plastic and FRP piping, equipment, and ductwork.

D. Do not coat over any code-required labels such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

E. Equipment manufacturers are responsible for surface preparation and coating of equipment, motors, and appurtenances. Equipment to be coated and coating system is identified in the equipment specification sections.

1.2 DEFINITIONS

A. Definitions as used in Coating Schedule included herein.
   1. Coatings: Paint or heavy duty finishes for use on surfaces subject to interior and exterior exposure, submergence, high moisture, splash, or chemical environment, including primers, sealers, fillers, and intermediate and finished coats.
   2. Submerged P: Surfaces submerged in potable water plus 1 foot-6 inches above high water level.
   3. Submerged NP: Surfaces submerged in non-potable liquid plus 1 foot-6inches above high liquid level.
   4. First Coat: Field primer, factory primer, or shop primer. When only one coat is required, first coat is the finished coat.
   5. Second, Third, or Intermediate Coats: Successive finished coats applied over first coat.
   6. DFT: Dry film thickness (mils/coat).
   7. sfpg: Square feet per gallon (per coat).

1.3 REFERENCES

A. MSDS: Material Safety Data Sheets

B. ASTM: American Society for Testing and Materials

C. SSPC: The Society for Protective Coatings

D. OSHA: Occupational Safety and Health Administration

E. NSF: National Sanitation Foundation

1.4 SUBMITTALS

A. Product Data:
   1. Manufacturer’s literature including application recommendations and generic makeup for each coating scheduled.
   2. Factory or shop-applied primer manufacturer’s literature including application recommendations and generic makeup shall be submitted with all material and equipment submittals. All primers shall conform to the requirements of this Section.

B. Samples:
   1. Actual color samples available for each coating scheduled.

C. Miscellaneous:
   1. Schedules:
      a. Schedule of proposed coating systems within 60 days after Notice to Proceed.

b. Schedule of proposed coating systems shall contain all information as indicated in Coating Schedule included herein.

2. Submit one copy of manufacturer's MSDS, for each type of coating, to Engineer's field office for information. Contractor shall post copy of MSDS on Site at all times coating is in progress.

D. Submit in accordance with Section 01340.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. All coatings shall conform to OSHA requirements for allowable exposure to lead and other hazardous substances.
2. All coatings in contact with potable water or within potable water reservoirs shall be NSF 61 approved.

B. Applicator Qualifications:
1. Engage an experienced field applicator with a minimum of 5 yrs successful experience and who has successfully completed coating system applications similar in material and extent to those indicated.

C. Single-Scource Responsibility:
1. Provide coating material produced by same manufacturer for each system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to site in original containers with labels intact and seals unbroken.

B. Protect and heat or cool material storage location to maintain temperature ranges recommended by coating manufacturers, but not less than 55° F.

C. Avoid danger of fire. Oily rags and waste must be removed from buildings each night or kept in appropriate metal containers. Provide fire extinguishers of type recommended by coating manufacturer's in areas of storage and where finishing is occurring. Allow no smoking or open containers of solvent.

D. Empty containers shall have labels canceled and clearly marked as to use.

1.7 PROJECT / SITE CONDITIONS

A. Environmental Requirements:
1. Dry-heat and ventilate areas to obtain conditions recommended by coating manufacturer.
2. Relative humidity conditions as specified by coating manufacturer shall be adhered to.
3. No unprotected, unheated exterior coating shall be undertaken when cold, damp, foggy, or rainy weather appears probable, nor when the temperature of the substrate is below 55° F, unless approved in writing by coating manufacturer.

4. Maintain manufacturer's environmental requirements until coating is fully cured.
5. Apply no coating in areas where dust is being generated.
6. Testing and disposal of any waste and coating shall be the responsibility of the Contactor.

B. Protection:
1. Drop cloths shall be provided in all areas where coating is done to fully protect other surfaces.
2. Remove hardware, accessories, plates, lighting fixtures, and similar items or provide protection by masking. Upon completion, replace items or remove protection and clean.

C. It is the intent of this Section that all ferrous metal items scheduled for coating be shop-primed. If items are not shop-primed, surfaces shall be prepared and coated in the field as specified.

D. Upon Substantial Completion, remaining unused material will become property of Owner. Seal material as required for storage, mark contents with color, type, location, and shelf life, and store on Site where required by Owner. Provide minimum of two gallons of each system component and color used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tnemec.

B. Sherwin Williams.

2.2 MATERIALS

A. Coatings shall meet surface burning characteristics as required by code and established by ASTM E84.

B. Coating products of Tnemec or Sherwin Williams, listed in the Coating Schedule, are set as a standard of quality. Coatings of substitute manufacturers shall meet or exceed the characteristics of the products listed as established by the following ASTM standards; B117, C307, C413, C579, C580, C868, D870, D1014, D1653, D2047, D2240, D2370, D2794, D3363, D4060, D4141, D4541, D4585, D4587, and G85.

C. If the Contractor wishes to offer a substitute to the Tnemec or Sherwin Williams products specified, the request for a substitute shall conform to the requirements of Section 01615.

D. The Contractor and top coat coating manufacturer shall verify the compatibility of their products with the various primers used on shop primed materials and equipment.

2.3 COLORS

A. Color shall be formed of pigments free of lead, lead compounds, or other materials which might be affected by presence of hydrogen sulfide or other gases likely to be present at Site.

B. Colors shall be as selected by Owner. System color-coding shall be as specified in Section 01080.

C. Coat access doors of electrical distribution panels and grilles to match color of adjacent wall or ceiling surfaces.

D. In areas scheduled for finishing, coat exposed piping, conduit, and ducts to match color of adjacent or near surfaces, except for color-coding.

E. In areas where existing surfaces are finished, coat new exposed piping, conduit, and ducts to match color of adjacent or near surfaces, except for color-coding.

F. Equipment Colors:
   1. Equipment includes pumps, blowers, valves, flow meters, etc, and associated motors, structural supports, hangers, and attached portions of electrical conduit, and other associated components.
   2. Color of non-submerged equipment, including equipment with a manufacturer-applied finish coat, shall be same color as piping equipment serves; see Section 01080.
   3. Color of submerged equipment can be manufacturer's standard color.

2.4 THINNING, MIXING, AND TINTING

A. Where thinning is necessary, only the products of the manufacturer furnishing the coating will be allowed. All such thinning shall be done in strict accordance with coating manufacturer's recommendations.

B. Mix in accordance with manufacturer's recommendations.

C. Each coat shall be slightly darker than preceding coat, unless otherwise noted. Tint undercoats similar to finish coat.

PART 3 PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine the areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Materials removed and replaced to correct defects due to Work placed on unsuitable surfaces shall be at Contractor's expense.

3.2 SURFACE PREPARATION

A. All surfaces to be coated shall be prepared as specified herein and in accordance with coating manufacturer's recommendations. The object shall be to obtain a uniform, clean, and dry surface.

B. Quality of surface preparation described herein is considered a minimum. If coating manufacturer requires a higher degree of preparation, comply with coating manufacturer's recommendations.

C. Where surface dryness is questioned, test with dampness indicating instrument. Do not apply coatings over surfaces where moisture content exceeds that permitted by coating manufacturer.

D. Shop primed surfaces shall be scarified before applying top coats. Conform to top coat manufacturers recommendations.

E. If recoat time between application of primer and second coat or between top coats is exceeded, scarify surface before applying coatings. Conform to top coat manufacturers recommendations.

F. Workmanship for surface preparation shall conform to the following SSPC specifications:
   a. Solvent Clean: SP-1.
   b. Hand Tool Cleaning: SP-2.
   c. Power Tool Cleaning: SP-3.
   d. White Metal Blast Cleaning: SP-5.
   e. Commercial Blast Cleaning: SP-6.
   f. Brush-Off Blast Cleaning: SP-7.
   g. Pickling: SP-8.
   h. Near-White Blast Cleaning: SP-10.
   i. Power Tool Cleaning to Bare Metal: SP-11.
   j. Surface Preparation by Water Jetting: SP-WJ-1.
   k. Surface Preparation of Concrete: SP-13.
   l. Industrial Blast Cleaning: SP-14.
   m. Commercial Grade Power Tool Cleaning: SP-15.
   n. Brush-Off Blast Cleaning of Non-Ferris Metals: SP-16

G. Ferrous Metal:
   1. Ferrous metal primed in the shop shall have all rust, dust, scale, and other foreign substances removed by abrasive cleaning conforming to SSPC SP-10. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
   2. Ferrous metal not primed in the shop shall be abrasive blast cleaned in the field prior to application of primer, pretreatment, or coating. Blast cleaning shall conform to SSPC
      SP-10 for submerged service. Blast cleaning shall conform to SSPC SP-6 for non-submerged service.

3. Prior to finish coating, primed areas that are damaged shall be cleaned and spot primed.

H. Concrete:
1. Concrete must be at least 28 days old and shall pass the overnight visqueen test for dryness before applying coating. Test for moisture in accordance with ASTM D4263.
2. Remove fins and other protrusions by grinding.
3. Repair surface defects/voids as recommended by coating manufacturer.
4. Concrete surfaces, including precast concrete, to be coated shall be cleaned of all form oil, curing compound, laitenance, and other foreign substances.
5. Surfaces shall be brush-off abrasive blast cleaned in accordance with SSPC-SP13/NACE 6 Surface Preparation of Concrete in order to remove laitance and efflorescence and to prepare the surface for adherence of the coating system. Acid etching will be allowed only where brush blasting is impractical. The following surface profiles are required:
   a. System No. 2, 3, 4, 5, 6 and 26 – ICRI CSP2-4
   b. System No. 6 ALT, 21, 29, 30, and 31 – ICRI CSP3-5
   c. System No. 24 and 28 – ICRI CSP4-6
6. After cleaning, surfaces shall be washed and all dust, sand, and loose particles removed by vacuuming. If Contactor elects to blow off the surfaces with air, it shall be oil-free air and the method shall conform to OSHA requirements.
7. Verify that pH of cleaned concrete surfaces to be coated is within range of 9 to 11. Application of coating materials outside this range will not be permitted without written approval from Engineer.

I. Galvanized Metal:
1. Where galvanized metal items are not submerged or buried, they shall be abrasive sweep blast cleaned per SSPC SP-16 and then solvent cleaned in accordance with SSPC SP-1.

J. Copper:
1. Where copper piping is not submergerd or buried, surfaces shall be scarified and then solvent cleaned in accordance with SSPC SP-1.

K. Masonry:
1. All masonry shall be aged a minimum of 28 days before application of coatings.
2. Remove loose grit and mortar.
3. Remove grease, oil, dirt, salts, or other chemicals, or other foreign substances by solvent, detergent, or other suitable cleaning methods.

L. Existing Surfaces:
1. Remove and replace or mask attachments if attachments are not to be coated.
2. Remove surface contamination such as oil, grease, loose or defective coatings, mill scale, dirt, rust, mold, mildew, mortar, efflorescence, and sealers to assure sound bonding to tightly adhered old coatings. Glossy surfaces of old coatings shall be cleaned and dulled before overcoating.
3. Sand surfaces and feather edges where chips have occurred.
4. Cut out and fill cracks or other defects to match adjacent surface.

5. Exact nature of existing coatings is not known. Check compatibility of new coating by application to small area prior to starting coating. If lifting or other problems occur, notify Engineer for direction.
6. Comply with new coating manufacturer's recommendations for preparation of previously coated surfaces.
7. Prepare surfaces subject to submerged service as specified for new surfaces.

3.3 APPLICATION

A. Surfaces shall be dry at time of application.

B. The minimum surface temperature shall be 55°F and rising. Some coatings are modified so that they may be applied at lower temperatures, conform to manufacturer's recommendations.

C. Apply in strict accordance with manufacturer's recommendations by brush, roller, spray, or other application method. The number of coats and thickness required is the same regardless of application method.

D. Each coat shall be allowed to dry in accordance with manufacturer's requirements. Drying time shall be construed to mean "under normal conditions". Where conditions other than normal exist, because of weather or because of confined space, longer times will be necessary. Units shall not be put in service until coatings are thoroughly dry and cured.

E. Surfaces to be coated that will be inaccessible in the completed work shall receive the final coat before enclosure.

F. Coatings shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Areas cut-in by brush prior to rolling shall have uniform appearance in comparison with adjoining surfaces.

G. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.

H. Concrete block walls shall be back-rolled in conjunction with application of sprayed prime coat.

I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of field applied prime coat or intermediate coat. This includes, but is not limited to: between pipe flanges, pipe flange/barrel joints, equipment fittings, and other narrow openings.

J. Finish edges of doors as specified for faces. Apply first finish coat on edges before fitting. After doors fitted and hung apply second finish coat.

K. Manufacturer-Applied Coatings:

1. Repair abraded areas on factory-finished items in accordance with equipment manufacturer's recommendations.
2. Blend repaired areas into original finish.

3.4 FIELD QUALITY CONTROL

A. Examination of Work on Site by coating manufacturer's representative shall be performed when requested by Engineer.

B. Sampling of Materials:
1. Engineer reserves the right to select unopened containers of materials furnished for the Project and have the materials tested at an independent laboratory. Owner will pay for first tests.
2. Retests of rejected materials and tests of replacement materials shall be paid for by Contractor.
3. Remainder of contents of containers not required for testing will be returned to Contractor.

C. Coverage:
1. 1. Before beginning Work, finish one complete room, space, surface, and item of each color scheme required, showing selected colors, finished texture, material, and workmanship. After approval, sample room, space, surface, and item shall serve as standard for similar Work.
2. 2. If coverage is not acceptable to Engineer, Engineer reserves the right to require additional application of coating at no extra cost to Owner.

D. Where coatings are to be applied at the Site, Engineer reserves the right to observe the Work. After surface has been prepared and before application of specified prime coat and each succeeding finish coat, Contractor shall provide three days notice to Engineer to allow the Engineer time to observe the Work. If notification is not provided, no credit for applied coat will be given and Contractor automatically assumes responsibility to recoat Work in question. Surfaces coated without notification shall be abrasive blast cleaned, re-prepared, and recoated at no addition cost to Owner.

3.5 FINAL TOUCH-UP AND CLEANING

A. Prior to Substantial completion, examine coated surfaces and retouch or refinish surfaces to leave in condition acceptable to Engineer.

B. Remove masking, coatings, and other material from floors, glass, and other surfaces not scheduled to be coated.

3.6 COATING SCHEDULE

A. Scheduled thickness or coverage rate is minimum as recommended by Tnemec. If other manufacturer is used, manufacturer's recommendations shall be followed, but in no case shall the thickness or coverage rate be less than scheduled.

B. Coatings shall conform to the following schedule and coating manufacturer's recommendations. Examples of surfaces to be coated may not be all inclusive.

COATINGS SCHEDULE

System No.	Application	Tnemec Coating System	Sherwin Williams Coating System
1	Interior Concrete Block Walls / Satin	First Coat – Series 130 Envirofill @ 90 sfpg, sprayed and backrolled Second Coat – Series 66HS @ 130 sfpg Third Coat – Series 66HS @ 140 sfpg	First Coat – Macropoxy 646 @ 90 sfpg, sprayed and backrolled Second Coat – Macropoxy 646 @ 130 sfpg Third Coat – Macropoxy 646 @ 140 sfpg
7	Ferrous Metal, Cast Iron, Ductile Iron / Submerged NP / Satin	First Coat – Series 1 @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Series 66HS @ 5 mils DFT Third Coat – Series 66HS @ 5 mils DFT	First Coat – Corothane I Mio-Zinc @ 3 mils DFT, touch-up primer prior to second coat Second Coat – DuraPlate 235 @ 5 mils DFT Third Coat – DuraPlate 235 @ 5 mils DFT
7 ALT	Ferrous Metal, Cast Iron, Ductile Iron / Submerged NP	First Coat – Series 1 @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Series 446 @ 7-9 mils DFT Third Coat – Series 446 @ 7-9 mils DFT	First Coat – Corothane I Mio-Zinc @ 3 mils DFT, touch-up primer prior to second coat Second Coat – DuraPlate 235 @ 7-9 mils DFT Third Coat – DuraPlate 235 @ 7-9 mils DFT
8	Ferrous Metal, Cast Iron, Ductile Iron / Interior Non-Submerged / Satin	First Coat – Series 1 @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Series 66HS @ 5 mils DFT Third Coat – Series 66HS @ 5 mils DFT	First Coat – Corothane I Mio-Zinc @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Macropoxy 646 @ 5 mils DFT Third Coat – Macropoxy 646 @ 5 mils DFT
9	Ferrous Metal, Cast Iron, Ductile Iron / Exterior Non-Submerged / Gloss	First Coat – Series 1 @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Series 66HS @ 5 mils DFT Third Coat – Series 1074U @ 3 mils DFT	First Coat – Corothane I Mio-Zinc @ 3 mils DFT, touch-up primer prior to second coat Second Coat – Macropoxy 646 @ 5 mils DFT Third Coat – Acrolon 218 HS Polyurethane Gloss @ 3 mils DFT
10	Doors, Frames, Motors and other Equipment with Non-Epoxy Primer / Interior / Satin	Lightly Hand Sand Solvent Clean SP-1 First Coat – Series 27-1255 Beige @ 3 mils DFT Second Coat – Series 66HS @ 5 mils DFT	Lightly Hand Sand Solvent Clean SP-1 First Coat – Recoatable Epoxy Primer Tan @ 3 mils DFT Second Coat – Macropoxy 646 @ 5 mils DFT
11	Doors, Frames, Motors and other Equipment with Non-Epoxy Primer / Exterior / Gloss	Lightly Hand Sand Solvent Clean SP-1 First Coat – Series 27-1255 Beige @ 3 mils DFT Second Coat – Series 1074U @ 3 mils DFT	Lightly Hand Sand Solvent Clean SP-1 First Coat – Recoatable Epoxy Primer Tan @ 3 mils DFT Second Coat – Acrolon 218 HS Polyurethane Gloss @ 3 mils DFT
15	Plaster, Gypsum Board / Satin	First Coat – Series 51-792 @ 225 sfpg Second Coat – Series 66HS @ 350 sfpg Third Coat – Series 66HS @ 350 sfpg	First Coat – ProMar 200 Zero VOC Primer @ 225 sfpg Second Coat – Macropoxy 646 @ 350 sfpg Third Coat – Macropoxy 646 @ 350 sfpg

System No.	Application	Tnemec Coating System	Sherwin Williams Coating System
19	Ferrous Metal, Cast Iron, Ductile Iron / Interior & Exterior / High Temperature to 1200°F	SP-10 First Coat – Series 39-1261 @ 1.5 mils DFT Second Coat – Series 39-1261 @ 1.5 mils DFT	SP-10 First Coat – Heat Flex Hi-Temp 1000 Aluminum @ 1.5-2.0 mils DFT Second Coat – Heat Flex Hi-Temp 1000 Aluminum @ 1.5-2.0 mils DFT
20	Dissimilar Metal Protection / Semi-Gloss	Scarify the Surface, SP-1 First Coat – Series 46H-413 @ 20 mils DFT	Scarify the Surface, SP-1 First Coat – HiMil Sher-Tar @ 20 mils DFT
21	Chemical Containment / Concrete / Interior / Gloss	Filler – Series 218 as needed to fill voids and bugholes First Coat – Series 201 @ 200 sfpg Second Coat – Series 282 @ 200 sfpg, hand broadcast anti-skid aggregate onto floor while still wet Third Coat – Series 282 @ 200 sfpg	Filler – Dura-Plate 2300 as needed to fill voids and bugholes First Coat – Corobond 100 @ 200 sfpg Second Coat – Cor-Cote HCR @ 200 sfpg, hand broadcast anti-skid aggregate onto floor while still wet Third Coat – Cor-Cote HCR @ 200 sfpg
29	Concrete / Submerged NP	Filler – complete parge coat Series 218 @ nominal 1/8” First Coat – Series 435 @ 30 mils DFT	Filler – Dura-Plate 2300 as needed to fill voids and bugholes First Coat – Dura-Plate 5800 @ 30 mils DFT

Foot Notes:

1. Where an Alternative System No. (ALT) is noted the Contractor may substitute the ALT system when approved by the Engineer. If the ALT system is used, it shall be used for all work covered by that system.
2. Tnemec Series N66HS may be substituted for Series 1.

END OF SECTION

SECTION 10950

MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Safety Equipment
   1. Fire extinguishers
   2. First Aid Kits

1.2 QUALITY STANDARDS

A. Provide experienced, trained workers competent to complete the work as specified

1.3 REFERNECES

A. ANSI/NFPA 10 – Portable Fire Extinguishers

B. ANSI/UL 711 – Rating and Fire Testing of Fire Extinguishers

C. UL 299 – Dry Chemical Fire Extinguishers

1.4 SUBMITTALS

A. In accordance with Section 01340

B. Shop Drawings: Indicate fire extinguisher wall bracket mounted measurements, and locations

C. Product Data: Provide extinguisher operational features, color and finish, anchorage details, shelving and desk dimensions and installation details

D. Submit for approval: Schedule of materials installation instructions with recommended mounting locations warranty, and maintenance data

1.5 OPERATIONS AND MAINTENANCE MANUALS

A. Operation and maintenance manuals are required for each piece of laboratory and testing equipment. Refer to Specification Section 01730

B. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements for extinguishers

PART 2 PRODUCTS

2.1 WALL MOUNTED FIRE EXTINGUISHERS

A. Manufacturers:
   1. Kiddle 899921
   2. Larsen's MP-10 N
   3. Sentry Extinguishers
   4. Or accepted substitution

B. Dry chemical type: UL 299, Cast steel tank, with pressure gage; Class B:C, Size 10

C. Finish: Steel, Red Enamel

D. Provide 4 (four) units with final locations to be determined by Engineer

E. Accessories: extinguisher brackets, formed steel, galvanized, white enamel finish

2.2 FIRST AID KITS

A. Manufacturer: Zee First Aid cabinet or accepted substitution

B. All weather, cabinet enclosed with wall mounting brackets

C. Cabinet: Number "0152"

D. Provide 2 (two) units, mount in location determined by Engineer

PART 3 EXECUTION

3.1 WORK CONDITIONS

A. All work conditions shall be as per manufacturer's instructions, trade association standards, and governing building and safety codes.

3.2 PREPARATION

A. As recommended by manufacturer.

3.3 INSTALLATION

A. Install products plumb and level. Provide shims as necessary

B. Secure rigidly in place

C. Place extinguishers on wall brackets

D. Install products per drawings and these specifications

E. Follow manufacturer's specifications

F. Upon completion, secure all required tests, inspections, and approvals of the completed system. Make all required adjustments and corrections at no added cost to the Owner.

3.4 REPAIR AND CLEANUP

A. After installation, inspect all work for improper installation or damage.

END OF SECTION

SECTION 11229

COARSE BUBBLE AERATION SYSTEM EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Complete aeration system, including all, equipment, labor, materials, incidentals, and hardware required for delivery to the project site ready for installation, testing and start-up for coarse bubble system components and accessories for the design conditions specified herein.

B. Aeration system for all digester tanks and shall consist of an integrated set of equipment components, including coarse bubble air diffusers with backflow prevention, drop pipes, distribution headers, manifolds, expansion joints, laterals, transition couplings, pipe supports, aeration grid structural supports, anchor bolts, expansions joints, and all necessary attachments and appurtenances for installation in digester tanks and pre-equalization.

C. Aeration system must be capable of delivering specified air flow and mixing tank contents, even with diffusers at elevation shown on drawings with fluctuating water levels

1.2 RELATED SECTIONS

A. Section 03300 – Cast-In-Place Concrete

B. Section 03600 – Non-Shrink Grout

C. Section 05501 – Anchor Bolts and Expansion Anchors

D. Section 05590 – Miscellaneous Metals

E. Section 09900 – Coatings

F. Section 15100 – Valves, Cocks, and Hydrants

1.3 REFERENCES AND STANDARDS

1. American Society for Testing and Materials – ASTM: A240 – Chromium-Nickel Stainless Steel Plate
   A312 – Seamless, Welded, and Cold Worked Austenitic SS Pipe
2. A351 – Castings, Austenitic, for Pressure-Containing Parts
3. A380 – Corrosion Protection, Acid Pickling
4. A403 – Wrought Austenitic Stainless Steel Piping Fittings
5. A480 – Stainless Steel Finish
6. A530 – Specialized Carbon and Alloy Steel Pipe
7. A554 – Welded Stainless Steel Mechanical Tubing
8. A743 – Castings, Iron-Chromium, Iron-Chromium Nickel for General Applications

9. A744 – Castings, Iron-Chromium-Nickel for Severe Service
10. A774 – Stainless Steel Welded Fittings
11. A778 – Stainless Steel Welded, Unannealed Austenitic Pipe
12. D1171 – Elastomer Deterioration

B. American Iron and Steel Institute – AISI:
1. 304 – 304 Stainless Steel Plate
2. 304L – 304L Stainless Steel Plate
3. 316 – 316 Stainless Steel Plate
4. 316L – 316L Stainless Steel Plate
5. American National Standards Institute – ANSI:B-16.1 – Pipe Flanges
6. B-16.5 – Pipe Flanges

C. American Waterworks Association – AWWA:
1. C606 – Grooved and Shouldered Joints

1.4 DEFINITIONS

A. AOTR – Actual Oxygen Transfer Rate

B. SCFM – Standard cubic feet per minute is understood to be air at 68°F, 14.7 psia, and 36% relative humidity flowing at a rate of 1 cubic foot per minute

C. SOTR – Standard oxygen transfer rate is understood to be the rate of oxygen transferred to tap water (pounds of oxygen per hour) at standard conditions of 20°C, 0.0 mg/L residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air)

D. SOTE – Standard oxygen transfer efficiency is understood to be the fraction of oxygen transferred to tap water under standard conditions of 20°C, 0.0 mg/L residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air)

E. Sidewater depth – Sidewater depth is understood to be the interior dimensions from the structure base to the water surface

F. ICFM – Inlet cubic feet per minute is understood to be SCFM conditions corrected to actual site conditions of pressure, temperature and humidity

G. Manifold: refers to the piping that connects the drop leg to the air distributor piping.

1.5 QUALITY ASSURANCE

A. All items of equipment specified herein shall be furnished by a single Manufacturer and Manufacturer shall have the responsibility of providing equipment, accessories, installation supervision, and testing services required to provide a functioning system

B. 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

1.6 TEST RESULTS

A. Provide three copies of all factory and field test results, including all initial measurements, computations, and final results. Factory testing shall have been completed by manufacturer during the past three (3) years. Test results provided shall be certified as to the accuracy of test performance as specified herein.

1.7 WARRANTY

A. The Manufacturer shall warrant all parts, including, but not limited to, diffuser assemblies, diffuser nozzles/assemblies, distribution piping, expansion joints, anchors, and supports, free from defective material and workmanship for a period of two (2) years from date of start-up.

B. Warranty shall cover all repairs, including parts and required certified technician labor (on-site and off-site), for all necessary repairs within the warranty period for the entire aeration system.

C. Multiple warranties for all individual components shall not be acceptable

1.8 SUBMITTALS

A. Submit under provisions of Section 01340 and 01600

B. Shop Drawings and Product Data: All submittal data shall be labeled in English units. All Drawings shall be drawn to scale, and test shall be in English. Submittals utilizing only metric units will be rejected. In addition, the following specific information shall be provided:
   1. Drawings showing plan, elevation, and appropriate cross sections of aeration equipment.
   2. Drawings shall include completed details of the proposed aeration grid system layout for each digester tank, showing all air pipe sizes and lengths, distances between air distribution headers, spatial compatibility with respect to other in-basin equipment/structures, and the location of all diffusers, supports, and expansion joints.
   3. Drawings shall include details of the connections to the air header, diffusers, drain line, supports, anchor details, expansion joints, air manifold and header joints, gaskets, bolts, nuts and washers, and all materials used
   4. Manufacturer, type, and model
   5. Detailed listing of materials of construction
   6. Assembly and installation instructions
   7. References from at least three existing installation with names and telephone numbers of plant design engineer and plant operator using similar equipment
   8. Certified oxygen transfer performance curve:
      a. Certified curve shall be an oxygen transfer efficiency in percent versus air fluxrate defined as SCFM per active diffuser surface area in tap water at 14.7 PSIA, 20°C and zero dissolved oxygen at the specified submergence
      b. The certified curve shall be based on aeration test results from a full-scale test facility. Minimum acceptable tank size is 200 square feet with a maximum length to width ratio of 3.5.

c. The diffuser density shall be equivalent to the actual project tank configuration Certified curve shall be prepared and sealed by a professional engineer

9. Complete factory or field oxygen transfer performance testing used to support the aeration calculations used for this project, including air source, method of airflow rate control and measurement, procedures for data collection, and sample calculations for data analysis.
10. Complete air headloss calculations (minimum and maximum) for the aeration equipment from the top of the drop pipe to the farthest diffuser bubble release point for each design airflow
11. Complete field test data, including certified oxygen transfer performance data, sufficient to determine the oxygenation capacity of the proposed aeration equipment
12. Design calculations showing the distribution and balancing of air between each air diffuser manifold in each tank for the minimum and maximum airflow rates
13. Design calculations showing uniform air distribution (10% maximum variation) through manifold header and diffuser element orifice system for each system
14. Design calculation showing loading condition on piping and support components. Pipe support components shall be designed with a minimum factor of safety equal to 10
15. A detailed plan describing the method for safe storage of the aeration system equipment at the site
16. Operating and maintenance manuals, including recommended spare parts list
    a. Recommended spare parts list including guaranteed unit costs for five (5) years where unit costs shall be the same for each year
17. Recommended unloading method at project site including implement (e.g., forklift, etc.) and maximum container or package weight
18. Field performance test procedures

C. Test results
1. Prior to shipment of equipment, submit to Engineer certified written report of aeration equipment performance test results and shop test results. Report shall be sealed by a professional engineer

1.9 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700

1.10 SPARE PARTS

A. Spare parts shall be furnished by the equipment Manufacturer. The following spare parts shall be furnished and the quantity of each spare part shall be 10 percent of number used for installation:
1. Air diffusers
2. Air diffuser piping gaskets
3. Nuts, bolts, U-bolts for installation

B. Provide spare parts suitably marked and boxed (protected from UV light) for shipment and storage. A packing list shall be provided with a description of all spare parts included. Each item or set of spare parts to be installed at one time shall be in individual packaging

C. Wrench per system required for diffuser installation

D. Any special tools required for maintenance

1.11 OPERATIONS AND MAINTENACE DATA

A. Submit under provisions of Section 01730

B. Operation Data: Include manufacturer's instructions, description of system operation, start-up data and trouble-shooting check lists, and repair data

C. Maintenance Data: Include manufacturer's literature, cleaning procedures, replacement parts lists, wiring diagrams, and repair data.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600 and in accordance with manufacturer's instruction

B. Protect equipment and components from physical damage including effects of weather, water, and construction debris

C. During loading, transporting, unloading, and storage, exercise care to prevent damage to materials and equipment

D. Do not drop pipe, fittings, or equipment

E. Adequately tag or otherwise mark all piping and fittings as to size

F. Store materials in original packing and prevent direct contact with ground

G. Replace damaged products with undamaged products

H. Reject any products dropped from truck or crane

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aqua-Aerobic System

B. Or accepted substitution

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Aeration System:
   1. Diffusers:
      a. Space to provide uniform pattern of mixing throughout basin

b. Shall be capable of preventing backflow of the process liquid into the diffuser and distribution piping through the diffuser air opening when the discharge air flow is shut off. No exceptions to this requirement will be acceptable.
c. Shall diffuse the air uniformly throughout each digester tank. Each drop pipe shall supply one grid of diffusers as shown on the Drawings.
d. Digester diffusers shall be capable of complete submersion in a sludge blanket with a solids content from 0.5% to 6.0% with zero airflow through the diffuser without causing clogging of the diffuser discharge opening or misalignment of the diffuser original orientation.
e. Pre-equalization diffusers shall be capable of complete submersion in a sludge blanket with a solids content from 0.1% to 2.0% with zero airflow through the diffuser without causing clogging of the diffuser discharge opening or misalignment of the diffuser original orientation.
f. Shall be capable of operating in an on-off blower operation mode without clogging of the diffuser. No exceptions to this requirement will be acceptable.

2. Aeration equipment provided by the manufacturer per this specification shall convey air from the drop pipe flange connection point to the air diffusers, as shown on the Drawings.
3. The aeration system in each digester tank shall be designed to convey the required airflow to each of the tanks and transfer the required amount of oxygen into solution.

B. Environmental and Operating Parameters:
1. Number of diffuser systems: Two (2), one per basin
2. Design site elevation: 7,500 feet above MSL
3. Relative Humidity:
   a. Summer time: 95 percent
   b. Winter time: 5 percent
4. Air Temperature:
   a. Ambient temperature range: -30°F (winter) to 105°F (summer)
5. Air flow rates, per digester:
   a. Minimum: 735 scfm at 11 psig discharge pressure
   b. Maximum: 939 scfm at 11 psig discharge pressure
6. Wastewater characteristics:
   a. Digester
      i) Percent solids: 0.5% - 6%
      ii) Temperature: 15°C
   b. Pre-equalization
      i) Percent solids: 0.1% - 2%
      ii) Temperature: 15°C
7. Factors:
   a. Alpha-fouling factor: 0.65
   b. Beta-factor: 0.95
8. AOR:SOR ratio: 27% (minimum)
9. Dimensions and Elevations:
   a. Digester tank floor elevation: 7386.50
   b. Elevation of drop pipe flange connections: 7402
   c. Maximum design diffuser submergence: 15.5 feet
   d. Digester Tank Dimensions

i) Length per tank: 50 feet
ii) Width per tank: 50 feet
iii) Normal operating sidewater depth: 13.5 feet
iv) Maximum operating sidewater depth: 15.5 feet

2.3 MATERIALS

A. Stainless steel: All stainless steel components of the aeration system shall be 2D finish conforming to AISI 304L
   1. Fabricate all welded parts and assemblies from sheets and plates of Type 304L stainless steel conforming to the requirements of ASTM A240. Finish shall be a No. 2D as specified in ASTM A480. Welds shall conform to the requirements of ASTM A774, Part 4
   2. Fabricate all non-welded parts and assemblies from sheets and plates of Type 304L stainless steel conforming to the requirements of ASTM A240. Finish shall be a No. 2D as specified in ASTM A480
   3. The following aeration equipment components shall be Type 304L stainless steel:
      a. Air distribution piping and fittings
      b. Aeration grids/manifolds
      c. Diffusers, if diffusers provided by manufacturer are stainless steel
      d. Air distribution/aeration manifold support pipes and pipe clamps
      e. Threaded Rods and U-bolts
      f. Support baseplates
      g. Diffuser connectors
   4. All stainless steel pipe shall be fabricated from Type 304L material conforming to the requirements of ASTM A240. Stainless steel pipe fabrication shall conform to the requirements of ASTM A530, ASTM A554, and ASTM A778
   5. All stainless steel pipe fittings shall be fabricated from Type 304L material conforming to the requirements of ASTM A240. Stainless steel pipe fittings fabrication shall conform to the requirements of ASTM A774
   6. Bolts, nuts, and washers shall be Type 316L stainless steel
   7. Furnish air distribution manifolds and connectors with a minimal nominal wall thickness corresponding to Schedule 10 (0.109 in. wall thickness) pipe or greater and adequate to handle the anticipated stresses for its particular application
   8. All fabricated stainless steel pipe manifolds and structural members shall be treated for corrosion resistance upon completion of the fabrication process

B. Air distribution piping
   1. General
      a. Submerged piping shall be designed for a long-term exposure to 40ºF mean-wall temperatures
   2. Drop Pipes
      a. Schedule 10 minimum, 304L or 316L stainless steel to conform to Section 2.2A
      b. To within 4 feet above the basin floor
      c. Flanged connection at top of drop pipe as indicated on Drawings
      d. All drop pipe materials shall be suitable for use with air temperatures up to 230ºF
   3. Manifolds
      a. Schedule 10 minimum, 304L or 316L stainless steel to conform to Section 2.2.A.

b. All manifold piping materials shall be suitable for use with air at temperatures up to 185ºF

4. Flexible connectors
   a. EPDM
   b. 316L stainless steel band clamps
5. Supports
   a. Fabricated of stainless steel to conform to Section 2.2.A
6. Anti-Seize thread lubricant shall be:
   a. Jet-Lube: Nikal
   b. John Crane: Thred Gard, Nickel
   c. Never-Seez: Pure Nickel Special
   d. Permatex: Nickel Anti-Seize

C. Elastomer Diffusers:
   1. Shall be clamped to a bushing or pipe nipple using a heavy duty 316 stainless steel clamp to ensure the diffuser will not separate from the connection during operation. Unrestrained elastomer components using compression fit, snap-on, and friction fit connections will not be accepted.

D. Gaskets
   1. Expansion joint and coupling gaskets: design to form an airtight connection at 50 psig minimum and temperature of 230°F
   2. Neoprene, 45 to 55 Durometer, Shore A in accordance with ASTM 52240

E. Miscellaneous: Nuts, bolts, washers, and other non-welded parts directly exposed to the wastewater
   1. Type 316L
   2. Threaded assemblies: chemically treated or lubricated prior to assembling to prevent galling

2.4 CONSTRUCTION, FABRICATION, AND MANUFACTURE

A. Aeration System
   1. Aeration system coverage system shall be in accordance with manufacturer recommendations and may differ from drawings
   2. System equipment shall begin at the drop pipe connection and consist of all air piping, air piping supports, aeration manifolds and manifold supports, and anchor bolts, specified herein or required for proper installation of the aeration system
   3. Where details must be modified to fit piping and structures, all such modifications shall be acceptable by the Engineer. Upon Engineer acceptance, the Contractor shall be responsible for notifying the Manufacturer of any required changes
   4. The aeration manifolds shall be designed so that moisture and retained wastewater can be drained from the aeration system when the basin is emptied

B. Air Distribution Piping
   1. Air piping system shall be provided to distribute air from the out-of-basin aeration supply piping to the aeration manifolds

2. Air distribution piping system shall include all piping, fittings, reducers, couplings, slip joints, expansions joints, gaskets, supports, nut bolts, required to bring the air supply to the aeration manifolds installed in the basin
3. Out-of-basin air piping includes all air piping upstream of the flange connection as indicated on the Drawings and specified herein
4. Location of the aeration supply drop pipe, flange connection shall be at elevation indicated on the Drawings
5. Each air distribution aeration grid shall evenly distribute the air flow to all diffusers served in each tank
6. All air distribution piping shall be supported as required to anchor the piping, to minimize deformation and/or fatigue from vibration or dynamic loads in the basin
7. Piping shall be assembled with flanged connections and restrained mechanical couplings designed to provide an airtight connection and allow for expansion
8. Drop Pipes
   a. Provide drop pipes from the air main connection to the aeration system as shown on the Drawings
   b. Contractor shall coordinate with manufacturer to ensure adequate number of drops are installed
   c. A flange shall be provided for connecting the header to each drop leg assembly. Provide a stainless steel flange design with a 150 pound drill pattern flange ring at top connection. Upstream isolation butterfly valves to be provided and installed by Contractor for each aeration system as shown on Drawings
   d. Provide a stainless steel band clamp coupling with gasket for the lower drop pipe to manifold connection for ease of installation and alignment
   e. Design and furnish an expansion/contraction system for all drop pipe to allow for temperatures between -20°F to 230°F
   f. Provide a wall or floor mounted support locking mechanism near the drop pipe to manifold connection which will:
      i) Provide vertical support for all uplift induced loads
      ii) Provide restraint of movement due to thermal expansion and blow apart

9. Manifolds/Air Distribution Headers
   a. Each row of aeration manifold grids shall be supplied with air by one dedicated air distribution pipe
   b. A flange connection configured vertically and facing upward shall be provided at the location indicated on the Drawings
   c. Bottom elevation of the manifold system shall be the same throughout the tank. Piping supports shall be sized such that the distribution piping and manifolds can be installed level on the sloped floor as indicated on the Drawings
   d. Provide either a flange and blind flange plate at the end of each lateral pipe or a removable end cap
   e. Join sections of manifolds with special flanged joints, expansion joints or compression-sleeve couplings so that individual manifold sections can be rotated independently of adjacent sections for alignment purposes during installation.
   f. Design and furnish an expansion/contraction system for all manifolds. The expansion/contraction system shall consist of simple supports, fixed supports and expansion joints in an integrated design

g. Design all joints to structurally transmit the longitudinal forces caused by expansion and contraction of the manifold and provide positive means to prevent joint blow apart
h. Design the expansion/contraction system for all manifolds to allow for temperatures between -20°F to 185°F
i. Provide simple manifold supports which allow for longitudinal movement and which act as longitudinal guides and restrain the manifold from buoyant uplift forces
j. Fabricate fixed supports to resist and limit longitudinal manifold movement
k. Provide each section of manifold with a minimum of two supports or thrust anchors with the maximum spacing between supports not to exceed 8 feet
l. Provide supports with a mechanism to provide for ±2 inches of vertical adjustment and ±1/2 inch of lateral adjustment for alignment of the manifolds in the field.
m. Position supports at the end of the manifold run to limit cantilevers to avoid excessive stresses on the manifold
n. Design manifolds and connectors to resist a vertical load applied at the threaded end of the connector that results in a bending moment of 1000 inch-lbs
o. Do not install manifolds over basin sumps or under access steps
p. Deformation of air headers, diffuser connectors, diffusers, or pipe supports to align or level the system shall not be allowed

C. Supports
1. Fabricated of stainless steel to conform to Section 2.2A
2. Supports shall be prefabricated and shall be provided complete with all bases, nuts, plates, rods, and other accessories required for proper installation
3. All supports shall be capable of providing adjustment so that all air distribution piping and aeration manifold piping can be leveled within ±1/8 inch vertical alignment. Adjustment shall be continuous and possible without removing the air piping from the support.
4. Supports shall allow for a minimum of ±2 inches adjustment in vertical adjustment and ±1/2 inch of horizontal adjustment of the lateral pipe in the field
5. Install pipe support at all pipe ends and joints
6. Support height shall be sufficient to install level aeration grid over sloping basin floor
7. Maximum distance between basin floor and aeration grid: Shall be per manufacturer's recommendation to meet Performance Requirements of this specification
8. Maximum support spacing: Shall be per manufacturer's recommendation to ensure structural stability for the life of the system
9. Attach manifold supports to concrete pad with anchor bolts designed for ten times the normal uplift force
10. Manifold supports shall allow longitudinal movement of the manifold section to prevent stress buildup in the manifold due to thermal expansion/contraction forces.
    a. Maximum horizontal thrust of 20 pounds or less shall initiate movement of the manifold relative to the mechanism under full buoyant up-lift load
11. Threaded support rods, if used, shall be a minimum of 7/8-inch diameter and not be used for pipes greater than 6 inches in diameter or anything located more than 20 inches from the tank floor.

12. Supports using worm gear clamps are not acceptable
13. All pipe saddle clamps used to fasten air distribution piping and aeration manifold piping shall have a minimum width of 2 inches and minimum thickness of 0.109 inches
14. Anchor bolts for fastening the supports shall be provided
    a. Fabricated of stainless steel to conform to Section 2.2.A
    b. Minimum anchor bolt diameter: 5/8 inch unless indicated otherwise on the Drawings
    c. Supports shall be located such that concrete anchors are not installed within 6 inches of any concrete expansion joint
    d. Pipe supports and anchor bolts shall be suitable to resist all loads including vibratory loads
    e. All level adjustment nuts shall lock in place to secure the piping in position after final adjustment and alignment

PART 3 EXECUTION

3.1 FABRICATION

A. Stainless steel welding
1. Field welding shall not be permitted without the written approval of the Engineer
2. Continuously weld both sides of face rings and flanges. All welding on the aeration equipment shall be completed in the factory. All stainless steel welding shall be by the shielded arc, inert gas, MIG, or TIG method.
3. Filler wire shall be added to all welds to provide a cross section or weld metal equal to, or greater than, the parent metal
4. Butt welds shall have full penetration to the interior surface, and gas shielding shall be provided to the interior and exterior of the joint
5. Interior weld beads shall be smooth, evenly distributed, with an interior projection not exceeding 1/16 inch beyond the inner diameter of the air header or fitting
6. All outside weld areas shall be wire-brushed to remove weld splatter. Brushes shall be of stainless steel and used only on stainless steel
7. Face rings and flanges shall be attached to pipe and fittings by continuous welds.
8. Stitch welds will not be acceptable
9. All welded stainless steel components shall be acid passivated after welding.
10. Passivation shall be achieved by treating the entire component surface by full submersion
11. After passivation, components shall be thoroughly rinsed with clean water and allowed to air dry
12. Passivation by means of bead or grit blasting shall not be acceptable
13. Aeration equipment will be rejected if rusting or any other impurities are observed at the welds or elsewhere on the equipment

B. Stainless steel corrosion protection and finishing
1. All in-basin pipes, supports, equipment, and fasteners shall be made of corrosion resistant materials

2. The materials shall adequately protect the equipment and appurtenances from corrosion caused by the service environment
3. Pickle all stainless surfaces by using the following procedure:
   a. Wire brush all outside weld areas to remove weld splatter. Brushes shall be of stainless steel and used only on stainless steel
   b. Remove all carbon deposits, greases, and oils by pickling and neutralization to aid the regeneration of a uniform corrosion resistant chromium oxide film
      i) Completely immerse all stainless steel assemblies and parts after welding and brushing in a pickling solution of 10% nitric acid and 3% hydrofluoric acid in a water bath at 140°F for a minimum of 15 minutes. Parts shall be free of iron particles or other foreign material after this procedure
      ii) Scrub as required. Immediate final through rinse in clean hot water and let dry
   c. Corrosion protection techniques not using full immersion will not be acceptable.

3.2 INSTALLATION

A. Equipment specified under this section shall be installed in accordance with manufacturer's recommendations and details shown
   1. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents
   2. Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding

B. Verify that interior of air distribution header is free of dirt and debris and has been pressure tested per Section 15060

C. An experienced, competent and authorized representative of the Manufacturer shall inspect, check, and approve the installation of all equipment specified herein

D. The representative shall be present when the equipment is placed in operation and shall revisit the jobsite as often as necessary until all issues are corrected and equipment installation is satisfactory in the opinion of the Engineer for testing and operation

E. The Manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed, is accurate in alignment, free from undue stress imposed by support pipe connections or anchor bolts, and ready for testing and full load operating conditions. All costs for these services shall be included in the Contract Prices as required for compliance

F. All equipment specified herein shall be installed in accordance with the Engineer and Manufacturer's recommendations. The following subsections describe the Work to be performed by the Contractor.
   1. Aeration System
      a. Air distribution piping and aeration manifolds shall be leveled so that all air distribution piping, aeration manifold piping, and air diffuser laterals, in all four reactors with ±1/4 inch vertical alignment and ±1/4 inch lateral alignment
      b. Supports of the air distribution piping and aeration manifolds shall be spaced as indicated on the drawings

c. Deforming of air piping, diffusers, or pipe supports to align or level the system shall not be allowed
d. Connection of dissimilar metals shall be made using an insulating flange connection. The insulating flange shall be furnished by the Contractor

3.3 PREPARATION FOR SHIPMENT

A. Aeration equipment shall be packaged and shipped by the Manufacturer ready for unloading, storage, and installation by the Contractor. The Contractor will provide a suitable storage space for the aeration equipment in accordance with requirements in Section 01600

3.4 MANUFACTURER'S CERTIFICATE

A. A manufacturer's certificate of satisfactory installation is required for work under this section

3.5 CLEAN WATER FUNCTIONAL TESTS

A. After installation of the aeration equipment is complete, witness functional testing conducted by the installation contractor to check for leaks, uniformity of air release and verification of level installation. Functional testing shall be performed with clean water.

B. Prior to startup, the Manufacturer shall perform an in-basin performance test to demonstrate that the equipment installed meets the maximum month mixing requirements at the design airflow specified in Section 2.2 of this specification

C. The Manufacturer shall coordinate the test with the Contractor's schedule. Coordination and execution of the testing is the sole responsibility of the Manufacturer. The performance tests shall be conducted at the same side water depth as the design conditions. Diffuser water depth and air flow rates per diffuser as determined by the Manufacturer to meet the mixing requirements and operating criteria as specified in Section 2.2 unless otherwise approved the Engineer. The performance test shall show that the mixing requirements in Section 2.2 can be achieved by the full-scale system

D. Personnel in charge of the tests shall be competent, authorized representatives of the Manufacturer who are familiar with the operation of the equipment furnished. Qualified personnel shall perform the test, record the data, make the required calculations, and prepare a report on the results

E. Representatives of the Engineer may elect to observe the test and collect a copy of the recorded data. The information collected will be used as a basis for determining acceptability of the Manufacturer's results

F. Uniform Aeration Pattern Visual Inspection:
1. This test to be performed with fully operational blowers. Fill basins to same side water depth at the design conditions. Deliver the required air flow to aeration system from the blower system per this specification. Visually inspect the basin surface to verify uniformly distributed air flow across the basin. Any leaks in the headers,

diffusers, pipes, or any part of the system shall be repaired by the installation contractor. The test shall be repeated until the installation is void of air leaks or other causes of non-uniform flow pattern

G. Performance Evaluation Test Procedures:
   1. Level Test: Fill basins with clear water to the top of the diffusers. Adjust all diffusers to be at the same elevation ±1/4 inch.
   2. The performance test shall be conducted using clean water with a water temperature at or less than 20°C and above 10°C unless otherwise approved by the Engineer
   3. The performance test shall use a minimum of five (5) dissolved oxygen meters in each basin. The test shall be performed three times and the average of the three tests will be used to evaluate performance. The person in charge of the test shall submit the proposed location and depth of the probes for approval by the Engineer before testing.
   4. Personnel in charge of the tests shall be competent, authorized representatives of the Manufacturer who are familiar with the operation of the equipment furnished. Qualified personnel shall perform the tests, record the data, make the required calculations, and prepare a report on the results. The Manufacturer shall provide a copy of the recorded data to the Engineer. The information collected will be used as a basis for determining acceptability of the Manufacturer's results. In case of conflict, interpretations and calculations made by the Engineer will govern.
   5. The Manufacturer shall be responsible for furnishing all equipment, material, and facilities required to perform the field performance tests
   6. The Manufacturer shall notify the Engineer of the proposed testing date at least two weeks in advance and shall submit a report from the equipment manufacturer detailing the proposed performance testing procedures and analyses. The report must be acceptable to the Engineer before the equipment is tested. If more than one day of testing is required, it shall be done on consecutive days
   7. The data to be determined in each test shall include, but shall not be limited to, the following:
      a. Airflow rate in scfm
      b. Air supply temperature and pressure
      c. Rate of change of the dissolved oxygen concentration
      d. Liquid temperature
      e. Uncorrected barometric pressure
      f. Additional data as necessary to determine compliance with Specifications
   8. Before each test, the aeration system shall be operated at the test airflow rate to achieve steady-state conditions. In each tests, sodium sulfite shall be added to the water to deplete the oxygen concentration to zero in both basins. A sufficient quantity sodium sulfite (Na_2SO_3) shall be dosed to deplete and maintain the zero condition for one (1) minute on all probe readouts simultaneously. Stoichiometrically, approximately 0.75 pounds of 96 percent pure technical grade sodium sulfite, free of catalyst, will be required per 10,000 gallons of water to deplete the oxygen concentration by 1 mg/L. Approximately 150 percent of the stoichiometric concentration is required to achieve and maintain zero conditions for one (1) minute.
   9. Data showing oxygen depletion shall be recorded. The data shall also show that all test points remained at zero dissolved oxygen for at least one (1) minute. If zero

dissolved oxygen is not reached for at least one (1) minute at all measurement locations simultaneously, the test shall be considered invalid

10. A ten percent (by weight) solution of cobalt chloride ($CoCl_2 \cdot 6H_2O$) shall also be prepared for the initial series of tests. About 0.34 pounds of cobalt chloride will be required per 10,000 gallons of water to obtain a cobalt ion concentration of 1 mg/L or less
11. For the initial series, the cobalt chloride solution shall be introduced into the basin with the diffused aeration system operating. After at least 15 minutes of operation, addition of the sodium sulfite solution shall be started slowly. Reducing the airflow to achieve better deoxygenation with sodium sulfite will not be acceptable. The entire quantity of sodium sulfite solution shall be added to the tank within approximately 5 minutes in a manner achieving uniform dispersion throughout the tank.
12. After the first test has been completed, another batch of sodium sulfite shall be prepared and the procedure repeated. Should additional chemical be required, they shall be provided at no additional cost to the Owner
13. The Equipment shall be operated to reaerate the water until oxygen saturation is reached. Dissolved oxygen (DO) concentrations shall be monitored continuously during the depletion and the reaeration in equal increments of approximately one (1) minute, or at a time interval which results in at least 15 readings between 10 and 90 percent of the measured DO saturation value. The temperature of the test liquid shall be recorded before and after each test run

H. Data Analysis

1. The dissolved oxygen deficit from saturation (C_s-C_t) for each measurement point shall be calculated and plotted on semilog scale versus time (t) where C_t is the measured oxygen concentration at any time (t), and C_s is the average dissolved oxygen concentration, at temperature T, attained by aerating the basin contents until no further increase in dissolved oxygen concentration is deleted. A line of best fit shall be drawn utilizing regression analysis on all points.
2. The overall oxygen transfer coefficient (K_La)T for each point of measurement specified shall be computed by determining the slope of the line the best fit by using the following equation:

$$(K_L a)_T = \frac{\ln[(C_s - C_1)/C_s - C_2)]}{(t_2 - t_1)} \quad \text{units of } [Hr^{-1}]$$

Where:

T	=	Water Temperature, (ºC)
C_s-C_1	=	Initial (t_1) dissolved oxygen deficit, (mg/L)
C_s-C_2	=	Final (t_2) dissolved oxygen deficit, (mg/L)
T_2-t_1	=	Time span, (hr)
C_s	=	Average of all dissolved oxygen concentrations, liquid temperature T, attained at each test location by aerating the basin contents until no further increase in oxygen concentration is detected, (mg/L)

3. The oxygen transfer constant for each measurement point shall be corrected to 20ºC by the following formula:

$$K_L a = (K_L a)_T (\mu_T / \mu_{20})^{0.62} \quad \text{units of } [Hr^{-1}]$$

Where:

μ = Absolute viscosity, (lb·sec/ft^2)

4. The individual values of $(K_La)_{20}$ from each test location for all three tests at maximum airflow shall be averaged, and at least two-thirds of the individual $(K_La)_{20}$ values shall be within 10 percent of the average value. If not, additional tests shall be conducted until two-thirds of the $(K_La)_{20}$ values are within 10 percent of the average of all $(K_La)_{20}$ values.
5. The standard oxygen transfer rate by the aeration system shall be calculated by using the average value of $(K_La)_{20}$ in the following equation:

$$SOTR = 8.34(K_L a)_{20} V_{Basin} C_{s(std)} \quad \text{units of [lb/hr]}$$

Where:

SOTR = Standard Oxygen Transfer Rate

V_{Basin} = Aeration basin volume tested, (million gallons)

$C_{s(std)}$ = The measured Cs value during the performance testing corrected to standard conditions (20ºC and sea level) and shall be determined by:

$$C_{s(std)} = [C_s] \times [9.09 / C_{s(a)}]1.146 \quad \text{units of [mg/L]}$$

Where:

$C_{s(a)}$ = Theoretical surface oxygen saturation value at test site barometric pressure and liquid temperature T, (mg/L)

C_s = Measured oxygen saturation value at test site conditions, (mg/L)

6. The field determined SOTR will be compared to the calculated SOTR provided in the Performance and Design Requirements section of this specification for the DO residual, etc. provided in the Performance and Design Requirements for this specification.
7. The airflow rates used in the performance tests to meet the specified maximum month oxygen transfer rate requirement shall not exceed the values specified under the Performance and Design Requirements.

I. Modifications
1. If the tests indicate the diffused aeration equipment will not be able to satisfy the performance requirements, the diffused aeration equipment shall be modified by the Manufacturer or as required to meet the performance requirements.
2. Adding more blowers will not be an acceptable modification.
3. Retesting shall be performed at no additional cost to the Owner.
4. The Manufacturer shall reimburse the Contractor for any costs incurred by the Contractor as a result of such modifications.

J. Training of Owner's Personnel
1. A qualified representative of the Manufacturer shall provide two (2) eight (8) hour days of training services, in one trip, to the Owner's personnel in the areas of

equipment startup, proper operation, troubleshooting, general, and preventive maintenance, and repair of the equipment. Training shall consist of combined classroom and hands-on instruction with separate sessions for operations training and maintenance training.

2. Each training session should be designed to accommodate up to 15 people. Training shall be conducted at a place and time mutually agreeable to the Owner and the Manufacturer.
3. Submittal and approval of a syllabus of training services, as well as the qualifications of the training instructor is required prior to scheduling any training sessions, as specified in the submittals section.
4. All costs for these services shall be included in the contract price for the number of days and round trips as specified herein.

3.6 MANUFACTURER'S SERVICES

A. Provide under provisions of Sections 01400 and 01600

B. Prior to start-up
   1. Test all valves, piping and diffuser system for proper settings, alignment, and operation
   2. Coordinate through Contractor the completed installation of the blowers
   3. Direct Contractor in necessarily corrections for start-up
   4. Provide written approval for start-up when system is satisfactory

C. Start-up
   1. Direct Contractor in proper start-up, checkout, and testing of aeration system
   2. All aeration system components and equipment to be operated over entire specified range
   3. Check for leakage in aeration system
      a. All joints shall be free of leaks
   4. Provide written direction to Contractor detailing adjustments and corrections necessary
   5. Provide preliminary instruction to plant personnel on operation and maintenance of aeration system.

D. Follow-up and Training
   1. Check that all adjustments and corrections detailed to Contractor at start-up have been accomplished
   2. Inspect aeration system with plant personnel, address installation, operation, and performance concerns of plant personnel.
   3. Provide written final approval of aeration system installation
   4. Provide final instruction to plant personnel on operation and maintenance of aeration system

E. Schedule
   1. Above services to be provided in at least 1 trip
      a. Prestart-up and start-up as requested by Contractor
      b. Follow-up approximately one month after start-up only if requested by Owner

2. Time spent at site shall be as required to perform above detailed services but at a minimum shall total one 8-hour day excluding travel to or from site.
3. Manufacturer to provide two (2) additional trips within twenty-four (24) months after start-up to address follow-up request by Owner, or to address operational or other related items shall be at no cost to Owner. Owner shall coordinate follow-up trips directly with manufacturer.

3.7 SYSTEM INSPECTION AND START-UP

A. Notify the Owner, Engineer, and Manufacturer, in writing, when the installation is ready for inspection.

B. Written notification must be given a minimum of 10 days prior to inspection date.

C. Do not put any water into basins or start-up any mechanical equipment until manufacturer has inspected and given written approval installation for start-up.

D. After inspection, perform any necessary corrections identified by Manufacturer and/or Engineer.

E. After written approval for start-up is issued by Manufacturer, conduct testing as outlined in Section 3.5, Clean Water Functional Tests, with water provided by Owner.

F. With Manufacturer, start-up, check-out and test aeration system.

G. Repair all leaks and make adjustments and corrections detailed by Manufacturer and/or Engineer.

END OF SECTION

SECTION 11310

NON-CLOG CENTRIFUGAL PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-clog centrifugal pumping units to be used for pumping raw wastewater from the pre-equalization basin to the wet well

1.2 DESCRIPTION

A. Contractor shall furnish and install three variable speed non-clog centrifugal pumps for pumping wastewater and shall be suitable for submersible application.

B. Centrifugal pumping units shall be non-clog pumps as specified and shall be furnished complete with pump casings, shafts, bearings, seals, pump rails and pedestal base, anchor bolts, piping assemblies, motors and controls, and all other parts and ancillary equipment and accessories indicated, specified or that is required for proper complete installation, operation and maintenance.

C. The system shall be by the same manufacturer as supplying the pump and motor control panel to insure suitability and assurance of experience in matching the equipment together and to insure single source responsibility for the equipment.

1.3 RELATED SECTIONS

A. Division 1 – General Requirements

B. Section 09900 – Coatings

C. Section 15060 – Pipe and Pipe Fittings

D. Section 15100 – Valves, Cocks, and Hydrants

E. Section 16050 – Basic Electrical Materials and Methods

F. Section 16200 – Electric Motors

G. Section 16260 – Variable Frequency Motor Controllers

1.4 REFERENCES AND STANDARDS

A. American National Standards Institute (ANSI):
   1. B16.1 Cast Iron Pipe Flanges and Flanged Fittings

B. American Society for Testing and Materials (ASTM):

1. A48 – Standard Specification for Gray Iron Castings
2. A108 – Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
3. A276 – Standard Specification for Stainless Steel Bars and Shapes
4. A278 – Standard Specification for Gray Iron Casting for Pressure-Containing Parts for Temperature up to 650°F (350°C)
5. A322 – Standard Specification for Steel Bars, Alloy, Standard Grades
6. A576 – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
7. A582 – Standard Specification for Free-Machining Stainless Steel Bars
8. A743 – Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
9. B148 – Standard Specification for Aluminum-Bronze Sand Castings
10. B505 – Standard Specification for Copper Alloy Continuous Castings
11. B584 – Standard Specification for Copper Alloy Sand Castings for General Applications
12. F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
13. F594 – Standard Specification for Stainless Steel Nuts

C. American Iron and Steel Institute (AISI)

D. Antifriction Bearing Manufacturer's Association (ABMA):
1. 9-90 – Load Ratings and Fatigue Life for Ball Bearings
2. 11-90 – Load Ratings and Fatigue Life for Roller Bearings

E. National Electrical Manufacturer's Association (NEMA):
1. 250 – Enclosures for Electrical Equipment (1,000 Volts Maximum)

F. Institute of Electrical and Electronics Engineers (IEEE)

G. National Fire Protection Association (NFPA)

H. National Electrical Code (NEC)

I. Insulated Cable Engineer’s Association (ICEA)

J. Underwriters Laboratories, Inc. (UL)

K. CSA International (CSA)

L. Factory Mutual (FM)

M. Hydraulic Institute (HI):
1. 1.1-1.2 – Rotodynamic Centrifugal Pumps for Nomenclature and Definitions
2. 1.3 – Rotodynamic Centrifugal Pumps for Design and Application
3. 3.6 – Rotary Pump Tests
4. 9.1-9.5 – Pump – General Guidelines

N. Conform to all applicable sections of American National Standards Institute/Hydraulic Institute (ANSI/HI) Pump Standards Version 4.0

1.5 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340

B. Shop drawings: Submit complete fabrication, assembly foundation, and installation drawing for all pumps, motors, and accessories to illustrate construction and assembly of components.

C. Product data: Data to be submitted to verify compliance with specifications shall include, but not limited to, the following:
   1. General
      a. Spare parts list, list of lubricants, and recommended spare parts
      b. Installation assembly/disassembly and repair instructions
      c. Layout dimensions
      d. Protective coating system
      e. Test certificates and results
   2. Pump
      a. Manufacturer name
      b. Type and model
      c. Diameter of suction end of pump
      d. Diameter of discharge end of pump
      e. Type of drive design
      f. Shaft design
      g. Type of bearings, bearings manufacturer, and bearing life calculations
      h. Guide rail details, dimensions, and support connection
      i. Provisions for removing rotor and stator assembly and changing bearings
      j. Weights
         1) Pump (with rotating assembly)
         2) Total each unit
         3) Base support
         4) Guide rails
         5) Motor and speed reducer
      k. Complete performance curves showing capacity versus head, NPSH required, operating speed, pump efficiency, and bhp
      l. Type of coupling
      m. Data on shop painting and coating system data
      n. Nameplate data:
         1) Name of manufacturer
         2) Type and model
         3) Design rotative speed
         4) Type of shaft and bearing
         5) Type and construction of pump seals
         6) Date of manufacturing
   3. Motor

a. Manufacturer name and serial number
b. Type and model
c. Rated size (hp) and horsepower output
d. Temperature rise and method indicated
e. Maximum ambient temperature
f. Insulation class
g. Rpm at rated load
h. Locked rotor amperes or code letter
i. Service factor
j. Type of shaft and bearings
k. Maximum noise level of pump/motor unit (dBA)
l. Efficiency
m. Enclosure and shaft dimensions
n. Weight
o. Bearing information
p. Rated load current (amperes)
q. Power voltage, phase and frequency
r. Control panel layout with devices and nameplates shown
s. Wiring schematics and diagrams with all devices, terminals, and wires uniquely numbered
t. Control panel device catalog data with bill of material. The bill of material shall be shown on the control panel drawings with all items numbered
u. Nameplate data:
   1) Name of manufacturer
   2) Type and model
   3) Type of bearings
   4) Rated hp size
   5) Full load current
   6) Motor performance data
   7) Date of manufacturing

D. Test reports
1. Certified performance curves plotted against shutoff to 150% of design flow at the conditions specified herein and shall be submitted for the following parameters as a function of pump capacity rotative speed and TDH at the design temperature:
   a. Total developed head
   b. Brake horsepower required
   c. Efficiency of pump
   d. Required NPSH
   e. Actual speed
   f. Minimum recommended submergence
2. Plot curve to be easily read at scales consistent with the performance requirements

E. Shop Drawings: Illustrative of complete fabrication, assembly, and installation drawings, including but not limited to:
1. Layout, overall dimensions, required clearances, anchorage requirements, location and dimensions of electrical equipment, control panels and other auxiliary equipment

a. Size, diameter, location and dimensions of all piping connections
2. Dimensions, weights, and lifting force required for each piece of equipment
3. Electrical control schematics, wiring diagrams, and general description including list of materials

F. Manufacturer's installation instructions
1. Provide connection requirements and start-up instructions for pumps

G. Manufacturer's field start-up report
1. Indicate personnel present and actual tests and start-up procedures that were performed by manufacturer's representative

H. Accessories
1. Provide manufacturer and types of seal and fittings
2. Provide discharge pressure monitoring and alarming devices

1.6 FACTORY ASSEMBLY

A. Pump and motor units shall be shop assembled and aligned completely prior to shipping to project site

B. Any components removed for shipping shall be match-marked prior to removal and shipment to project site

C. After completion of specified factory tests, all pumps shall be prepared for shipment with minimum amount of assembly required, and such that no field disassembly, cleaning, and/or flushing is required

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730

B. Operation data: Include manufacturer's instructions, description of system operation, start-up data, trouble-shooting check lists, and repair data for pumps and motors

C. Maintenance data: Include manufacturer's literature, cleaning procedures, replacement parts lists, wiring diagrams, for pumps and motors

1.8 DELIVERY STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept pumps and components on site in factory packing. Inspect for damage. Comply with manufacturer's installation instructions

C. Protect pumps and components from physical damage including effects of weather, water and construction debris

D. Provide temporary inlet and outlet caps, and maintain in place until installation

1.9 WARRANTY

A. Contractor shall furnish a manufacturer's warranty, in writing, for at least two (2) years or 10,000 operating hours, for the pumping units, against defects in materials and workmanship

B. Multiple warranties for individual components shall not be acceptable

1.10 QUALITY ASSURANCE

A. Pumping unit and accessories shall be supplied by a single manufacturer

1.11 MAINTENANCE MATERIALS

A. Provide spare parts as follows:
   1. Repair Kit: Includes bearings, wear rings, mechanical seals, and seals

1.12 SPACE CONSTRAINTS

A. Pump and motor shall fit into the space indicated. Any modifications to piping or equipment to comply with this paragraph shall be at no cost to Owner

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Units manufactured by:
   1. ABS (Sulzer)
   2. Flygt (Xylem)
   3. KSB
   4. Gorman-Rup
   5. Or Engineer accepted substitution

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. General
   1. Provide completely sealed non-clog and electrically operated pump that is capable of pumping wastewater
   2. Provide base pedestal
      a. No portion of the pump shall bear directly on the sump floor
   3. Pumps shall be designed and built for continuous service at all points within the specified range of operation, without overheating, without cavitation, and without excessive vibration or strain
   4. Provide renewable casing wearing ring for efficient sealing between volute and impeller
   5. Pumps shall be stable and free of cavitation and noise throughout the specified operating head range

6. Pumps shall be capable of operating continuously for extended periods of time without damage to the pump
7. Seal interface of pump and pedestal base (discharge elbow) shall be by metal to metal watertight contact
8. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or optional Viton rubber O-rings
9. The minimum hydrostatic test pressure shall be 1.5 times the shutoff head plus the suction pressure
10. Pump shall operate near or at maximum efficiency at the specified operating conditions
11. Pump head-capacity curve shall be continuously falling from shutoff head
12. Pump discharge connection elbow and discharge piping shall be installed
    a. Pump shall automatically (mechanically) connect and seal to discharge connection elbow when lowered into place in the sump
13. Impellers shall be single vane, totally enclosed
14. Pump shall be easily removable for service or inspection
15. Mechanical seals shall be double mechanical
16. Provide the following appurtenances for each pump:
    a. One 50-ft power cable
    b. Moisture and/or motor temperature relays as required by the manufacturer for inclusion in the motor controls
17. Motor shall be inverter rated along with motor shaft grounding

B. Environmental conditions
1. Pump shall be rated for Class 1, Division 2, Group C&D environment
2. Wastewater Temperature range: 8 - 22°C
3. Site Elevation: 7,500 ft above sea level
4. High humidity and corrosive environment [*review for application*]

C. Wetwell Pumps

1. Number of Pumping Units:	3
2. Drive Type:	Variable speed
3. Design Points	
a. Duty Point	
1) Flow:	800 gpm
2) TDH:	22.5 feet
b. Minimum Shutoff Head:	28.1 feet
4. Maximum Rotational Speed:	1800 rpm
5. Minimum Motor Horsepower:	15 hp
6. Solids Handling Capacity:	2.0-inch sphere
7. Minimum Efficiency:	71%
8. Minimum NPSH Available:	27 feet
9. Discharge Connection:	8-inch

D. Motor
1. Shall be inverter rated with motor shaft grounding
2. In accordance with Section 16200

2.3 DESIGN, FABRICATION, AND MATERIALS

A. Pump
   1. Pump casing (housing): Cast iron, ASTM A48-83
      a. Impeller: Cast iron, non-clog design
      b. Shafting: Stainless steel, ground and polished
      c. Bearings: Heavy duty mill bearing construction with minimum B-10 life of 30,000 hours
      d. Exposed Nuts, Bolts, and Washers: ASTM A276, Type 316 stainless-steel construction
      e. Finishes: Spray exterior with PVC epoxy primer and chloric rubber paint finish

B. Impeller and Volute:
   1. Impeller:
      a. Gray cast iron, ASTM A48, Class 30
      b. Dynamically balanced
      c. Double-shrouded, non-clogging design having long through-let without acute turns
      d. Two-vane design, capable of passing minimum 3-inch solid sphere
      e. Capable of handling solids, fibrous materials, sludge, grit, and other matter found in normal domestic sewage applications
   2. Impeller and Shaft Fit: Sliding fit with one key
   3. Volute:
      a. Single piece
      b. Non-concentric design
      c. Smooth fluid passages capable of passing solids through impeller
   4. Wear Ring:
      a. Use for sealing between volute and impeller
      b. Stationary ring composed of VITRON rubber, molded with steel ring insert drive-fitted to volute inlet
      c. Rotating ASTM A276, Type 304 stainless-steel ring drive-fitted to impeller skirt

C. Mechanical Seal System:
   1. Shaft: ASTM A276, Type 420 stainless steel
   2. Shaft Seal: Tandem mechanical type
      a. Upper Tandem Set of Seals:
         i) Operating in oil chamber located just below stator housing
         i) One stationary tungsten-carbide ring and one positively driven rotating carbon ring
      b. Lower Tandem Set of Seals: Stationary tungsten-carbide ring and positively driven rotating tungsten-carbide ring
   3. Oil Chamber for Shaft-Sealing System: Drain and inspection plug, with positive anti-leak seal, accessible from outside

D. Motor
   1. Motor housing: Cast iron, ASTM A48

E. Appurtenances:
   1. Quick disconnect discharge elbow (pedestal base): 4-inch, 125 lb flanged ductile iron conforming to ANSI B16.1
   2. Guide rail pipes: 316 Stainless steel pipe
   3. Upper guide rail brackets: 316 Stainless steel
   4. Lifting chain and hook: 316 Stainless steel
   5. Anchor bolts, nuts and washers: 316 stainless steel

F. Accessories
   1. Discharge connection
      a. Quick disconnect discharge elbow: 4-inch, 125 lb flanged ductile iron conforming to ANSI B16.1
      b. Shall be connected to discharge piping and anchored to wetwell floor
   2. Power and Signal Cable: 40 feet hypalon-jacketed type SPC
   3. Cable holder
      a. Grip holders shall be provided for pump and control cable
      b. Continuous cables shall be provided from control panel to pumps and level controls
      c. Cables shall be adjusted easily to pumping level without the need of any splices
   4. Guide rails
      a. 316 stainless steel
      b. Fasten stainless steel guide supports to pump so that no lifting loads are applied to pump or motor housing
   5. Upper guide rail brackets
      a. 316 stainless steel
   6. Lifting chain and hook
      a. 316 stainless steel
      b. Shall be designed to lower and raise pump to overcome pump hang-forces
   7. Anchor bolts, nuts and washers
      a. 316 stainless steel
   8. Moisture and/or motor temperature relays as required by the manufacturer for inclusion in the motor controls for alarm
   9. Refer to drawings for access details and dimensions

G. Bearings:
   1. Rotate shaft on two permanently lubricated bearings
   2. Upper Bearing: Single-row roller bearing
   3. Lower Bearing: Two-row angular-contact ball bearings

H. Cable Entry Seal:
   1. Single cylindrical elastomer grommet, flanked by stainless-steel washers with close tolerance fit against cable outside diameter and entry inside diameter, and compressed by entry body containing strain-relief function, separate from function of sealing cable
   2. Bear assembly against shoulder in pump top

3. Separate cable entry junction chamber and motor by stator-lead sealing gland or terminal board, which isolates motor interior from foreign material gaining access through pump top

I. Electrical equipment
   1. Conform Division 16 on all electrical equipment and controls
   2. Electrical switch gear, control panel, VFDs, and pump controls shall be provided under Division 16
   3. Motor(s) shall be equipped with thermal sensor(s) attached to or imbedded in the motor windings and connected to pump controls

2.4 FABRICATION

A. Pump
   1. Heavy duty, non-clog pumping units
   2. Complete with electric motor, discharge piping, float switch actuated control, power cord, and other accessories required for proper installation or operation
   3. Impeller
      a. Shall be secured to shaft with key and self-locking device to prevent slipping in either direction
      b. Casing repair by plugging, welding or other means shall not be acceptable
      c. Shall be balanced statically and dynamically to eliminate vibration and minimize hydraulic end thrust
   4. Motor
      a. Hermetically sealed, squirrel-cage induction motor with shell type design in air-filled watertight chamber
      b. 460V, 3 phase, 60 hz
      c. Waterproof, oil-resistant, grounding, flexible power cord, length as necessary per plans
      d. Shall be inverter duty

2.5 SHOP COATINGS

A. Steel and iron surfaces
   1. Inaccessible surfaces: Prime and paint surfaces to provide protection for life of equipment
   2. Exposed surfaces
      a. Preparation: Finish, smooth, and thoroughly clean surfaces to provide smooth uniform base for painting
      b. Coating: Prime surfaces to be painted after installation
   3. Pump shall be coated in accordance with Section 09900

B. Machined, polished and nonferrous surfaces: Coat surfaces not to be painted with rust preventive compound

PART 3 EXECUTION

3.1 FACTORY QUALITY CONTROL AND TESTING

A. Testing
   1. Testing of equipment shall be in accordance to manufacturer's recommendations and shall include, but not limited to, the following contained herein this section
   2. Factory test each pump for capacity, power requirements, efficiency at specified rated flows, head, operating extremes, and as many other points as necessary for accurate performance curve plotting
      a. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for all pumps
      b. Certified pump performance curves shall be submitted, including head, capacity, and brake horsepower, for each pump supplied
      c. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the Engineer at least ten working days before the scheduled test date. All electronic transducers, meter, gauges, and other test instruments shall have been calibrated in accordance with the requirements of the Hydraulic Institute Standards. Copies of calibration data shall be provided
      d. All pumps shall be tested at full speed and complete staging through the specified range of flow, and head/capacity/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency
      e. If any pump tested, fails to meet any specification requirement, it will be modified until it meets all specification requirements. If any pump tested, fails to meet the efficiency requirements at any of the listed flow or head conditions listed and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with units(s) which meet the specified requirements
   3. Equipment and operational factory testing shall be witnessed by the Owner’s authorized representatives and Engineer

3.2 SPARE PARTS

A. Spare mechanical seal(s) for each pump is required

B. Additional spare parts as recommended and provided by pump manufacturer

C. Provide is sealed boxes and cartons well marked and labeled with a packing list. Provide to Owner with a written transmittal log.

3.3 INSTALLATION

A. Provide a complete unit with all materials, components and adjustments as required for complete and proper operation

B. Make electrical connections required for proper pump operation

C. Provide all necessary lubrication for initial start-up, testing and as required for final acceptance

D. Do not place grout for pump pedestal bases until pumps are completely aligned

E. Install in accordance with pump manufacturer's instructions, Hydraulic Institute, and as specified

F. Ensure proper operation of guide rail system for easy removal and installation of pump

G. Test pump connections for piping stresses after final alignment and bolting, adjust if necessary

H. Install pipe and pipe appurtenance supports to minimize stresses being placed on pump discharge flange

3.4 FIELD INSPECTION AND START-UP

A. Engineer shall be notified in writing prior to initial shipment, in ample time so that arrangements can be made for inspection by the Engineer when equipment delivery is made

B. Manufacturer's field service technician shall be provided, who has complete knowledge of proper operation and maintenance of the equipment, for a period of no less than two (2) days to inspect the installed equipment, supervise the initial test run, and to provide instruction to the operation and maintenance personnel. The first visit shall be checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test

C. At least one (1) of the two (2) days shall be allocated solely to instruction of Owner's personnel in operation and maintenance of the equipment. The instruction period shall be scheduled at least 14 days in advance with the Owner and shall take place prior to start up and acceptance by Owner. The final copies of operation and maintenance manuals specified must be delivered to the Engineer prior to scheduling the instruction period with the Owner with the permission of the Engineer, these services may be combined with those specified by Paragraph 3.4.B.

3.5 INSTALLATION QUALITY CONTROL AND TESTING

A. Testing
   1. Testing of equipment shall be in accordance to manufacturer's recommendations and shall include, but not limited to, the following contained herein this section
   2. Field tests, equipment and operational, shall not be conducted until such time that the entire installation is complete and ready for testing
   3. Equipment and operational field testing shall be witnessed by the Owner's authorized representatives and Engineer
   4. Check the following before operating pumps:

a. Loosen flange bolts on pump; if any movement or opening of joint observed adjust piping to proper fit
b. Ensure piping is clear of all debris
c. Check for sufficient lubrication
d. Check for open discharge piping valves
e. Check for correct rotation
f. Re-check alignment after grout completely set and re-align as required
g. Check pump rotation

5. Equipment Tests:
   a. Check performance of all components as a functioning unit
   b. Verify conformance to specifications
   c. Check alignment of each unit
   d. Conduct tests at maximum rpm of pump
   e. Verify factory test as well as possible with facilities available at the site of installation, including head capacity and overall unit efficiency
   f. Check each alarm, detection device, and level control for proper operation
6. Operational Tests:
   a. Conduct such operational tests as necessary to determine that the performance of equipment (each pump) and controls is as specified
   b. Tests will generally consist of placing equipment in operation under varying conditions and observing performance, minimum of three points for flow, discharge pressure, and motor amps:
      1) Shutoff head
      2) Design duty operating point
      3) Designated test run time to be coordinated with Engineer

B. If the Equipment mechanism exhibits any problems due to defects in materials or manufacturing workmanship, the tests shall be halted and the problem corrected by the manufacturer, and the test period started over again

C. All labor, materials, and test apparatus necessary for conducting the field acceptance test shall be furnished by Manufacturer at no additional cost

D. Perform tests and prepare test reports in accordance with Hydraulic Institute Standards and Manufacturer's standard reports

E. Submit a written test report to Contractor and with one copy to Engineer in a letter form stating operations performed and results obtained for each unit in addition to the submittal requirements for test reports. Include written test report in final O&M manual.

END OF SECTION

SECTION 11316

ROTARY LOBE PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rotary lobe pumping units to be used for pumping aerobically digested solids for recirculation and transfer to dewatering equipment

1.2 DESCRIPTION

A. Contractor shall furnish and install two variable-speed rotary lobe pumps for pumping aerobically digested solids for recirculation in and transfer among Digester Tanks

B. Pumps shall be furnished complete with suction/discharge nozzles, casings, shafts, bearings, wearing rings, seals, shaft, sleeves, anchor bolts, motors, speed reducers, and all other parts and accessories indicated, specified, or required for proper installation, operation, and maintenance

1.3 RELATED SECTIONS

A. Division 1 – General Requirements

B. Section 09900 – Coating

C. Section 15060 – Pipe and Pipe Fittings

D. Section 15100 – Valves, Cocks, and Hydrants

E. Section 16050 – Basic Electrical Materials and Methods

1.4 REFERENCES AND STANDARDS

A. American Gear Manufacturers Association – AGMA:
   1. 2001-B88 – Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
   2. 6001-B89 – Design and Selection of Components for Enclosed Gear drives
   3. 6010-E88 – Spur, Helical, Herringbone and Bevel Enclosed Drives

B. American National Standards Institute/American Society of Mechanical Engineers - ANSI/ASME:
   1. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
   2. B16.5 – Pipe Flanges and Flanged Fittings

C. American Society for Testing and Materials – ASTM:
   1. A48 – Standard Specification for Gray Iron Castings

2. A108 – Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
3. A276 – Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes
4. A283 – Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
5. A576 – Standard Specification for Steel Bars, Carbon, Hot Wrought, Special Quality
6. A681 – Standard Specification for Tool Steels Alloy
7. A743 – Standard Specification for Castings, Iron-Chromium, Iron-Nickel, Corrosion Resistant, for General Application
8. E10 – Test Method for Brinell Hardness of Metallic Materials

D. American Iron and Steel Institute – AISI:
1. 4140 – Heat Treated Hexagon Steel
2. 4130 – Heat Treated Alloy Steel

E. Antifriction Bearing Manufacturer's Association – ABMA:
1. 9-90 – Load Ratings and Fatigue Life for Ball Bearings
2. 11-90 – Load Ratings and Fatigue Life for Roller Bearings

F. American National Standards Institute/Hydraulic Institute (ANSI/HI):
1. 3.1 – Rotary Pumps – Nomenclature Definitions, Application and Operation
2. 3.6 – Rotary Pump Tests
3. 9.1 – Pumps – General Guidelines for Types, Definitions, Application and Sound Measurement

G. Institute of Electrical and Electronics Engineers – IEEE

H. National Electrical Manufacturers Association – NEMA

I. National Fire Protection Association – NFPA

J. National Electrical Code – NEC

K. Underwriters Laboratories – UL

1.5 SUBMITTALS

A. Submit under provisions of Section 01340

B. Shop drawings: Submit complete fabrication, assembly foundation, and installation drawing for all pumps, materials, parts, devices, motors and accessories to illustrate construction and assembly of components.

C. Product data: Data to be submitted to verify compliance with specifications shall include, but not limited to, the following:
1. General
   a. Spare parts list, list of lubricants, and recommended spare parts
   b. Installation assembly/disassembly and repair instructions
   c. Layout dimensions
   d. Protective coating system

e. Test certificates and results.

2. Pump
   a. Manufacturer name
   b. Type and model
   c. Diameter of suction end of pump
   d. Diameter of discharge end of pump
   e. Type of drive design
   f. Shaft design
   g. Type of bearings, bearings manufacturer, and bearing life calculations
   h. Provisions for removing rotor and stator assembly and changing bearings
   i. Weights
      i) Pump (with rotating assembly)
      ii) Total each unit.
      iii) Rotating assembly
      iv) Based plate
      v) Removable section of casing
      vi) Motor and speed reducer
   j. Complete performance curves showing capacity versus head, NPSH required, operating speed, pump efficiency, and bhp.
   k. Type of coupling
   l. Data on shop painting and coating system
   m. Nameplate data:
      i) Name of manufacturer
      ii) Type and model
      iii) Number of lobes and design rotative speed
      iv) Type of line shaft bearing
      v) Type and construction of pump seals
      vi) Type and size of shafting
      vii) Date of manufacturing
3. Motor
   a. Manufacturer name and serial number
   b. Type and model
   c. Rated size (hp) and horsepower output
   d. Temperature rise and method indicated
   e. Maximum ambient temperature
   f. Insulation class
   g. Rpm at rated load
   h. Locked rotor amperes or code letter
   i. Service factor
   j. Type of shaft and bearings
   k. Maximum noise level of pump/motor unit (dBA)
   l. Efficiency
   m. Enclosure and shaft dimensions
   n. Weight
   o. Bearing information
   p. Rated load current (amperes)
   q. Power voltage, phase and frequency

r. Control panel layout with devices and nameplates shown
s. Wiring schematics and diagrams with all devices, terminals, and wires uniquely numbered
t. Control panel device catalog data with bill of material. The bill of material shall be shown on the control panel drawings with all items numbered
u. Nameplate data:
   i) Name of manufacturer
   ii) Type and model
   iii) Type of bearings
   iv) Rated hp size
   v) Full load current
   vi) Motor performance data
   vii) Date of manufacturing

D. Test reports
1. Certified performance curves plotted against shutoff to 120% of design flow at the conditions specified herein for Phase I and Phase II and shall be submitted for the following parameters as a function of pump capacity rotative speed and TDH at the design temperature:
   a. Total developed head
   b. Brake horsepower required
   c. Efficiency of pump
   d. Required NPSH
   e. Actual speed
2. Plot curve to be easily read at scales consistent with the performance requirements

E. Factory Tests
1. Perform standard tests on all motors in accordance with IEEE standards

F. Accessories
1. Provide manufacturer and types of seal and fittings
2. Provide manufacturer and types of no-flow switch or dry-run protection device
3. Provide discharge pressure monitoring and alarming devices

G. Manufacturer's installation instructions
1. Provide connection requirements and start-up instructions for pumps

H. Manufacturer's field start-up report
1. Indicate personnel present and actual tests and start-up procedures that were performed by manufacturer's representative
2. Submit all field test data

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730

B. Operation data: Include manufacturer's instructions, description of system operation, start-up data, trouble-shooting check lists, and repair data for pumps and motors

C. Maintenance data: Include manufacturer's literature, cleaning procedures, replacement parts lists, wiring diagrams, and for pumps and motors

1.7 FACTORY ASSEMBLY

A. Pump and motor units shall be shop assembled and aligned completely prior to shipping to project site

B. Any components removed for shipping shall be match-marked prior to removal and shipment to project site

C. After completion of specified factory tests, all pumps shall be prepared for shipment with minimum amount of assembly required, and such that no field disassembly, cleaning, and/or flushing is required

1.8 DELIVERY STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600

B. Accept pumps and components on site in factory packing. Inspect for damage. Comply with manufacturer's installation instructions

C. Protect pumps and components from physical damage including effects of weather, water and construction debris

D. Provide temporary inlet and outlet caps, and maintain in place until installation

E. All equipment and parts must be properly protected against any damage during a prolonged period at the site. Pumps shall be rotated 2 revolutions every 30 days of storage time

F. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion

G. Each box or package shall be properly marked to show its net weight in addition to its contents

1.9 WARRANTY

A. The manufacturer of the positive displacement pump shall offer a 100-percent Parts and Labor warranty with shipping included, wear and tear to the complete pumping assemblies for a period of 2 years beginning from date of substantial completion. This warranty shall include, but not be limited to, mechanical seals, wear plates, housing segments, and lobes. Warranty shall be valid for the process as described and specified herein

B. Multiple warranties for individual components shall not be acceptable

1.10 QUALITY ASSURANCE

A. Pumping unit and accessories shall be supplied by a single manufacturer

B. All pumping equipment furnished under this section shall be of a design and manufacture that has been used in aerobic wastewater sludge applications and shall be demonstrated to the satisfaction of the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer and specifically named herein

C. The manufacturer of this equipment shall comply with the requirements of ISO 9001 and such compliance shall be verified by an independent certification agency approved by the International Organization for Standardization. Documentation shall be submitted for approval showing compliance with this requirement

D. Pumps complete with motor, drives, base plate, necessary guards, and all other specified accessories and appurtenances shall be furnished by the pump manufacturer to insure compatibility and integrity of the individual components, and provide the specified warranty for all components

1.11 SPARE PARTS

A. Provide spare parts as follows:
   1. One set of special tools for pump service
   2. Two sets of mechanical seals and o-rings
   3. Two spare rotor sets, as specified
   4. Two front and back wear plates

1.12 SPACE CONSTRAINTS

A. Pumping unit and motor shall fit into the space indicated. Any modifications to piping or equipment as indicated on the Drawings shall be at no cost to the Owner

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Pump Manufactures
   1. Vogelsang
   2. Boerger
   3. Or engineer-accepted substitution

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. General
   1. All lubrication fitting shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards

2. All fluid-wetted parts including the mechanical seal shall be replaceable through the quick release front cover without disassembly of coupling, drive unit or the pipe system
3. Pumps shall be designed to temporarily run dry and operate in either direction
4. Oil quench for protection of mechanical seals is mandatory. Seal water flush systems are not acceptable
5. The pumps shall be constructed with an oil-filled intermediate chamber between the pump casing and the gearbox with the following functions:
   a. Oil-Quench (Lubrication and cooling) of the mechanical seals
   b. Detection of seal failures
   c. Buffer zone to the sealed timing gear
6. Oil drain of gearbox and intermediate chamber shall be easily accessible with side mounted drain screw. Oil drain under the pump is not acceptable
7. Rotor/shaft connection shall be oil-lubricated fed by an intermediate chamber and shall not come in contact with the pumped fluid
8. Pumps
   a. Pumping units shall be designed and selected for continuous duty pumping of digested sludge
   b. Shall operate at constant speed and be capable of running dry, for a short period of time, without damage to the pump and or drive unit
   c. Pumps shall be suitable for exposure to digested sludge and organic particles in concentrations up to 6 percent
   d. Stable and free of cavitation and noise throughout the specified operating head range
   e. Minimum hydrostatic test pressure: 1.5 times the shutoff head plus suction pressure
   f. Performance requirements based on aerobically digested sludge for temperatures ranging from 10°C to 25°C
9. Motors
   a. Nameplate ratings of the motors shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its characteristic curve at maximum speed
   b. Motors, intermediate shafting, couplings, and accessories shall be furnished by the pump manufacturer
      i) Coordinate the torsional analysis to include pump, driver, and intermediate shafting, bearings, and supports
      ii) Provide equipment necessary to restrain and maintain torsional stability and identify critical and half-critical speeds
   c. All motors shall be built in accordance with the latest NEMA, IEEE, ANSI, and AFBMA standards where applicable
   d. Motors shall conform to all requirements as specified herein and in Section 16200

B. Pump design conditions and solids characteristics are as follows for digester sludge pumps P-511 and P-512:
   1. Number of Pumping Units: 2
   2. Drive Type: Variable speed, gear drive, inverter duty

3. Pump Design Point 1:	75 gpm at 15 feet of total dynamic head at 2.0% solids
4. Pump Design Point 2:	150 gpm at 31 feet of total dynamic head at 2.0% solids
5. Pump Capacity Range:	75 – 150 gpm (each pump)
6. Minimum NPSH Available:	27 feet
7. Suction Condition:	5 feet
8. Fluid Type:	Aerobically digested sludge
9. Solids Content:	0.5% min – 6.0% max
10. Solids Handling Capacity:	3.0-inch sphere
11. Solids Temperature:	10°C to 25°C
12. Maximum Pump Rotational Speed:	320 RPM
13. Maximum Motor Rotational Speed:	1800 RPM
14. Minimum Motor Horsepower:	75 HP
15. Maximum Discharge Connection:	4 inches
16. Maximum Suction Connection:	4 inches

C. Motors
1. Shall be inverter duty in accordance with Section 16150
2. Shall be in-line geared type
3. Motors shall have a minimum of 1.15 service factor and shall have a TEFC, class F insulation
4. Shall include variable speed service
5. Shall be 460-volt, 3-phase, 60-Hz
6. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards where applicable

2.3 DRIVE UNITS

A. Geared Drives
1. Selection of gear drive unit shall be the responsibility of the rotary lobe pump manufacturer

2.4 DESIGN, FABRICATION, AND MATERIALS

A. General
1. Pumps shall be positive displacement rotary lobe type
2. Front cover shall permit the removal of the rotors without disturbing piping, bearings, and mechanical seals
3. Pumps and motors shall operate at any point within their operating range without undue noise and vibration
   a. Vibration at any point in the operating range shall not exceed the limits allowed by the Hydraulic Institute Standards
4. Complete units including motor, geared-drive, and pumping unit shall be mounted on a common base plate

B. Pump

1. Provide pump casings constructed of ductile iron or cast iron of sufficient thickness to withstand stresses and strains from service throughout the operating range
    a. Casing material shall have a Brinell Hardness Number (BHN) between 230 to 260
2. Casing shall also be machined to accept a reversible front and rear wear plate, constructed of Hardox 500 material or equal, to a finished hardened reversible surface of 370 to 430 BHN
    a. Pumps not equipped with a removable wear plate that use the front end cover for its wear surface or require bolts that are recessed below the lobe path, are not acceptable for any wearing surface
3. Pump shall have a smooth end cover
    a. End cover material shall have a BHN between 230 to 260
    b. Removable end cover shall be flush with no recesses or dead pockets where solids can accumulate
    c. Cover shall be with Buna-N or EPDM O-ring and provide complete access to the pump chamber without disconnecting pip work glands or bearings
    d. Shall be mounted to pump where it allows unhindered access to the rotors to facilitate ease of maintenance and operator safety
4. Casing and front cover shall be designed to allow removal of rotating elements without disturbing piping, bearings, or mechanical seals
5. Shall be designed with sufficient strength to withstand a minimum of 150 percent of the maximum head

C. Shafts
1. Shall be carbon steel ASTM A470 or ASTM A293 fitted with replaceable stainless steel sleeves where passing through the seal area
2. Shall be timed in their rotation by straight cut timing gears running in a separate oil chamber that contains ball and roller bearings for each shaft
3. Shaft shall be a minimum of 85 mm in diameter where rotors, bearings, and mechanical seals contact the shaft to decrease the potential of torsional shaft fatigue
    a. Step down or threaded shafts will not be acceptable
4. Shaft sleeves where mechanical seal rides shall be removable through the front of pump where removing cartridge mechanical seal and without disturbing the surrounding piping
5. Maximum shaft deflection at operating pressure shall be 0.0045 inches

D. Lobe Rotors
1. Shall have a gray cast iron core coated with abrasion-resistant Buna-N
    a. Core shall have a BHN between 65 to 72 with a minimum of three lobe tips
2. Geometry of rotor core shall be the same as that of the finished rotor
    a. Rotor vane geometry shall be convoluted to provide pressure-pulse free operation
    b. Design with rotor vanes parallel to shaft centerline will not be accepted
3. Balance lobes both statically and dynamically
4. Pump manufacturer shall be fully responsible for the excess vibration-free operation of the pumping units throughout the entire operating range
5. Provide two intermeshing rotors with a minimum of three lobes suitable for handling aerobically digested sludge
    a. Lobes shall be capacity of handling up to 6 percent solids content

6. Rotors shall be accessible through the removable front cover for maintenance and replacement
7. Rotors shall be positioned to the shaft by replaceable hardened key ways, and secured to the shaft by internal and external expansion clamp sleeves and flush discs requiring no recesses in the end cover

E. Mechanical Seals
1. Pumps shall be fitted with maintenance free, mechanical seals
2. Shall be cartridge style Tungsten Carbide/Silicon Carbide or of seal carrier in mild steel 304 stainless steel chrome oxide coated
3. Seal shall include mechanical seal faces, seal holder, and carrier, all applicable O-rings, and stainless steel shaft sleeve
4. Blocking chamber located behind mechanical seal and in front of bearing housing lip seal shall be fitted into the cartridge seal of pump to prevent contamination of bearings in the event of a seal failure
   a. Chamber shall be suitable for fill, from top of pump, and have an external pressurized oil bottle to review status of mechanical seals operation, mounted on top of pump, located in easy view of operator

F. Elastomers
1. Shall be EPDM

G. Port Connections
1. Shall be ANSI Class 150-lb flanges
2. Suction and discharge ports connection shall be provided by Manufacturer
3. Shall be hot dipped galvanized for long life and abrasion resistances

H. Base Plate
1. Pump, gear reducer, and motor shall be mounted on a galvanized steel base plate complete with necessary couplings, guards, and mounting hardware
2. Provide single piece base plate and mount equipment with in-line arrangement with space coupling

I. Pump Timing Gears
1. Shall run in oil and shall be mounted in a gear case contiguous with pump case
2. Gear case shall be fitted with oil fill and drain connections on top and bottom
3. Designs using side drains will not be acceptable

J. Bearings
1. Bearing life shall be designed for L-10 life of 100,000 hours

K. Gear Reducers
1. Shall be rated for 24 hour-a-day continuous service or frequent stops-and-starts intermittent service, whichever is most severe, and sized with a minimum service factor of 1.5
2. Provide NEMA C face connection between motor and gearbox
3. Provide helical reduction gears, rated for AGMA Class II service with a 1.5 service factor

4. Provide oil bath lubrication

L. Drivers
1. Provide 460V, 3-phase, 60 Hz, TEFC motors meeting all requirements of Division 16
2. Motor shall be high efficiency inverter duty rated for use with VFDs and shall have insulation Class F
3. Provide temperature switches as specified in Division 16

M. Pressure Discharge Monitor and Dry Run Protection
1. Pumping units shall including the following:
   a. Dry run protection
   b. Over-pressure protection
2. Provide a flanged wafer pressure isolator and control unit on the discharge side of each pump
3. Each pressure isolator shall be equipped with a pressure gauge and switch
4. Pressure switches shall comply with Division 16
5. Pressure gauge
   a. Pressure Gauges: Provide one pressure gauge per pump
   b. Ashcroft Type 1009, 1% accuracy or accepted substitution
   c. Pressure gauge range: 0 to 60 psi
   d. ½-inch NPT instrument-grade fittings, made of carbon steel with zinc plate
   e. Include with each gauge:
      i) Ashcroft No. 1092, brass tee handle cock for isolation cock or accepted substitution
      ii) Ashcroft No. 1/4-1106B brass pulsation dampener or accepted substitution
      iii) Schedule 160 brass connecting nipples
      iv) Factory-mounted and filled diaphragm pressure seal with clean out ring and flushing connection and shall be Ashcroft No. 1/4-101SS-02T-CG or accepted substitution
      v) Ashcroft No. 1094 brass lever handle union cock for vent cock or accepted substitution
      vi) Isolation cock, diaphragm seal, a vent cock and dampener shall be installed between gauge and header
6. All fasteners and wetted components shall be 316 stainless steel
7. Pressure switches shall comply with Division 16
8. Provide pressure isolator ring complete with pressure gauge and high pressure switch
9. Gauge and switch shall be rigidly mounted to pressure isolator with ½-inch NPT instrument-grade fittings, made of carbon steel with zinc plate
10. Sensor body shall be manufactured from 125-lb ASTM size carbon steel flanges and shall consist of a metal ring with Buna-N inner tube filled with silicone instrument oil
11. Sensor shall be flow-through design with a flexible Buna-N sleeve around full circumference. Center section shall have a cavity behind the Buna-N sleeve filled with silicone fluid to transfer pressure to gauge
12. Provide dry run control system. Sensor shall be capable of detecting dry suction and over-pressure occurrences in the pipe. If a dry suction or over-pressure occurrence is sensed, pump shall shut down or shall not start and a signal shall be relayed to PLC indicating dry suction or over-pressure, respectively

2.5 PAINTING AND PROTECTIVE COATINGS

A. Shop Painting
   1. Manufacturer shall prepare surfaces, prime, and finish paint all iron and steel surfaces with coating system suitable for service intended (corrosive environment) and as specified in Section 09900
   2. All stainless steel surface shall not be painted

B. Field Painting
   1. Contractor shall touch-up all coatings damaged during shipment or installation of pumping units
   2. Pump manufacturer shall furnish Contractor with adequate supply of touch-up paint

PART 3 EXECUTION

3.1 INSTALLATION

A. Use procedures recommended by pump manufacturer, Hydraulics Institute, and specified herein

B. Level, plumb, align drive shaft, and wedge unit into position to fit connecting piping

C. Grout pump base after initial fitting and alignment but before final bolting of connecting piping

D. Take special care to maintain alignment of components

E. No strain shall be transmitted to the pump flanges

F. Test pump connections for piping stresses after final alignment and bolting
   1. Loosen flange bolts
   2. If any movement or opening of joints is observed, adjust piping to fit

G. Realign couplings after grouting

H. Do not shim between machined surfaces

I. Provide all lubricants necessary for initial startup operations and testing or as required for final acceptance

J. Lubricate all bearings, gears, and other items required before equipment placement for operation
   1. Replace all lubricant consumed during testing, startup, and operation prior to acceptance of equipment by Owner

3.2 FIELD INSPECTION

A. Manufacturer's field service technician shall be provided, who has complete knowledge of proper operation and maintenance of the equipment, for a period of no less than two days to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel. The first visit shall be checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test

B. At least one of the two days shall be allocated solely to instruction of plant personnel in operation and maintenance of the equipment. The instruction period shall be scheduled at least 14 days in advance with the Owner and shall take place prior to start up and acceptance by Owner. The final copies of operation and maintenance manuals specified must be delivered to the Engineer prior to scheduling the instruction period with the Owner with the permission of the Engineer, these services may be combined with those specified by Paragraph 3.2.A

C. Engineer shall be notified in writing prior to initial shipment, in ample time so that arrangements can be made for inspection by the Engineer

D. Warranty shall be for a period of two years

3.3 QUALITY CONTROL AND TESTING

A. Testing
   1. Testing of equipment shall be in accordance to manufacturer's recommendations and shall include, but not limited to, the following contained herein this section
   2. Factory test each pump for capacity, power requirements, efficiency at specified rated flows, head, operating extremes, and as many other points as necessary for accurate performance curve plotting
      a. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for all pumps
      b. Certified pump performance curves shall be submitted, including head, capacity, and brake horsepower, for each pump supplied
      c. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the Engineer at least ten working days before the scheduled test date. All electronic transducers, meter, gauges, and other test instruments shall have been calibrated in accordance with the requirements of the Hydraulic Institute Standards. Copies of calibration data shall be provided
      d. All pumps shall be tested at full speed and complete staging through the specified range of flow, and head/capacity/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency
      e. If any pump tested, fails to meet any specification requirement, it will be modified until it meets all specification requirements. If any pump tested, fails to meet the efficiency requirements at any of the listed flow or head conditions listed and all

reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with units(s) which meet the specified requirements

3. Equipment and operational testing shall be witnessed by the Owner's authorized representatives and Engineer
4. Field tests, equipment and operational, shall not be conducted until such time that the entire installation is complete and ready for testing
5. Equipment Tests:
   a. Check performance of all components as a functioning unit
   b. Verify conformance to specifications
   c. Check alignment of each unit
   d. Conduct tests at maximum rpm of pump
   e. Verify factory test as well as possible with facilities available at the site of installation, including head capacity and overall unit efficiency
   f. Check vibration. Amplitude shall be measured at centerline of pump and motor bearing housing in all planes
   g. Vibration velocity shall not exceed 0.12 inches per second and shall be measured at centerline of pump and in all planes
   h. Check each alarm and detection device for proper operation
6. Operational Tests:
   a. Test in accordance with manufacturer's recommendations
   b. Conduct such operational tests as necessary to determine that the performance of equipment and controls is as specified
   c. Tests will generally consist of placing equipment in operation under varying conditions and observing performance

B. If the Equipment mechanism exhibits any problems due to defects in materials or manufacturing workmanship, the tests shall be halted and the problem corrected by the manufacturer, and the test period started over again

C. All labor, materials, and test apparatus necessary for conducting the field acceptance test shall be furnished by Manufacturer at no additional cost

D. Perform tests and prepare test reports in accordance with Hydraulic Institute Standards

E. Submit a written test report to Contractor and with one copy to Engineer in a letter form stating operations performed and results obtained for each unit in addition to the submittal requirements for test reports

3.4 FIELD START -UP SERVICES

A. Provide manufacturer's field service representative for a minimum of one 8-hour day on-site to inspect installation and witness testing. Also instruct plant personnel on its proper operation in compliance with requirements of Division 1

B. Check the following before operating pumps:
   1. Loosen flange bolts on pump; if any movement or opening of joint observed adjust piping to proper fit
   2. Ensure piping is clear of all debris

3. Check for sufficient lubrication
4. Check for open discharge piping valves
5. Check for correct rotation
6. Re-check alignment after grout completely set and re-align as required

END OF SECTION

SECTION 11321

GRIT CLASSIFIER EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. One complete grit classifier system receiving flow from one grit pump, consisting of one screw-type dewatering classifier complete with grit cyclone or concentrator

B. Any equipment located in the Headworks Building shall be rated for Class 1, Division 2. The control panel for the Grit Classifier shall be located in the Headworks Electrical/Control Room, which is an unclassified space.

1.2 DESCRIPTION

A. Contractor shall furnish, install, and place into satisfactory operating condition, equipment for one grit classifier system located in the Headworks Building.

B. Grit classifier equipment shall be rated for a minimum peak flow of 2.6 MGD (peak hourly) influent flow to the wastewater treatment facility

C. Grit classifier equipment shall include electric motor, cyclone or concentrator, settling hopper and trough classifier, drive assembly, shaftless spiral, electrical and controls, and all other appurtenances required for proper operation, and maintenance

1.3 RELATED SECTIONS

A. Division 1 – General Requirements

B. Section 05500 – Metal Fabrications

C. Section 09900 – Coatings

D. Section 11322 – Mechanically-Induced Vortex Grit Removal Equipment

E. Section 15060 – Pipe and Pipe Fittings

F. Section 16050 – Basic Electrical Materials and Methods

G. Division 16 – Electrical

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. American National Standards Institute (ANSI)

C. American Bearing Manufacturer's Association (ABMA)

D. National Electrical Code (NEC)

E. National Electrical Manufacturer's Association (NEMA)

F. Institute of Electrical and Electronic Engineers (IEEE)

G. American Gear Manufacturer's Association (AGMA)

H. American Society of Mechanical Engineers (ASME)

I. Occupational Safety and Health Act (OSHA)

J. American Iron and Steel Institute (AISI)

1.5 SUBMITTALS

A. Shop Drawings consistent with Section 01340
   1. Layout, overall dimensions, required clearances, and general description of the equipment, including location of electrical equipment, control panels and other auxiliary equipment.
   2. Electrical control schematics, wiring diagrams, panel layout and general description including list of materials, and cut sheets on all control equipment

B. Product data
   1. General
      a. Spare parts list, list of lubricants, and recommended spare parts
      b. Installation assembly/disassembly and repair instructions
      c. Layout dimensions
      d. Protective coating system
      e. Wash water requirements
      f. Test certificates and results
   2. Classifier
      a. Manufacturer name
      b. Type and model
      c. Diameter of inlet
      d. Diameter of overflows and drains
      e. Screw length
      f. Screw pitch
      g. Type of bearings, bearings manufacturer, and bearing life calculations
      h. Weights
         i) Classifier (with rotating assembly)
         ii) Total each unit
         iii) Rotating assembly
         iv) Base plate
         v) Removable sections of classifier
         vi) Motor and speed reducer

i. Complete performance information showing grit removal efficiency, NPSH headloss through unit, operating speed, and bhp
j. Data on shop painting and coating system data
k. Nameplate data:
   i) Name of manufacturer
   ii) Type and model
   iii) Number of stages and design rotative speed
   iv) Date of manufacturing

3. Motor
   a. Manufacturer name and serial number
   b. Type and model
   c. Rated size (hp) and horsepower output
   d. Temperature rise and method indicated
   e. Maximum ambient temperature
   f. Insulation class
   g. Rpm at rated load
   h. Locked rotor amperes or code letter
   i. Service factor
   j. Type of shaft and bearings
   k. Maximum noise level of motor unit (dBA)
   l. Efficiency
   m. Enclosure and shaft dimensions
   n. Weight
   o. Bearing information
   p. Rated load current (amperes)
   q. Power voltage, phase and frequency
   r. Control panel layout with devices and nameplates shown
   s. Wiring schematics and diagrams with all devices, terminals, and wires uniquely numbered
   t. Control panel device catalog data with bill of material. The bill of material shall be shown on the control panel drawings with all items numbered
   u. Nameplate data:
      i) Name of manufacturer
      ii) Type and model
      iii) Type of bearings
      iv) Rated hp size
      v) Full load current
      vi) Motor performance data
      vii) Date of manufacturing
4. Complete data on materials to be used for fabrication
5. Electrical schematics and layouts
6. UL listing

C. Manufacturer's installation instructions
   1. Provide connection requirements and start-up instructions for equipment

D. Manufacturer's field start-up report

1. Indicate personnel present and actual tests and start-up procedures that were performed by manufacturer's representative
2. Submit all field test data

1.6 OPERATION AND MAINTENANCE DATA

A. Operation and Maintenance Data consistent with Section 01730 and including:

B. Operation data: Include manufacturer's instructions, description of system operation, start-up data, trouble-shooting check lists, and repair data for pumps and motors

C. Maintenance data: Include manufacturer's literature, cleaning procedures, replacement parts lists, wiring diagrams for equipment and motors

1.7 FACTORY ASSEMBLY

A. Equipment and motor units shall be shop assembled and aligned completely prior to shipping to project site

B. Any components removed for shipping shall be match-marked prior to removal and shipment to project site

C. After completion of specified factory tests, all equipment shall be prepared for shipment with minimum amount of assembly required, and such that no field disassembly, cleaning, and/or flushing is required

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600

B. Accept equipment, components, and spare parts on site in factory packing. Inspect for damage. Comply with manufacturer's installation instructions

C. Protect equipment and components from physical damage including effects of weather, water and construction debris

D. Provide temporary inlet and outlet caps, and maintain in place until installation

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion

F. Furnish any special tools required for equipment assembly or disassembly

G. Each box or package shall be properly marked to show its net weight in addition to its contents

1.9 WARRANTY

A. A two-year warranty shall be provided from date of substantial completion.

B. Multiple warranties for individual components shall not be acceptable

1.10 QUALITY ASSURANCE

A. The grit classifying system specified in this section shall be furnished by and be the product of one manufacturer including the grit pump, cyclone/concentrator, classifier and all specified accessories and appurtenances to ensure compatibility, integrity of individual components and unit responsibility

B. All grit classifying equipment furnished under this section shall be of a design and manufacture that has been used in similar applications and it shall be demonstrated to the satisfaction of the Owner and Engineer that the quality is equal to equipment made by the manufacturer specifically named herein.

C. Manufacturers shall provide evidence of at least five installations in which identically sized equipment has provided satisfactory performance for a minimum of five years in a similar application. No consideration will be given to equipment that has not been commercially available for five years

D. To insure a consistently high standard of quality, the manufacturer of this equipment shall comply with the requirements of ISO 9001 and such compliance shall be verified by an independent certification agency approved by the International Organization for Standardization. Documentation shall be submitted for approval showing compliance with this requirement and the equipment will not be released for shipment until approved

1.11 SPARE PARTS

A. Provide spare parts as indicated below for the grit classifier:
   1. One set of drive bearings
   2. One set of oil seals and gaskets
   3. One upper gasket
   4. One drive belt
   5. One lock bushing
   6. One set of wearing shoes with 316 SS nuts and bolts

1.12 SPACE CONSTRAINTS

A. Grit classifier and all appurtenances shall fit into the space indicated on the Drawings. Any modifications to piping or equipment as indicated on the drawings shall be at no cost to the Owner

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. WesTech

B. Enviro-Care

C. Hydrodyne

D. JWC Environmental

E. Or accepted substitution

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. General
1. Provide one grit screw classifier with integral grit concentrator. The grit slurry shall be pumped through the grit cyclone mounted on top of the screw classifier over the settling pool. Grit is settled in the classifier hopper while returning the overflow and light organics to the flow stream. The grit is then conveyed out of the hopper by the shaftless spiral, dewatered and discharged by gravity into a dumpster.

B. Design Criteria

1. Number of Grit Cyclones:	1
2. Average Influent Wastewater Flow:	0.995 MGD
3. Peak Influent Wastewater Flow:	2.6 MGD
4. Pumped Flow to each Cyclone:	200-300 gpm
5. Cyclone Inlet Connection:	4 inch flanged
6. Cyclone Overflow Outlet Connection:	6 inch flanged
7. Cyclone Underflow Rate:	20-30 gpm
8. Solids Throughput Capacity:	50 cfh
9. Screw Diameter:	9 inch (minimum)
10. Classifier Screw Angle of Inclination:	25 degrees
11. Classifier Outlet Connection:	4 inch flanged
12. Classifier Tank Drain Connection:	2 inch NPT

C. Environmental Conditions

1. Elevation:	7,385 feet above sea level
2. Indoor temperature:	40ºF to 75ºF
3. Location:	Class 1, Division 2, Group D

2.3 DESIGN, FABRICATION, AND MATERIALS

A. General
1. Entire motor, drive, screw conveyor and lower bearing assembly shall be designed so the screw can be raised for inspection without the need to disassemble components or drain the classifier tank.
2. Shop Surface Preparation/Coating: All welds shall be cleaned and passivated to remove weld spatter, slag and discoloration. Bearings, electrical devices, motor and gear reducer shall be provided with the manufacturer’s standard coating system.

B. Grit Cyclone
1. One grit separation cyclone shall be provided to remove excess liquid and organics from the pumped flow to improve the efficiency of the grit classifier. The unit shall be watertight and remove grit through hydraulic forces requiring no moving parts.

2. Cyclone housing constructed from steel with pure gum rubber inlet head liner and Nihard vortex finder.
3. Fixed pure gum rubber apex liner and quick release toggle clamps on apex. The underflow apex shall be interchangeable with different size openings to adjust the flow split as required.
4. Tangential inlet connection to induce a vortex for separation of grit from the liquid.
5. Neoprene elbow for gravity discharge from the underflow to the classifier hopper.
6. Support stand from type 304 stainless steel.
7. The manufacturer shall provide an inlet pressure gauge for field installation at the inlet to the cyclone. The pressure gauge shall have a dial indicator with a range from 0-15 psig and be protected by a silicon or glycerin filled diaphragm assembly.

C. Classifier Hopper and Trough
1. The concentrated grit slurry from the cyclone will enter the screw classifier. Classifier hopper shall provide adequate volume to ensure that the inflow grit and water mixture has sufficient retention time for full separation of the heavy grit from the water and residual light organic solids.
2. The grit hopper and trough shall be constructed from 0.12 inch thick type 304 stainless steel. The unit shall be supported by an integral base at the bottom of the hopper and support stand bolted to the trough portion.
3. The hopper will contain a weir to drain off the water which will be adjustable to allow precise control of the floatation and removal of light organic solids and to minimize the carry over of fine grit. There shall be no parallel plate separators inside the hopper that can accumulate solids and inhibit performance. An underflow baffle shall separate the grit settling area from the overflow weir.
4. A drain connection will be located at the base of the hopper and trough, to allow the equipment to be emptied of water. The drain connection shall be provided with a 2” brass ball valve.
5. Wear bars constructed from 0.31 inch thick type 304 stainless steel shall be mechanically fastened in the trough to support the spiral assembly. Screws fastening the bars shall use seal washers and have their heads external to the unit to allow for periodic tightening or adjustment of the bars. Wear bars shall be replaceable without requiring welding or replacement of the conveyor tube.
6. Sectional covers constructed from type 304 stainless steel shall be bolted to the top of the classifier hopper and inclined trough.
7. A spay bar shall be installed inside the inclined trough to help rinse organics from the collected grit. The spray bar shall be constructed from type 304 stainless steel pipe with a 1/2 inch NPT connection and brass body manual ball valve.

D. Drive Assembly
1. The drive assembly transmits power generated by the motor to the spiral screw of the classifier to convey settled grit up the inclined trough to the discharge of the unit.
2. The reducer shall be a helical gear type. The unit will be provided with a cast iron frame and be designed in accordance with AGMA recommendations for Class II service based on the horsepower required to operate the screen.

3. The motor shall be TEFC, 1800 RPM, 460 Volt, 3 phase, 60 Hz. The motor shall be NEMA design code B and be direct coupled to the reducer. The motor will be suitable for a Class 1 Division 2 location.
4. The motor/reducer assembly shall be directly connected to the main drive shaft via the reducer's hollow shaft. Designs that incorporate additional chain and sprocket assemblies that might bind or break are not acceptable.
5. The main drive shaft of the classifier extends from the reducer into the end of the inclined trough. The drive shaft shall be constructed from high strength alloy steel and supplied with a protective epoxy primer. The free end of the drive shaft shall end in a mounting flange for connection of the spiral screw.

E. Shaftless Spiral Assembly
1. The shaftless spiral conveys the settled material up the inclined trough to the discharge of the unit.
2. The spiral screw shall be shaftless throughout the length of the trough. The screw shall be fabricated from a high strength alloy steel section formed continuously into a spiral. The flight shall have a minimum thickness of 0.79 inch. The spiral shall be supplied with a protective epoxy primer.
3. The drive end of the spiral at the discharge location shall be welded to a coupling plate to mate with the drive shaft connected to the motor/reducer assembly. The screw shall have the ability to be replaced as an individual item without the need to disconnect the drive system from the unit, or removing the shaft from the gearbox.

F. Electrical
1. In addition to the drive motor, the equipment supplier shall furnish all electrical items specifically called for in this specification section. The contractor shall supply all other electrical items, and interconnecting wiring of proper size, including all conduit and supports required to place the equipment into service.
2. Control Panel of the grit classifier shall be provided by the vortex grit removal system panel. The following components shall be added to the grit system control panel to provide control of the classifier unit:
   a. Branch circuit protection.
   b. Drive motor starter.
   c. Hand-Off-Auto selector switch for the spiral screw.
   d. Current monitor shall provide overload protection by sensing motor current draw.
   e. Hour meter for motor.
   f. Run indicating light.
   g. Alarm light indicating over current, and starter overload.
   h. Run and alarm auxiliary contacts for use by the customer.

G. Local Emergency Stop Pushbutton: A local emergency stop pushbutton station will be provided in a NEMA 4X enclosure for field mounting at the unit.

H. Solenoid Valve
1. One 1/2 inch solenoid valve shall be provided to control flow to the spray wash assembly. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.

2.4 SEQUENCE OF OPERATION

A. Classifier Hand Operation
   1. When the classifier selector switch is in the Hand position, the classifier spiral will run continuously. Turning the selector switch to Off will stop the unit.

B. Classifier Automatic Operation
   1. When the classifier selector switch is in the Auto position, the classifier will be activated by the operation of the grit pump. While the pump is operating, the classifier shall cycle on and off by the settings of a repeat cycle timer. Once the pump completes operation, the classifier shall run for an adjustable off delay time.

C. Spray Wash Hand Operation
   1. When the spray selector switch is in the Hand position, the spray wash will run continuously. Turning the selector switch to Off will stop the spray wash.

D. Spray Wash Automatic Operation
   1. When the spray selector switch is in the Auto position, the spray wash will cycle on and off with the operation of the spiral.

E. Fault Conditions
   1. Excessive motor current will trip the starter overload relays, immediately stop the drive motor, and illuminate the alarm indicating light. This fault must be reset by depressing the motor starter overload reset internal to the control panel.
   2. Momentary motor over current will trip the current monitor, immediately stop the drive motor, and illuminate the alarm indicating light. Pushing the reset pushbutton will reset this fault.

F. Anchorage and Fasteners
   1. Anchor Bolts: All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
   2. Fasteners: All fasteners shall be type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

2.5 FINISHING

A. Surface preparation, factory prime, field prime, and finish coats per Section 09900

PART 3 EXECUTION

3.1 INSTALLATION

A. Install as indicated on the Drawings and in strict accordance with manufacturer’s written instructions, shop drawings, and recommendations.

B. Prior to startup, the equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance

A. Install the grit classifier system in accordance with the manufacturer’s instructions

B. Lubricate the equipment before start-up

C. Conduct field tests to demonstrate that the system performs according to the specifications

D. The equipment supplier shall furnish four copies of operation and maintenance manuals which will be retained at the installation site to assist Town staff. The manual shall include the supplier’s erection and assembly recommendations, a complete parts list, a list of recommended spare parts, and complete maintenance procedures.

3.2 QUALITY CONTROL AND TESTING

A. Assemble the grit dewatering units and test all mechanical and electrical components for proper operation including grit screw mechanism, grit screw drive, and emergency stop switch.

B. Perform all field testing with Engineer present and in accordance with manufacturer's recommendations

C. Manufacturer shall provide written statement indicating that all equipment was installed in accordance with their instructions, shop drawings, and recommendations.

3.3 MANUFACTURER’S FIELD SERVICES

A. Manufacturer to include a minimum of one day for eight hours of onsite inspection, start-up, and training with base bid

B. Coordinate field service work with the manufacturer’s representative, Owner, and Engineer prior to initiating work

END OF SECTION

SECTION 11322

MECHANICALLY-INDUCED VORTEX GRIT REMOVAL EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall furnish, install and place into satisfactory operating condition, equipment for one vortex grit chamber. Each chamber shall consist of a concrete chamber, drive unit, torque tube with impeller, grit well cover plate, electrical controls, and all other piping and appurtenances required or shown on the drawings or necessary for the proper operation of the specified equipment.

B. Any equipment located in the Headworks Building shall be rated for Class I, Division II.

1.2 RELATED SECTIONS

A. Section 03300 – Cast-In-Place Concrete

B. Section 03600 – Non Shrink Grout

C. Section 05501 – Anchor Bolts and Expansion Anchors

D. Section 05590 – Metal Fabrications

E. Section 07920– Joint Sealers

F. Section 09900 – Coatings

G. Section 11321 – Grit Classifier

H. Section 16050 – Basic Electrical Materials and Methods

1.3 REFERENCES AND STANDARDS

A. American National Standards Institute (ANSI)
   1. B3.15 – ABMA Standard, Load Ratings and Fatigue Life for Ball Bearings
   2. B3.16 – ABMA Standard, Load Ratings and Fatigue Life for Roller Bearings
   3. B16.1 – Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 Pound

B. American Society for Testing and Materials International (ASTM)
   1. A36 – Carbon Structural Steel
   2. A48 – Gray Iron Castings
   3. A689 – Carbon and Alloy Steel Bars for Springs
   4. A743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01340

B. Shop drawings: include the following:
   1. Layout, overall dimensions, required clearances and general description of the equipment, including location of electrical equipment, control panels and other auxiliary equipment
   2. Electrical control schematics, wiring diagrams, panel layout and general description including list of materials

C. Product data: include the following:
   1. Motor characteristics and performance
   2. Accessories
   3. List of recommended spare parts other than specified spare parts
   4. Wash water requirements
   5. UL listing

D. Templates or setting plans, with tolerances, for anchor bolts

E. Operation and maintenance manuals: include shop manuals

F. Equipment manufacturer certification of bearing life

G. Motor shop test results

H. Certified data and capability: include the following:
   1. Detailed certified test data, furnished with shop drawings, establishing grit removal performance. Obtain test data from test conducted on operating unit, of same model, 20 foot diameter or larger and in same service as units to be supplied.
   2. Certified test data to establish that unit meets requirements.
   3. Accepted certified test data does not relieve Contractor nor manufacturer of equipment from performing additional tests, at no additional cost to the Owner, on installed equipment utilizing wastewater to demonstrate that equipment equals or exceeds minimum requirements as specified.

I. Shop and field testing procedures and equipment.

J. Manufacturer’s installation instructions

1.5 SYSTEM REQUIREMENTS

A. Grit basin design requirements
   1. Influent/Effluent Orientation: 360 degrees
   2. Unit capacity
      a. Peak hourly flow: 2.6 MGD
      b. Maximum month average daily influent wastewater flow: 0.995 MGD
   3. Head loss
      a. At Peak Flow: 0.20’ maximum

b. At Average Flow: 0.09’ maximum

4. Number of basins: 1
5. Upper Chamber Diameter: 8 feet
6. Upper Chamber Depth: 4 feet
7. Lower Chamber (Hopper) Diameter: 3 feet
8. Lower Chamber (Hopper) Depth: 5 feet
9. Vortex Drive Motor HP: 0.5 HP
10. Grit Removal: Self Priming Pump
11. Pump Capacity: 250 gpm
12. Pump TDH (maximum): 44 feet
13. Pump Motor (minimum): 5 hp
14. NPSH available (minimum): 26 feet
15. Access: No moving parts subject to wear or stoppage shall be below the water surface. All drives, lubrication, and bearings shall be readily accessible from the grit basin deck.
16. Velocity in grit trap chamber: minimum 1 foot per second
17. Influent and effluent channel widths and depths: as indicated on the Drawings
18. Water depth in channels at peak flows: as indicated on the Drawings

B. Environmental conditions
1. The grit chamber shall be used on wastewater
2. Temperature range (ambient): 50-77°F
3. Installation elevation: 7,385 ft

C. Modifications to contract documents:
1. Modifications to the Drawings and Specifications, directly or indirectly related to the grit basins, that may be required to accommodate a particular manufacturer's equipment, shall be at no change in Contract price. This shall include structural, mechanical, HVAC, and electrical design and construction modifications.
2. When modifications are required, the grit removal equipment submittal shall also include, but not be limited to, the following information, in addition to that required as part of the specified shop drawing information:
   a. Details of structural modifications, including dimensions and concrete reinforcement, when required.
   b. Details of mechanical modifications, including piping, and air and water connections, if required.
   c. Details of electrical modifications for power and control, if required.
   d. Details of HVAC modifications, including relocating ducts, when required.
3. The above-listed modifications information shall be prepared by a Professional Engineer licensed in the State where the Project is located in the branch of engineering appropriate to the modification desired and accompanied by a letter attesting to this, signed by the Engineer preparing the information.
4. Submit details: Any revisions or modifications to the submitted details the Engineer deems necessary to comply with the intent of the original design shall be at no additional cost to the Owner.

D. Performance requirements:
1. Grit chambers shall perform the following removal efficiencies at 2.6 MGD:

Percent Removed	Grit Mesh Size or Greater
95	Greater Than 50
85	50 – 70
65	70 – 100

2. Capacities and operating data: as specified above

1.6 QUALITY ASSURANCE

A. Manufacturer qualifications:
   1. Minimum five years of experience with the design, manufacture and operation of similar type units.
   2. Submit list of installations of units similar to specified units, including at least 10 installations of 8-foot diameter or greater.

B. Welding: In accordance with AWS Code
   1. Qualification for welders: AWS certified
   2. Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and clean them before the inspector makes the check inspection. Inspect welds under light for surface cracking, porosity, slag inclusions, excessive roughness, unfilled craters, gas pockets, undercuts, overlaps, size, and insufficient throat and concavity. Correct deficiencies until accepted by the Engineer.

C. One manufacturer shall furnish paddle, drive tube, drive head, electric motor, and when required, floor plates, regardless of manufacturer, as a complete and integrated package for proper coordination and compatibility of equipment.

D. The paddle, drive tube, and related equipment as indicated on the Drawings are general in nature and vary per manufacturer. Modifications required to accommodate a particular manufacturer's equipment will be at no cost to the Owner and subject to the Engineer's acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Ship equipment, material, and spare parts complete, except where partial disassembly is required by transportation regulations or for protection of components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. WesTech

B. Enviro-Care

C. Hydrodyne

D. JWC Environmental

E. Or accepted substitution

2.2 GENERAL DESIGN

A. Functional Description
   1. The influent is tangentially introduced into the vortex chamber where impeller blades create a forced vortex causing the organics to separate from the grit and be lifted up with the effluent while the heavier grit particles settle to the bottom of the lower chamber. A slurry pump shall pump the grit into other grit dewatering equipment.

B. Materials of Construction
   1. All structural steel shall conform to the requirements of ASTM A36. Steel pipe used for structural members shall conform to ASTM A53. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4". All aluminum shall be type 5052, 6061, or 6063 alloy unless noted.

C. Shop Surface Preparation/Coating
   1. All stainless steel welds and surfaces shall be cleaned and passivated to remove weld spatter, slag and discoloration. All carbon steel components shall be hot dip galvanized. Bearings, electrical devices, and drive shall be provided with the manufacturer’s standard coating system.

2.3 EQUIPMENT

A. Provide induced vortex grit removal system for use, as indicated on the Drawings and specified herein capable of removing grit from raw wastewater in a grit trap chamber and depositing the grit in a storage hopper where it can be pumped out for further dewatering in separate equipment.

B. Vortex Grit Separator Drive Unit
   1. Design Parameters
      a. The drive unit shall be manufactured by the vortex grit separator equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values and speeds previously listed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L10 life of 50 years or 450,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 5 rating when rated in accordance with AGMA 2001-B88. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.
      b. All gearing shall be designed per AGMA standard 2001-B88 for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the two values

determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.

c. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.

d. Any and all welding on the drive unit shall be done using E70XX weld rod.

2. Physical Characteristics

a. The drive unit shall consist of a solid external main gear, turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the operating platform frame and support the entire rotating load of the mechanism. The main external gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. All speed reducers shall be fully enclosed and running in oil or grease. Support base for the drive shall be of welded steel to assure rigidity. Oil and dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set with fully contoured raceways hardened to a minimum 58-60 Rc. The main gear and pinion shall run in an oil bath or be grease lubricated. If an oil bath is used, an oil sight glass, fill pipe, and drain line shall be provided for the reservoir. Lubrication fittings shall be readily accessible.

b. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29 x 106 psi. The drive shaft shall be fastened to and supported from the gear hub. Ball bearings shall be of the highest quality high carbon chrome alloy steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals.

c. The speed reducing unit shall consist of cycloidal or helical speed reducers directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.

d. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft.

e. Speed reducer helical gearing shall be manufactured to AGMA standards. The speed reducer shall have a service factor of 1.25.

f. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and run in a totally submerged oil bath or be grease lubricated.

g. The motor shall be an 1800 RPM, squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a service factor of 1.15. A motor canopy shall be provided. The motor shall be designed for 3 phase, 60 hertz, 480/240 volt power supply.

C. Vortex Grit Separator Equipment.

1. The torque tube shall be attached to the drive gear, and shall be fitted with adjustable axial flow impeller blades to rotate the upper chamber contents about the vertical axis. All components shall be constructed from A36 carbon steel.

2. The grit lift pipe shall be a single length of standard weight pipe ending in a flange. The pipe shall extend through the center of the drive torque tube and be supported from the stationary part of the drive gear housing. The pipe shall be constructed from carbon steel.
3. The water scour piping shall be provided to extend down from the drive to within 6 inches of the lower chamber floor. Piping shall be 1-1/2 inch standard weight pipe. A manual brass body ball valve and solenoid valve shall be supplied by the manufacturer for installation on the scour piping.
4. Lower Chamber (Hopper) Cover Plate: A floor plate to cover the lower chamber (hopper) shall be provided for installation by the contractor. The floor plate shall be provided in two sections to allow for removal and access to the lower hopper and shall include a circular opening centered over the hopper and sized to allow grit passage while minimizing organic capture. The floor plate shall not interfere with the operation of the grit removal mechanism or the scour assemblies if provided. The cover plates shall be constructed from 1/4 inch thick A36 carbon steel.

D. Grit Removal Pump – Self Priming Type
1. One pump shall be supplied for each vortex system.
2. Pumps shall be horizontal, self-priming, centrifugal type, and shall be designed for pumping the specified flow at the indicated total dynamic head and at the specified horsepower.
3. The pump shall be furnished complete with a ductile iron volute capable of passing a 3” sphere solid, hard iron (ADI) with 400 BRN hardness impeller and seal plate, and wear plate of hardened alloy steel.
4. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means with no special tools or shims. The pump shaft shall be 4150 alloy steel with a double oil lubricated mechanical seal with silicon carbide faces, assembled on a replaceable shaft sleeve.
5. Suction and discharge spool flanged shall be one-piece cast iron, class 30. Each spool shall have one 1-1/4” NPT and one 1/4” NPT tapped hole with pipe plugs for mounting gauges and other equipment.
6. The pump shall be mounted on a common base plate (pump over motor design) with the applicable configuration motor with constant speed V-belt drives and guard.
7. The pump motor shall be designed for non-overload operation conditions and should be suitable for service in wet conditions. The motor shall be a NEMA design, 1800-RPM, TEFC, severe-duty unit with 1.15 service factor. Power supply to the motor shall be 3 phase, 60 Hz with 230-460 VAC.

E. Electrical
1. In addition to the drive motor, the equipment supplier shall furnish all electrical items specifically called for in this specification section. The contractor shall supply all other electrical items, and interconnecting wiring of proper size, including all conduit and supports required to place the equipment into service. Each vortex system shall be provided with the following:
2. Control Panel
   a. A 480 volt primary control panel shall be provided in a NEMA 4X type 304 stainless steel enclosure suitable for wall mounting with the following components to provide proper operation of the equipment:

i) Step down control transformer, and disconnect.
ii) Branch circuit protection.
iii) Vortex and pump drive motor starters.
iv) Emergency stop pushbutton.
v) Vortex drive On-Off selector switch.
vi) Hand-Off-Auto selector switches for the pump and water scour.
vii) Cycle start pushbutton.
viii) Hour meter for each motor.
ix) Control power and run indicating lights.
x) Alarm light indicating over current, and starter overload.
xi) Alarm reset pushbutton.
xii) Programmable control relay to provide necessary control logic and monitor equipment mounted electrical devices.
xiii) Run and alarm auxiliary contacts for use by the customer

3. Solenoid Valve
   a. One (1) normally closed solenoid valve shall be provided to control flow to the water scour. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.

F. Anchorage and Fasteners:
   1. Anchor Bolts
      a. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
   2. Fasteners
      a. All structural fasteners shall be type 18-8 stainless steel. Drive assembly fasteners shall be ASTM A449 (SAE Grade 5) zinc plated carbon steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

2.4 SEQUENCE OF OPERATION

A. Grit Removal Sequence Automatic Operation
   1. In automatic mode, the grit removal sequence is initiated by the cycle start pushbutton, control panel 24 hour clock, or a dry contact input from the plant SCADA system for wet weather override. When the removal sequence is initiated, the scour solenoid will open for an adjustable period of time to fluidize the settled grit. Once the scour solenoid closes, the grit pump shall start and continue to run for an adjustable period time.

B. Vortex Impeller Operation
   1. When the vortex selector switch is in the On position, the drive and impeller will run continuously. Turning the screen selector switch to Off will stop the unit.

C. Pump Hand Operation
   1. When the grit pump selector switch is in the Hand position, the pump will run continuously. Turning the selector switch to Off will stop the pump.

D. Pump Automatic Operation

1. When the grit pump selector switch is in the Auto position, the pump shall cycle on and off per the grit system automatic sequence.

E. Water Scour Hand Operation
   1. When the water scour selector switch is in the Hand position, the scour water will run continuously. Turning the selector switch to Off will stop the scour.

F. Water Scour Automatic Operation
   1. When the water scour selector switch is in the Auto position, the scour shall cycle on and off per the grit system automatic sequence.

G. Fault Conditions:
   1. Excessive motor current will trip the starter overload relays, immediately stop the drive motor, and illuminate the alarm indicating light. This fault must be reset by depressing the motor starter overload reset internal to the control panel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with manufacturer's printed instructions, as indicated and specified. All equipment shall be installed properly to provide a complete working system. The Contractor shall supply and install the required anchors, supports, field piping between unit connections, plans supply piping, and equipment pieces. Adjust equipment to operate at optimum performance. Install equipment on concrete pads as necessary and align thereon

B. Paint steel components per Section 09900

3.2 WARRANTY

A. A two-year warranty shall be provided from date of substantial completion.

B. Multiple warranties for individual components shall not be acceptable

3.3 MANUFACTURER’S SERVICES

A. Provide services of factory trained service engineer, for 3 days in 2 separate trips, specifically trained on grit removal equipment, to provide the following services:
   1. Supervise location of anchor bolts, setting, leveling, alignment, field erection and installation of equipment, provide start-up assistance, testing, and training of operating personnel
   2. Coordinate piping, electrical, and miscellaneous utility connections
   3. Assist in placing equipment in operation and to correct defects
   4. Conduct grit removal efficiency testing

END OF SECTION

SECTION 11332

CENTER FLOW BAND SCREEN AND WASHER/COMPACTOR

PART 1 GENERAL

1.1 SUMMARY

A. Contractor shall furnish, install, and place into properly operating condition a center flow band screen with perforated filter panels for removing floating, particulate, and fibrous material and for conveying, washing, dewatering, and compacting the screenings, and for discharging the compacted screenings into a dumpster; as shown on the Drawings and described in the Specifications.

B. The center flow band screen shall be furnished with perforated filter panels, roller drive chain, upper drive sprockets and bearings, rotating cleaner brush and/or spray water system, drive motors, gear reducers, anchor bolts, controls, and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

C. It is the intent of these Specifications that all equipment called for under this Section shall be supplied by a single manufacturer.

D. Any equipment located in the Headworks Building shall be rated for Class 1, Division 2. The control panel for the center flow band screen and washer/compactor shall be located in the Headworks Electrical/Control Room, which is an unclassified space.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. A322: Standard Specification for Steel Bars, Alloy, Standard Grades
   2. A507: Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled

B. Anti-Friction Bearing Manufacturers Association (AFBMA):
   1. Standard 9: Load Ratings and Fatigue Life for Ball Bearings
   2. Standard 11: Load Ratings and Fatigue Life for Roller Bearings

C. American Institute of Steel Construction (AISC)

D. American Iron and Steel Institute (AISI)

E. American Bearing Manufacturers Association (ABMA)

F. American Gear Manufacturers Association (AGMA)

G. International Building Code (IBC)

H. International Electric Code (IEC)

I. Institute of Electrical and Electronics Engineers (IEEE)

J. National Electrical Manufacturers Association (NEMA)

K. National Fire Protection Association (NFPA)

L. National Electrical Code (NEC)

M. Underwriters Laboratory Standards (UL)

N. American Welding Society (AWS)

1.3 SUBMITTALS

A. The following information shall be submitted to the Engineer, in accordance with Section 01300, copies of all materials required to establish compliance with this Section. Submittals shall include the following:
   1. Product Data:
      a. Descriptive literature, brochures, catalogs, cut-sheets and other detailed descriptive material of the equipment.
      b. Motor characteristics and performance information.
      c. Gear reducer data including service factor, efficiency, torque rating, and materials.
      d. Parts list including a list of recommended spare parts.
      e. Screen belt width
      f. Velocity through clean screen at peak flow
      g. Screenings discharge height from top of channel
      h. Screenings capture ratio
      i. Wash water requirements for screen
      j. Wash water requirements for washer/compactor
      k. Recommended maximum upstream water level at peak flow
      l. Recommended maximum downstream water level at peak flow
      m. Total headloss at peak flow at 30% blinding
      n. Total headloss at peak flow at 50% blinding
   2. Shop Drawings:
      a. Manufacturer’s installation drawings.
      b. Wiring and schematic diagrams.
   3. Operations and maintenance manual: See Section 01300.
   4. Equipment weights and lifting points.
   5. Recommendations for short- and long-term storage.
   6. A copy of the manufacturer’s warranty.
   7. A copy of the industry recognized, independent testing facility’s results verifying headloss through the center flow band screen and compliance with Screening Capture Ratio requirement
   8. Explanations of any deviations to the specifications described herein

B. Failure to include all drawings applicable to the equipment specified in this section will result in rejection of the entire submittal with no further review.

1.4 QUALITY ASSURANCE

A. To ensure quality, conformance, and reliability with regard to the manufacturing and production of the equipment, the manufacturer shall meet all requirements listed hereafter:

B. The Contract Documents represent the minimum acceptable standards for the screening equipment for this project. All equipment shall conform fully in every respect to the requirements of the respective parts and sections of the drawings and specifications. The entire unit shall be Manufacturer's standard product, but shall be modified, redesigned, furnished with special features or accessories, made of materials or provided with finishes as may be necessary to conform to the quality mandated by the technical and performance requirements of the specification.

C. All the equipment specified under this Section shall be supplied by a single manufacturer with a minimum of ten years' experience in the design and manufacture of the type of screen described in this specification and a minimum of ten installations in successful operation.

D. Manufacturer shall have established an ISO 9001 certified quality management system.

E. Manufacturer shall have established an ISO 14001 certified environmental protection management system.

F. Electric motors, gear reducers, and other self-contained or enclosed components shall have an acrylic enamel finish.

G. All stainless steel parts of the unit shall be fully submerged into a pickling bath for at least 8 hours to remove welding spots and to protect the stainless steel against corrosion. Glass bead or sand blasted, brushed or otherwise treated stainless steel shall not be allowed.

H. Fabrication shall be done in compliance with all applicable ASTM standards or equivalent international standards.

I. All welding in the factory shall use shielded arc, inert gas, MIG or TIG method. Filler wire shall be added to all welds to provide for a cross section equal to or greater than the parent metal. Butt welds shall fully penetrate to the interior surface and gas shielding to interior and exterior of the joint shall be provided.

J. Bolts, nuts, and washers shall be selected from AISI 304L Stainless Steel such that they are anti-seizing.

K. All welding is performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.

L. Manufacturer shall provide screen, wash press, motors, gear reducers, controls, control panels, and lifting attachments as a complete integrated package to ensure proper

coordination, compatibility, and operation of the system. The manufacturer shall test-run the fully assembled machine in his factory before shipment. A certificate of the shop run test shall be supplied with the shipping documents.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Ovivo

B. Enviro-Care

C. Hydrodyne

D. Or accepted substitution

2.2 PERFORMANCE REQUIREMENTS

A. Center Flow Band Screen Design Summary:

1. Number of screens	1
2. Average flow per screen (MGD)	0.995
3. Peak flow per screen (MGD)	2.6
4. Screen perforation diameter (mm)	6
5. Screen panel minimum thickness (mm)	7
6. Inclination (degrees)	90
7. Channel width upstream and downstream (maximum) (in)	24
8. Channel width recess around screen (in)	30
9. Channel invert upstream of screen (ft)	7380.71
10. Channel invert downstream of screen (ft)	7380.46
11. Upstream depth at peak flow (ft)	1.75
12. Downstream depth at peak flow (ft)	1.12
13. Minimum inlet channel velocity (fps)	1.2
14. Wet screenings capacity (ft^3/hr)	37
15. Number of Washer/Compactors	1

B. The center flow band screen will have a continuous stainless steel belt of perforated filter panels that rotates within the internal guide system of the static frame. The screen will be of the center flow type, in which the flow enters the inside of the continuous belt and exits through both sides and the bottom of the belt.

C. The center flow band screen shall have undergone performance testing by an industry recognized, independent testing facility. The results of this testing shall verify headloss through the screen and compliance with the Screening Capture Ratio requirement.

D. The center flow band screen will be installed into a widened chamber section of the channel, as shown on the Drawings, to accommodate the flow pattern through the screen belt.

E. The solids will collect on the belt and the belt will intermittently rotate and elevate the solid screenings to the discharge point. Larger objects screened will be picked up by a series of hooks and/or trays placed at regular intervals on the belt.

F. The belt will be cleaned by a rotating motor driven cleaner brush and/or spray jet nozzles. The screenings will drop into a hopper and be fed to the washer/compactor system.

G. The center flow band screen will be totally enclosed and have access covers that will be lightweight and easily removable for maintenance.

H. The center flow band screen shall be designed to handle the maximum flow with the maximum upstream and downstream liquid levels as specified above.

I. The center flow band screen shall be designed to withstand maximum forces exerted during operation. All structural and functional members shall be sized to prevent deflection or vibration which could impair operation.

J. Operation of the screen drive shall be automatically initiated at a preset high upstream liquid level. Operation of the screen drive shall also be able to be initiated via timer. Screens which operate continuously or via timer only will not be acceptable.

K. The washer/compactor will be adequately sized to handle all the screenings and wash water that will be generated by the screen at peak flow. The system will be required to wash the screenings to reduce the organic content and compact the remaining solids into a dry plug.

L. The washer/compactor will generally comprise of a screw auger rotating within the washing and drainage trough, a wash water system, a compaction zone, and an outlet chute arrangement.

M. The washer/compactor system shall be enclosed such that spray water, aerosols, or leakage do not contaminate the operating floor.

N. The screening equipment shall produce dewatered screenings capable of passing the EPA Paint Filter Test as described in method 9095 of EPA Publication SW-486.

2.3 PRODUCT DESIGN SPECIFICATIONS

A. Materials
   1. Unless otherwise specified in these specifications, the entire equipment shall be manufactured from AISI 304L austenitic stainless steel shapes (rods, angles, and channels), pipes, and sheets. All mechanical parts shall be designed to handle the forces that may be exerted on the unit during fabrication, shipping, erection, and proper operation according to the O&M manual.
   2. The entire equipment shall be manufactured in a stainless steel only factory to prevent contamination of the stainless steel with rusty dust.
   3. The equipment, after its fabrication, shall undergo a passivation (pickling) process to ensure maximum resistance to corrosion. All stainless steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid to remove

any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel.

B. Center Flow Band Screen
   1. Perforated Plate Screen Belt
      a. The center flow band screen shall be designed and built to withstand all static and hydraulic forces exerted by the liquid to the screen. All structural and functional parts shall be sized for the loads encountered during screening, conveying and pressing operations.
      b. The screenings belt shall consist of panels of the specified thickness manufactured from a UHMWPE or type 304 stainless steel with perforations of the specified opening.
      c. The perforated panels shall be connected by stainless steel axles to form a continuous belt that will rotate within the frame's guide system. The axle design shall allow the plates to pivot and create a seal between the perforated panels to prevent the passage of solids.
      d. The axles shall be extended to fix a guide link to the side of each perforated plate. These guides shall interlock to create a continuous guide link system that will slide within the frame.
      e. Guide links shall be UHMWPE or stainless steel
      f. The seal shall be continuous from grade level through the water flow forming an uninterrupted closure between the traveling screen grid and the stationary frame. The seal shall be stainless steel, fixed to the screen frame and be adjustable so it will remain in contact with the rotating screen belt at all times. There shall be no gap in the grid to frame seal larger than 1.0 mm.
      g. All water access points shall be provided with solenoid valves, piping and flexible reinforced PVC hoses.
   2. Frame
      a. The continuous screen belt shall rotate within a stainless steel static support frame.
      b. The frame shall be designed to support all required loads.
      c. The guide link system shall travel around a stainless steel guide track that is integral to the support frame.
      d. The design shall ensure that the support frame meshes with the seals on the guide link system so as to prevent passage of screening material and grit particles.
      e. The frame shall accommodate stainless steel protective covers designed to prevent leakage and contain spray wash. Access covers for maintenance shall be lightweight and easily removable.

C. Screen Drive Mechanism
   1. Each screen will have an electric motor suitable for a 460/3/60 supply and rated for a Class I Div II environment in accordance with Division 16.

D. Offloading of Screenings from Screen

1. The screened solids shall be removed from the filter panels near the top of the center flow band screen with spray wash header(s) and/or a rotating or static brush system.
2. The spray jet wash assembly shall consist of stainless steel piping, brass body solenoid valve, stainless steel spray nozzles, and brass body ball valve.
3. Brush(s) may or may not be provided in combination with the spray jet wash assembly
4. The wash system shall be operated on an intermittent basis only. Wash systems which operate continuously will not be acceptable.
5. The solenoid valves shall be operated by the programmable logical controller. Individual manual operation of each solenoid shall also be possible from the control panel.
6. Solenoid valves shall be brass body, 2-way, and designed for 120 VAC operation with an explosion-proof rating. Solenoid valves shall be normally closed and rated for up to 100 psig.

E. Washer/Compactor
1. Wash water for the washer/compactor shall be a maximum of 125 percent of the wash water capacity requirements for the screen
2. The wash system shall be operated on an intermittent basis only. Wash systems which operate continuously will not be acceptable.
3. The solenoid valves shall be operated by the programmable logical controller. Individual manual operation of each solenoid shall also be possible from the control panel.
4. Solenoid valves shall be brass body, 2-way, and designed for 120 VAC operation with an explosion-proof rating. Solenoid valves shall be normally closed and rated for up to 100 psig.

F. Anchor Bolts
1. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be stainless steel. Anchor bolts shall be wedge or epoxy type.
2. Anchor bolts shall be set by the contractor. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

G. Control System
1. All controls necessary for the fully automatic operation of the screen shall be provided.
2. The electrical control system shall provide for automatic control of the screen via a high liquid level using a float switch system in connection with an adjustable timer.
3. Control panel shall be suitable for outdoor, wall-mounting. If mounted in Headworks Building, the enclosure shall be NEMA 4X 304L stainless steel with continuous hinge and lockable door latch, and shall include the following:
   a. Door-interlocked and fused disconnect
   b. 600 VAC terminal block
   c. NEMA reversing motor starter and Circuit Breaker Branch Circuit Protection for screen motor
   d. Control power transformer with 120 VAC transient voltage surge compressor (TVSC) and fused primary and secondary
   e. Programmable logic controller (PLC), Allen Bradley Micrologix 1400

f. Operator Interface (OIU), Allen Bradley PanelView C400
g. Hand-Off-Auto selector switches for the following
   i) Screen drive
   ii) Screen forward-off-reverse
   iii) Screenings washing system
   iv) Screen press zone flushing
h. Pilot lights for:
   i) Control power on (white)
   ii) Screen running (green)
   iii) Screen high level (amber)
   iv) Screen fault (red)
i. E-stop push button (red)
j. Screen reset push button (black)
k. Door mounted elapsed time meters for the following:
   i) Screen drive
l. Digital inputs for the following:
   i) High water level
   ii) One spare input
m. Remote dry contact outputs for the following:
   i) Screen running
   ii) One spare output
n. Remote 4-20 mA output for influent channel level
o. Flashing alarm light and alarm horn with silencer-reset button
p. Plastic Nameplates
q. UL listing

2.4 SPARE PARTS

A. The following Spare Parts shall be included and supplied together with the equipment:
   1. Two cleaning brushes (if required)
   2. One Solenoid valve rebuild kit

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING OF EQUIPMENT

A. All equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.

B. The Contractor shall be responsible for unloading of the machinery and shall have equipment on-site available at the time of delivery permitting proper hoisting of the equipment.

3.2 FIELD PREPARATION AND PAINTING

A. Contractor shall touch-up all shipping damage to the paint and stainless steel as soon as the equipment arrives on the job site.

B. Contractor shall supply paint for field touch-up and field painting.

C. Contractor shall finish paint electrical motors, speed reducers, and other self-contained or enclosed components with oil-resistance enamel.

D. Contractor shall coat all stainless steel bolts and nut threads with a non-seizing compound prior to final assembly.

3.3 WARRANTY

A. A two-year warranty shall be provided from date of substantial completion.

B. Multiple warranties for individual components shall not be acceptable.

3.4 INSTALLATION, START-UP AND OPERATOR TRAINING

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of significant deviations.

B. Installation of the equipment shall be in strict accordance with the contract documents and the manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the manufacturer's recommendations

C. Manufacturer shall provide services by a factory-trained Service Engineer, specifically trained on the type of equipment specified. The Service Engineer requirements include, but are not limited to the following:
   1. The Service Engineer shall be present during initial energizing of equipment to determine directional testing as described herein
   2. The Service Engineer shall inspect and verify location of anchor bolts, placement, leveling, alignment and field erection of equipment, as well as control panel operation and electrical connections.
   3. The Service Engineer shall provide classroom and/or field training on the Operation and Maintenance of the equipment to operator personnel. These instructions may include the use of slides, videos, literature, and/or oral presentations.
   4. Manufacturer shall state field service rates for a Service Engineer to Owner and Contractor. In the event that the field service time required by this section should not be sufficient to properly place the equipment into operation, and the requirement for additional time is beyond the manufacturer's responsibility, additional time shall be purchased by Contractor to correct deficiencies in installation, equipment, or material without additional cost to Owner.

D. Manufacturer shall furnish the services of a factory-trained Service Engineer for one trip including two days to inspect the installation, observe start up, and provide operator training.
   1. Equipment shall not be energized, or “bumped” to check the electrical connection for motor rotation without the Service Engineer present.
   2. The Service Engineer shall make all necessary adjustments and settings to the controls. In particular, Service Engineer shall verify the measurement relay setting and the initial water level setting for the screen.
   3. The Service Engineer shall demonstrate proper operation of screen and screenings washer. The screen shall operate automatically based on the water level.
   4. Manufacturer to provide two additional trips within twenty-four months after start-up to address follow-up request by Owner, or to address operational or other related items shall be at no cost to Owner. Owner shall coordinate follow-up trips directly with manufacturer.

END OF SECTION

SECTION 11377

ROTARY LOBE BLOWERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. All labor, materials, equipment, and incidentals required for delivery to the project site ready for installation for two rotary lobe blowers. Blowers shall supply a variable volume of air to two digester tanks.

1.2 DESCRIPTION

A. Blower Manufacturer shall furnish, test, and place in satisfactory operation two (2) electric motor driven rotary lobe blower units. Digester aeration blowers, controls and all appurtenances shall be provided as indicated on Drawings and as specified herein for a complete and automated aeration system.

B. All blower units shall include, but not be limited to, the following components for each unit:
   1. Rotary lobe blower with a belt-driven motor
   2. Inverter for variable speed operation
   3. Outdoor air inlet filter and silencer connected to common aeration blower header
   4. Blower inlet filter and silencer
   5. Discharge silencer
   6. Flexible connections and expansion joints
   7. Check valve
   8. Pressure relief valve
   9. Unloading valve
   10. Instrumentation and controls
   11. Pressure and temperature monitoring devices
   12. Miscellaneous appurtenances as necessary for a fully operational system

C. Blower equipment package shall include the following:
   1. Two complete blower and aeration system accessories and ancillary equipment as specified herein with control panels, special tools, and spare parts
   2. Shipping and insurance FOB jobsite
   3. Equipment submittals
   4. Operation and maintenance manuals
   5. Shop testing of equipment
   6. Project site equipment installation inspection and approval and mechanical testing
   7. Operation and maintenance training of Owner’s personnel
   8. Any additional equipment or accessories not specified but are required to achieve the specified performance. If additional equipment or instrumentation not specified herein is required by the Manufacturer in order for the blower aeration system to

operate and perform as specified herein, the Manufacturer shall submit detailed information for the proposed items for the Engineer review and approval.

1.3 RELATED SECTIONS

A. Section 03600 – Grout

B. Section 05501 – Anchor Bolts and Expansion Anchors

C. Section 05590 – Miscellaneous Metals

D. Section 09900 – Painting

E. Section 15060 – Pipe and Pipe Fittings

F. Section 15100 – Valves, Cocks, and Hydrants

G. Division 16 – Electrical

1.4 REFERENCES AND STANDARDS

A. American National Standards Institute – ANSI:
   1. B16.1: Cast-Iron Pipe Flanges and Flanged Fittings

B. American Gear Manufacturer's Association – AGMA

C. American Society of Mechanical Engineers – ASME

D. Antifriction Bearing Manufacturer's Association – ABMA:
   1. Load Rating and Fatigue Life for Ball Bearings

E. Institute of Electrical and Electronics Engineers – IEEE

F. National Electrical Manufacturer's Association – NEMA:
   1. MG-1: Motors and Generators

1.5 SUBMITTALS

A. Provide as specified under provisions of Section 01340

B. Cost Evaluation
   1. Manufacturer shall provide blowers' 20-year operating and maintenance (O&M) costs under the conditions specified in Paragraph 1.11.B
   2. Manufacturer's projected power consumption will be confirmed based on Test 1 and Test 2 specified in Paragraph 1.11.C. Conditions for Test 1 and Test 2 are included in Paragraph 1.11.C

C. Shop Drawings and Product Data: Includes, but not limited to, the following:
   1. General

a. Certified general arrangement drawings showing materials, details of construction, dimensions and connections
b. Materials
c. Parts
d. Accessories
e. Assembly
f. Installation

2. Blowers and silencers
   a. Sufficient data to verify compliance with the specifications and to illustrate construction or assembly of the products
   b. Equipment manufacturer, model, and type
   c. Complete and detailed assembly, foundation, and installation drawings, prepared to scale
   d. Detailed specifications and data describing materials, parts, and accessories used that together make up the complete blower package
   e. Electrical wiring diagrams
      i) Power and control schematic diagram indicating factory and field wiring
      ii) All diagrams shall be complete and be uniquely numbered for terminals, wires and devices
   f. Manufacturer’s rating, performance data for all blower accessories
   g. Indicated capacities at the specified conditions shall be at the minimum acceptable efficiency
   h. Submit performance curves and data to show the blower output, horsepower requirement, blower efficiency, and surge point. Performance curves for blowers and motors shall be submitted for the following site conditions:
      i) Elevation (reference to mean sea level): 7,385 feet
         a) Inlet air of 105 degrees F, 95% RH (summer)
         b) Inlet air of -30 degrees F, 5% RH (winter)
      ii) Curves shall indicate brake horsepower and efficiency at specified conditions and shall indicate surge and overload points
      iii) Curves shall include blower shaft hp, motor hp and package hp
   i. Submit noise attenuation curves to verify the suitability of the silencers for use with the blowers
3. Submit manufacturer's rating, performance data for all blower accessories
4. Testing
   a. Factory test all units with all components installed through full range with all data documented
   b. Submit all data from factory tests including noise dB rating at 3-feet from machine
   c. Blowers shall be tested in accordance with ASME power test code. Final performance curves shall be representative of this test. Submit test results as specified
   d. Prepare a log book recording all running tests and time including duration of tests and all malfunctions and corrections. List causes and adjustments of blower, motor or connected accessories
5. Control panel layout with devices and nameplates shown

6. Wiring schematics and diagrams with all devices, terminals, and wires uniquely numbered
7. Control panel device catalog data with bill of material. The bill of material shall be shown on the control panel drawings with all items numbered
8. Motor nameplate data:
   a. Name of manufacturer
   b. Type and model
   c. Type of bearings
   d. Rated hp size
   e. Full load current
   f. Motor performance data
   g. Date of manufacturing
9. Motor data and instrumentation and wiring diagram
10. Operating and maintenance manuals, including recommended spare parts list in accordance with Division 1
11. Life cycle cost evaluation over a period of 20 years for conditioning specified in Paragraph 1.11.C

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730

B. Operation Data: Include manufacturer's instructions, description of system operation, start-up data and trouble-shooting check lists, and repair data for blowers

C. Maintenance Data: Include manufacturer's literature, cleaning procedures replacement parts lists, wiring diagrams, and repair data for blowers and components

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600 and in accordance with manufacturer's instruction

B. Protect blowers and components from physical damage including effects of weather, water, and construction debris

C. During loading, transporting, unloading, and storage, exercise care to prevent damage to materials and equipment

D. Do not drop pipe, fittings, or equipment

E. Adequately tag or otherwise mark all piping and fittings as to size

F. Store materials in original packing and prevent direct contact with ground

G. Replace damaged products with undamaged products

H. Reject and products dropped from truck or crane

I. Shall be as specified in Division 1 and as in this section

1.9 MAINTENANCE MATERIALS AND SPARE PARTS

A. For each blower, provide the following spare parts:
   1. Bearings – Four of each size and type
   2. Bearing locknut and lockwasher – Four of each size and type
   3. Impeller locknut and lockwasher – One of each size and type
   4. Belts - Two of each size and type
   5. Filters – Two
   6. Oil, grease, and air filters for a 24 months period after the date of Substantial Completion
   7. Absorption plates – Two of each size and type
   8. Piston ring seals - Two

1.10 QUALITY ASSURANCE

A. All equipment specified herein shall be furnished complete by one manufacturer

B. Manufacturer shall be responsible for providing equipment, accessories, installation supervision, and testing services in order to provide a complete functioning blower system

C. Components specified herein establish minimum requirements only and does not relieve the manufacturer of responsibility for providing a properly complete functioning blower system

D. The blowers and equipment covered by this specification are intended to be standard blower equipment, of proven ability, as manufactured by a reputable CE certified manufacturer having at least five years experience in the production of such blowers. The blowers furnished shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed

E. Manufacturer of blower shall have a minimum of five installations of rotary lobe blowers of similar design in the continental United States

F. Similar items of equipment shall be the end product of a single manufacturer in order to achieve standardization of appearance, maintenance, operation, spare parts, and service

G. Contractor shall schedule blower manufacturer’s authorized personnel representative to the job site to verify proper equipment installation, supervise and direct initial start-up of blowers, partake in performance testing and plant personnel training. Training of personnel shall consist of training required in order properly operate and maintain blower and control equipment

1.11 WARRANTY

A. The manufacturer and contractor shall warrant the rotary lobe blowers for two years from date of substantial completion.

B. O&M Cost
   1. Blower manufacturer shall provide blowers' estimated 20-year operating and maintenance (O&M) costs
   2. Blowers' 20-year O&M costs shall be evaluated based on the following conditions:
      a. Condition 1: Air flow of 1,754 scfm total
         i) Number of blowers in operation: One
         ii) 12 hours/day
         iii) 365 days/year
         iv) Discharge pressure of 9.5 psig
         v) Side water depth in digester: 13.5 feet
         vi) Power unit cost: $0.08/kw-hr
      b. Condition 2: Air flow of 1,470 scfm total
         i) Number of blowers in operation: One
         ii) 12 hours/day
         iii) 365 days/year
         iv) Discharge pressure of 9.5 psi
         v) Side water depth in digester: 13.5 feet
         vi) Power unit cost: $0.08/kw-hr
      c. Condition 3: Air flow of 735 scfm total
         i) Number of blowers in operation: One
         ii) 12 hours/day
         iii) 365 days/year
         iv) Discharge pressure of 9.5 psi
         v) Side water depth in digester: 13.5 feet
         vi) Power unit cost: $0.08/kw-hr

C. Certification Letter
   1. Manufacturer shall provide a letter on company letterhead guaranteeing that the blowers' actual 20-year O&M costs shall not exceed the projected 20-year O&M costs provided by the manufacturer.
   2. Manufacturer shall provide in the same letter as specified above that the blowers' actual power consumption and costs for Test 1, Test 2, and Test 3 specified in Paragraph 1.11.C shall not exceed the manufacturer's project costs for these tests

1.12 SPACE CONSTRAINTS

A. Blower unit and motors shall fit into the space indicated on Drawings. Any modifications to piping or equipment as indicated on the Drawings shall be at no cost to the Owner

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Blower equipment manufacturer
   1. Aerzen
   2. Kaeser
   3. Roots
   4. Gardner-Denver
   5. Or accepted substitution

B. Outdoor filter/silencer equipment manufacturer
   1. Universal Silencer, Acoustic and Emission Technologies, CCS Series
   2. Or accepted substitution

C. Blower filter/silencer equipment manufacturer
   1. Burgess Manning
   2. Or accepted substitution

2.2 PERFORMANCE AND DESIGN CONDITIONS

A. Rotary lobe blowers shall be designed to minimize the life-cycle costs and maximize plant reliability

B. Design and selection of components shall be based on a minimum useful life of 20 years

C. Design equipment with due regards to safety of operation, accessibility, and durability of parts, and comply with applicable OSHA, state, and local safety regulations

D. Blowers will receive ambient outdoor air from a main air suction header

E. Blowers shall be motor driven, type complete with integral gearbox and accessories as specified herein.

F. Blowers shall be sized such that the specified speed of operation at the specified conditions does not exceed 80 percent of the maximum blower design speed set forth by the manufacturer

G. No special concrete housekeeping foundations shall be required for installation
   1. Blower units shall be installed directly on a concrete slab without grouting the base frame

H. Each blower shall have two dynamically balanced multi-lobe rotors constructed of high strength cast iron. Rotors shall be designed to carry loads that exceed those required at maximum design conditions

I. Blower casings shall be one piece with separate head plates and shall be made of close-grained cast iron. The casings shall be suitably ribbed for maximum strength and to prevent distortion under the operating conditions

J. Inlet and outlet connections shall be flanged and oriented as shown on Drawings

K. Blower manufacturer shall be responsible for attenuating noise and vibration in the blower package such that no special installation base shall be required nor shall any vibration from the blower package be transmitted to the base or the piping

L. Blower manufacturer shall provide the outdoor inlet filter/silencer unit including pressure differential monitor, blower inlet filter/silencer unit included in blower unit, and blower discharge silencer

M. Blower manufacturer shall supply, coordinate, start-up, and calibrate all items specified in this section

N. Each blower shall be provided with an outdoor inlet filter and silencer, blower inlet filter and silencer, discharge silencer, flexible connectors, discharge temperature gauge, discharge pressure gauge, inlet filter pressure gauge, check valve, blow off valve and all instrumentation and controls specified herein, indicated on the Drawings, and in Division 16

O. Intermittent and continuous operations in an indoor environment

P. Blowers shall start no more than four times per hour when operating in intermittent service

Q. Blowers shall meet rated performance and sound level when operating at maximum gear speed. Operational speed of blowers shall not exceed 80 percent of rated speed

R. Free Field Maximum Sound Pressure Level of 80 dBA, factory calculated, with inlet and discharge silencers, measured at noise enclosure

S. Manufacturer shall guarantee that the rotary lobe compressor shall provide oil-free operation and be certified to ISO 8573-1 Class Zero

T. System discharge pressure includes pressure through an outdoor clean inlet filter/silencer, blower inlet filter/silencer, blower discharge silencer, check valve and all other pipe, fittings, and valves indicated on Drawings

U. Aerobic Digester Blowers (BL-501, BL-502) Design Conditions

1. Number of blowers:	Two
2. Nominal size of inlet connection:	10-inch
3. Nominal size of outlet connection:	10-inch
4. Design operating capacity range:	735 scfm to 1,754 scfm
5. Turndown:	110% to 50% of design capacity range
6. Maximum barometric pressure:	9.5 psia
7. Site Elevation:	7,385 feet above mean sea level
8. Ambient air temperature and relative humidity at inlet:	
a. Summer:	105 deg F, 95% RH

b. Winter: -30 deg F, 5% RH

9. At 735 scfm
   a. System discharge pressure: 9.5 psi
10. At 1,470 scfm
    a. System discharge pressure: 9.5 psi
11. At 1,754 scfm
    a. System discharge pressure: 9.5 psi
12. Maximum motor hp: 100 hp
13. Minimum efficiency: Motor full load premium efficiency

V. Outdoor Inlet Silencer/Filter
1. Size: 14-inch
2. Maximum pressure drop across filter: 3-inches of w.c. at specified design airflow with clean filter
3. Rated flow capacity: 1,754 scfm

W. Blower Inlet Silencers/Filter
1. Shall have front access for element access
2. Provide 99 percent removal efficiency on 5 micron particle size and larger per ASHRAE 52.2 MERV7 per Section 2.3.G.3
3. Manufacturer shall supply the inlet filter silencer
4. Maximum pressure loss through entire filter/silencer unit: 3-inches w.c. at specified design airflow with a new element

X. Discharge Silencer
1. Maximum pressure drop across filter: 3-inches of w.c. at specified design airflow with clean filter

Y. Motors
1. Number of units: Two
2. Minimum Motor size, hp: 75
3. Satisfactory operation without surging or overloading the motor over the range of capacity and environmental conditions specified
4. Motors
   a. Class F insulation
   b. In accordance with 16200
   c. Inverter duty rated

2.3 DESIGN, FABRICATION AND MATERIALS

A. Outdoor Inlet Filter/Silencer
1. Shall be equipped with differential pressure monitor
2. Shall be flanged for 150 lb ANSI
3. Filter element media shall be wire mesh for easy removal and cleaning
4. Shall have a built-in silencer

B. Blower Inlet Filter/Silencer
1. Silencer shall be carbon steel and wear-free absorptive type

2. Filter elements shall be polyester

C. Blowers
1. Shall be capable of variable speed operation
2. Base
   a. Fabricated or structural steel
   b. Mount each blower and motor unit on single, heavy full length base
   c. Welded steel base
      i) Cover top with heavy steel plate so that entire base is neat appearing smooth box
      ii) Continuously weld and grind smooth all seams and contact edges between plates and shapes
   d. Mount each base on suitable vibration isolators, rubber or spring type
   e. Reinforce base to withstand loads normally encountered
   f. Each blower unit shall be supplied with vibration isolating feet with a minimum efficiency of 80 percent
      i) Manufacturer shall be responsible for attenuating noise and vibration in the package such that no special install base shall be required nor shall any additional measure be required to reduce vibrations form the package being transmitted to the base or the piping
3. Belt Drive Guards
   a. Guards: Rugged design, manufactured from 16 gauge steel
4. Balance
   a. Rotating parts: Accurately machined and as perfect rotational balance as practical
   b. Sufficient mass of assembly to avoid resonance at normal operating speeds
   c. Vibration:
      i) Amplitude measured at inlet and discharge flanges not to exceed 2 mils
      ii) Vibration level as measured at the casing, in the X and Y planes of the bearings, shall not exceed 0.3-inch/second RMS when operating at the specified operating pressure and speed
      iii) Vibration level shall be checked at start-up and documented in the field start-up report
5. Casing
   a. Shall be one piece with separate head plates that are bolted and pinned to the housing
   b. Shall be made of close-grained cast iron ASTM A48 suitably ribbed to prevent distortion under the specified operating conditions
   c. Inlet and outlet shall be flanged connections and not threaded
   d. Each head plate shall incorporate a vent to atmosphere to prevent pressurization of oil chambers
   e. Inlet and discharge opening shall be rectangular with maximum area for minimum pressure drop
   f. Casings shall be suitably ribbed for maximum strength and to prevent distortion under the operating conditions
6. Enclosures
   a. Each blower unit shall be supplied with a sound enclosure covering the entire blower package

b. Blower noise rating at the stated conditions shall not exceed 80 dBA at 3-feet distance, exclusive of enclosure
   i) Enclosure shall provide up to 20-dba attenuation free field
c. Blower electrical enclosure shall be UL certified with certification label shown on nameplate at point of manufacturing
d. Shall be galvanized sheet steel construction with powder coat finish or zinc coated steel powder coat finish
   i) Skid shall be of the same color
   ii) Sound enclosure acoustic material shall comply with UL 940HF1 for fire-retardant, self-extinguishing non-dripping materials
e. Enclosure and blower package must be both mounted on a skid/oil-drip pan designed for meeting environment protection standards and for easy transportation and installation
f. A grounding strap shall be installed between the blower base and package skid to bypass any vibration isolating mounts for grounding continuity
g. Quick release panels, each less than 50-lb must provide easy and quick access for routine maintenance of blower and package components
h. At least one installed, integral ventilation fan, sized to provide adequate cooling of package shall be provided with all controls associated with fan
   i) Fan shall be sized for sufficient heat removal from the sound enclosure, even when the blower is driven separately by an electric motor
   ii) If a separate motor driven fan is provided, the manufacturer shall provide wiring with the enclosure as well as the safety interlock that will shut down the main motor if the cooling fan stops operating
i. Blower package sound enclosure shall be designed for permanent indoor installation
j. Enclosure shall include an outdoor air connection and discharge connection and shall be flanged connections
k. Electrical components, instrumentation, and instrument connections shall not be mounted or interface with moving panels of the sound enclosure
l. The enclosure shall include a vent system and removable panels for easy access and maintenance mounted access doors
m. Both blower oil sumps shall be piped to a common fill and drain, located at the front of the package for easy maintenance
   i) An oil level indicator shall be mounted on the outside of the enclosure which gives an accurate oil indication while the blower is in operation
   ii) All oil lines shall be industrial-quality hydraulic hose and fittings

7. Rotors
   a. Each rotor, male and female, shall be of the “stiff” design with the first lateral critical speed at least 120 percent of the maximum allowable operating speed
   b. Rotors shall operate without rubbing nor shall they require lubrication
   c. Rotors shall be drop forged in one single piece of AISI 1043 or equivalent
   d. Open rotors are not acceptable
   e. Rotors shall be statically and dynamically balanced per ISO 1940/ANSI S2.19 G2.5
8. Impellers-Shaft Assembly

a. Each impeller shaft assembly integrally cast from high strength ductile iron with a minimum tensile strength of 60,000 pounds per square inch
b. Positioned by timing gears shall be mounted on shaft supported by antifriction bearings, fixed to control the axial location of the impeller/shaft in the casing
    i) Impellers shall be timed by a pair of single helical gears with quality equivalent to AGMA 12
    ii) Gears shall have hardened and ground teeth and a minimum AGMA service factor of 1.70
    iii) Gears shall be mounted on the hydraulically expanded onto the shafts with a tapered interference fit and secured by a locknut
c. Shall be statically and dynamically balanced by removing metal from the impeller body
d. Each shaft is fitted with a cast iron ASTM A48 Class 30B sleeve and ductile iron piston ring
e. Piston ring seal shall be located on the shaft at the point where the shaft passes through the head plate

9. Seals
    a. Shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine
    b. Shall consist of four rotary slip rings mounted in a retainer with an atmospheric air gap in the center
    c. Rotor shaft shall be protected by a shaft sleeve
    d. An O-ring shall be provided under the shaft sleeve to prevent oil migration along the shaft into the air conveying chamber
10. Timing Gears
    a. Positively timed by a pair of accurately machined and carbonized steel helical gears hardened to 58-62 Rockwell alloy timing gears manufactured to comply with AGMA and have a minimum AGMA quality rating of 10
    b. Gears mounted on shafts with tapered hydraulic fit and secured by locknuts
11. Bearings
    a. Each impeller and shaft assembly shall be supported by oversized anti-friction bearings engineered for long service life and fixed to control the axial location of the impeller/shaft in the unit
        i) Regardless of the theoretical bearing life calculations, the bearings shall be sized for a minimum expected life of five years between overhauls
    b. Cylindrical roller or spherical bearing shall be provided at all four locations for each blower to control radial and axial movement
    c. All bearings shall be oil-splash lubricated from oil-tight housing
        i) Oil level sight glasses shall be provided
12. Rotary lobe stage
    a. Each rotary lobe stage shall be factory performance tested in accordance with ISO 1217 standards to verify flow and brake horsepower at specified design conditions
    b. Slip test shall not be acceptable
    c. Acceptance criteria are +5 percent on power and -5 percent tolerance on flow regardless of the size of the machine
13. Oil sight glass

a. Shall be provided on the exterior of the noise enclosure to allow the operator to easily view oil level
b. Sight glass inside enclosure or those not easily viewable by the operator will not be accepted

14. Fasteners
    a. Shall be SAE Grade 5, high strength materials at a minimum
15. Lubrication
    a. PTFE hydrodynamic lip seal shall be installed on the drive end of the drive shaft only. All internal seals shall be as specified in Paragraph 2.3.D.9 above
    b. Bearings and timing gears shall be oil lubricated
        i) Grease lubrication shall not acceptable

D. Motors
1. Rotary lobe type belt driven motors
2. Motors shall be TEFC, 480V/3-Phase/60 Hz in accordance with Division 16
3. Each blower shall be suitable for operation with a variable frequency drive
4. Brake horsepower requirement with relief valve fully open shall not exceed the motor nameplate horsepower
5. Motors operating in the service factor at design and/or relief setting are not acceptable
6. Motors shall be mounted on a pivoting base to provide automatic tensioning of belts with no adjustment required on the part of the operator
7. Motor nominal rating after any corrections for ambient conditions shall be 10 percent above the maximum operating horsepower
8. Motors to be horizontal foot mounted, ball bearings, heavy-duty steel or cast iron frame, gasketed conduit boxes and manufactured to NEMA standards
9. Motor minimum service factor: 1.15

E. Belt Drive System
1. V-belt drive of the high capacity type
2. Shall be oil and heat resistant
3. Belt tension device must be designed to allow the maintenance personnel to replace the belts without exerting or lifting over 40 pounds (OSHA Limitation) through the use of a bottle jack provided by the manufacturer
4. Belt tensioning shall be automatic without the use of any spring devices or interaction on the part of the operator
    a. Slide rails shall not be used as a tensioning device
5. Sheaves shall be dynamically balanced regardless of the operating speed and hydraulically mounted on the compressor drive shaft
6. Minimum service factor of 1.4 or 1.1 times the motor nameplate hp, whichever is larger to allow a minimum of 1.4-service factor based on maximum blower bhp
7. Designed not to exceed allowable overhung load limits of blower and motor
8. Provide belt guard
    a. Shall be designed into noise enclosure and meet OSHA standards

F. Accessories
1. Blower accessories specified herein shall be provided by the blower manufacturer
2. Outdoor filter/silencer
3. Blower inlet filter/silencer

a. Each blower unit package shall be supplied with one combination inlet/filter silencer
b. Filter media must meet the requirements of ASHRAE 52.2 MERV7 50-70% @ 3-10 microns corresponding to EN779 G4
c. Inlet filter and silencer shall be mounted directly to the inlet flange of the blower
d. Silencer portion shall be located upstream of the inlet filter
e. Filter element shall be designed to trap dirt on the inside s that upon changing, dirt does not fall into the machinery
f. Filter and silencer performance losses (clean element) shall be included in the entire package performance calculation

4. Blower discharge silencer
   a. 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)
   b. Fabricated of a single shell of pressure vessel quality steel with continuous welds, silencer must be subject to a pressure test for tightness and strength at a minimum of 1.65 times the maximum design pressure
   c. Silencer shall have a machined flanged inlet connection and bolts directly to the discharge flange of the rotary lobe compressor, with no intermediary or interconnecting pieces
   d. Insulation shall be provided surrounding the discharge silencer to reduce the heat loss within the sound enclosure and keep the air temperature at the inlet of the compressor as low as possible therefore contributing to a high compression efficiency
   e. Discharge silencer performance loses shall be included in the entire package pressure calculation
   f. Base frame is constructed from welded carbon steel that shall be designed to maintain alignment of the blower internal components and the drive during operation
   g. Shall be designed to resist distortion while being installed on vibration isolating mounts
   h. Manufacturer shall supply a stainless steel grounding lug fully welded to the base
5. Air flow indicators
   a. Provide factory calibrated, air flow indicating system, including current transformer, transmitter and ammeter to be installed in blower room
   b. Current transformer/transmitter
      i) 600 V insulation rating
      ii) Connect in phase of motor supply circuit
      iii) Indicates blower air discharge on ammeter according to motor load experienced with Ac amps converted to mA
      iv) All solid state
      v) Accuracy: ± 1% of span
      vi) Output: zero and span adjustment
      vii) Manufacturer: Moore, RIS, Acromag or approved equal
   c. Transmitter
      i) Input signal coordinated with current transformer
      ii) 4-20mA output capable of driving a minimum 500κΩ impedance load for use with a current indicating controller

d. Ammeter
   i) Accuracy of indication within 5 percent of actual discharge rate from 0 to 75% of meter scale
   ii) Furnish loose for installation in the blower building
   iii) Indicate current and icfm with surge and overload point
   iv) Digital or analog scale: not less than 4" long, and icfm indication to be provided at minimum 50 icfm intervals
   v) With adjustable height and low dry contact outputs
e. Mask the portions of meter face below surge point and above motor overload point with red, transparent overlay

6. Flexible connections
   a. Each blower unit shall be provided a flexible ANSI style inlet and discharge connector
   b. Flanged rubber sleeve, synthetic fiber reinforcements, galvanized steel retaining ring
   c. Provide each blower with an elastomeric compensator/flexible connector at the inlet and discharge of blower to reduce transmission of structure borne noise as well as prevent unacceptable loading of the silencer and blower casing
      i) Shall be sized for standard pipe diameter and shall prevent noise transmission and vibrations from blower into the blower piping
      ii) Shall have flanged ends to connect to blower
   d. Provide each blower with a Unaflex Supreme Style 189 expansion joint at the inlet and discharge of blower
      i) Discharge expansion joint shall be capable of withstanding vacuum, pressure, and temperature under all operating conditions
      ii) Shall be suitable for maximum operating temperature and pressure ratings of equipment in the air stream
   e. Suitable for an operating temperature of 300°F
   f. Connectors to have flanges conforming to ANSI 150 lb
   g. Provide stainless steel restraining bolts and hardware
7. Unloading Valve
   a. Shall be supplied by blower manufacturer for each blower
   b. Shall be installed to allow the motor to accelerate prior to system pressurization and eliminate pneumatic shock
   c. Shall be an automatic type pneumatically operated valve requiring no electrical nor compressed air connections mounted upstream of the check valve
8. Discharge Pressure Relief Valve
   a. Provide a properly sized pressure relief valve to protect unit from excessive temperature caused by internal air recirculation in the event air flow is interrupted
   b. Shall be located downstream of the discharge silencer and upstream of the check valve
   c. Shall be spring type pressure relief valve type
   d. Capable of operating at 300°F discharge air
   e. Shall be furnished on each blower
   f. Shall be sized at a minimum of 120 percent of full-specified air flow and set at 0.5 psig above the maximum specified discharge pressure
   g. Shall include a pressure relief valve silencer

i) Shall be carbon steel
ii) Shall be an integral unit with pressure relief valve, fitted with one flange for direct bolting to pressure relief valve, with installation by the Contractor
iii) Silencer sound attenuation shall not be less than 85 dB
iv) Shall relieve hot air into a segmented and sealed section of the sound enclosure so that the hot air cannot re-enter the inlet of the machine

9. Check Valve
   a. Provide each blower with a discharge wafer type check valve
      i) Shall be of the full-bore low pressure-drop flapper type design with a steel body and steel flap embed in EPDM with full-contact seal
      ii) Valve shall be easily removable without disturbing the piping
      iii) Pressure loses produced by the check valve shall be included in the entire package performance calculation
   b. Resilient seat capable of operating with 400°F discharge air
10. Pressure/Vacuum gauges
   a. Blower package shall include connections for pressure/vacuum gauges on either the suction or discharge of the blower
   b. Gauges shall be mounted on the noise enclosure
   c. All gauges shall be supplied by the blower manufacturer
   d. Inlet filter gauge: 63-mm dial and scale from 0 to 40-inches of w.c.
   e. Discharge gauge: 63-mm dial and scale from 0 to 20-psig
      i) Shall have stainless steel case and by glycerin-filled for pulsation dampening
      ii) Pulsation snubber shall be provided
   f. Gauges manufactured by Ashcroft model 1009SW with 2.5” dial or accepted substitution
11. Temperature switch and gauge
   a. Blower package shall include a discharge temperature gauge/switch with 63 mm dial and scale from 32ºF to 572ºF
   b. Shall have a NEMA 4 enclosure discharge pressure switch (provided by blower manufacturer), 5A at 250V, SA 28 SPDT microswitch, and UL and CSA approval
   c. Switch to be shipped loose to be installed by the Contractor
   d. Temperature switch manufacturer shall be Ashcroft Type 400, B-Series model B424V or accepted substitution
   e. Blower package shall include a discharge temperature gauge mounted on the noise enclosure
   f. Discharge temperature gauge shall be supplied by blower manufacturer as manufactured by Weiss model 25UB3-5131 with 2.5” dial or accepted substitution
12. Pressure switch and gauge
   a. Blower package shall include a NEMA 4 discharge pressure switch
   b. Switch to be installed by Contractor
   c. Switch manufacturer shall be Ashcroft Type 400, B-Series model B424V or accepted substitution
   d. Blower package shall include an inlet filter differential pressure gauge mounted on the noise enclosure to indicate filter change requirement
   e. Inlet filter pressure gauge shall be supplied by blower manufacturer

f. Pressure filter gauge manufacturer shall be Dwyer model 2-5040 Minihelic II with 2.5-inch dial or accepted substitution

13. Oil fill container with a blower oil drain manifold where oil drains from the blower drive-end and gear-end lubricating oil sumps shall be piped to the front of the base for ease of maintenance
14. Each blower shall receive its initial oil filling at the factory
    a. Oil to be fully synthetic and rated for 16,000 hours of operation between change interval
15. Mounting
    a. Vibration mounts shall be supplied and capable of leveling the blower package to insure proper oil level to increase service and longevity of the equipment
    b. Vibration mounts to be supplied by blower manufacturer
    c. Vibration mounts shall be made of rubber in a steel footing designed to bear the weight of entire blower package assembly without degrading
    d. Blower manufacture must insure proper selection for the specific blower system offered
    e. Blower manufacturer shall provide all nuts, bolts, and accessories required for proper anchoring of blowers
16. Blower packaged system shall be provided with all internal space cooling fans required by the manufacturer along with all associated controls for these fans

G. Anchor
1. Provide 316 stainless steel anchor bolts as required for installation of equipment

H. Motor Control Center and Control Equipment
1. The locally mounted control panel with Hand-Off-Auto switch and local control potentiometer, shall be provided by the system integrator
2. All relays listed below will be provided by the manufacturer and installed by the system integrator. In addition the listed relays, any signals from the equipment requiring special relays or sensors shall be provided by the equipment supplier and provided to the system integrator
3. PTC Thermistors and associated relay to ensure complete communication. Refer to Division 16 - Electrical specifications for additional wiring and electrical requirements

2.4 COATING

A. Factory coat assembly with manufacturer's standard coating suitable for intended service meeting the following criteria
1. Except for machined sealing and machined mounting surfaces, the package shall be painted dark blue
2. Aluminum, stainless steel, and brass shall not be painted
3. Supplied motor shall not be over sprayed and will be supplied with the motor manufacturer's standard protection and paint color
4. Painted cast iron and carbon steel shall be Alkyd Resin SSPC10 or better
5. Sound enclosure shall be powder0coated polyester base total dry film thickness 80 µm
6. Galvanized components may only be painted with appropriate surface preparation

B. Shall also be in accordance to Specification Section 09900 - Painting

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all blower equipment in accordance with manufacturers instructions

B. Blowers
   1. Anchor bolts: manufacturer's standards
   2. Eliminate any strain between blower and attached air piping
   3. Set blower base on vibration isolators
   4. Correct any misalignment, noisy operation, or other signs of improper setting

C. Provide all necessary lubrication for initial start-up, testing and final acceptance

3.2 MANUFACTURER'S FIELD SERVICES

A. Provide under provisions of Sections 01400 and 01700

B. Provide all necessary lubrication for initial start-up, testing and final acceptance

C. Prior to start-up
   1. Test all valves, switches and gages for proper settings an operation
   2. Check completion of all electrical connections
   3. Check assembly alignment
   4. Check to ensure all rotational parts are properly lubricated
   5. Bump motors to check direction or rotation
   6. Direct Contractor in necessarily corrections for start-up
   7. Provide written approval for start-up when system is satisfactory
   8. All aeration diffusers shall be installed and basin filled with water prior to start-up of blowers

D. Start-up
   1. Check equipment vibration for conformance with specification
   2. Test blower controls for proper operation
   3. Provide written directions to Contractor detailing adjustments and corrections as necessary
   4. Provide preliminary instruction to plant personnel on operation and maintenance of blowers
   5. Manufacturer will provide two 8-hour days on-site for start up, as well as an additional day if needed for training at no additional cost
      a. Manufacturer's local sales representative is not acceptable

E. Schedule
   1. Above services to be provided in at least 1 separate trip
      a. Prestart-up and start-up as requested by Contractor
      b. Follow-up approximately on month after start-up as requested by Owner

c. Site visit within 24-months of startup owner to coordinate directly with manufacturer

3.3 PERFORMANCE TESTS

A. Factory
1. All critical dimensions of the blower components actually provided by the manufacturer shall be verified and documented prior to assembly
2. The rotating parts of each blower actually provided by the manufacturer shall be statically and dynamically balanced before final assembly. The blower alone shall operate without vibration in excess of the limits stated in the latest revision of NEMA MG-1. Removal of material from the face of the rotors for balancing purpose is not allowed
3. Documentation certifying that the supplied blowers conform to design specifications shall be provided per ISO-1217, as noted in Section 2.3.D.12
4. On completion of final assembly of the packaged blower and prior to shipment, each packaged blower shall be mechanically run for a minimum of 15 minutes

B. Field Tests
1. Operational
   a. Prior to start-up, all blowers shall be inspected for proper alignment, function and connection
2. Performance
   a. Contractor shall perform tests to demonstrate that the blowers conform to specifications to the satisfaction of Engineer
   b. Performance shall be documented by obtaining concurrent readings indicating supply voltage, blower speed/inlet pressure/outlet pressure/inlet temperature/outlet temperature, and motor amperage
   c. Each blower motor lead shall be inspected for proper current balance
3. Blowers shall operate at rated capacity for 4 continuous hours
4. Blowers shall be run for 30 minutes at full capacity and 10 minutes off for a total of 4 hours
5. Blowers that fail to meet specifications to the Engineer’s satisfaction shall be corrected and re-tested by Contractor
6. If upon failing a second test, the blower will be rejected and the Contractor shall furnish a blower that will perform as specified herein
7. A test log shall be submitted to Engineer and Owner upon completion of each test. Tests shall record the following:
   a. Blower model number and facility tag ID
   b. Serial number
   c. Date of testing with time of testing on that day (start and end)
   d. Motor hp and speed
   e. All other performance documentation parameters specified herein

END OF SECTION

SECTION 11380

DEWATERING SYSTEM – INSTALLATION ONLY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of the dewatering system and associated appurtenances including: screw press, and polymer blend system to be supplied by a single supplier

1.2 RELATED SECTIONS

A. Division 1 – General Conditions

B. Section 00315 – Pre-Purchased Equipment

C. Section 01340 – Shop Drawings, Submittals, and Product Data

D. Section 01600 – Materials and Equipment

E. Section 03600 – Non-Shrink Grout

F. Section 09900 – Coatings

G. Section 15060 – Pipe and Pipe Fittings

H. Section 16050 – Basic Electrical Materials and Methods

1.3 REFERENCES

A. AGMA – American Gear Manufacturers Association

B. ASME – American Society of Mechanical Engineers

C. ASTM – American Society of Testing and Materials

D. ANSI – American National Standards Institute

E. IEEE – Institute of Electrical and Electronics Engineers

F. NEC – National Electrical Code

G. U.L – Underwriters Laboratories

H. AFBMA – Anti-friction Bearing Manufacturers Association

I. AWS – American Welding Society

1.4 QUALITYASSURANCE

A. Shop drawings and submittals per Section 001340

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730

B. Operation Data: Include manufacturer's instructions, description of system operation, start-up data and trouble-shooting check lists, and repair data for the dewatering system and ancillary equipment

C. Maintenance Data: Include manufacturer's literature, cleaning procedures replacement parts lists, wiring diagrams, and repair data for blowers and components

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01600

PART 2 PRODUCTS

2.1 DEWATERING SYSTEM AND APPURTENANCES

A. Equipment specified in Section 00315.

PART 3 EXECUTION

3.1 FIELD PREPARATION

A. Finish field preparation and painting shall be performed as specified in Section 09900.

B. Contractor shall correct any painting or finish defects from shipping damage prior to installation.

3.2 INSTALLATION

A. Screw Press
   1. Install in accordance with Manufacturer’s instructions
   2. Eliminate any strain between screw press and attached feed or drain piping
   3. Correct any misalignment, noisy operation, or other signs of improper setting
   4. Provide all necessary lubrication for initial start-up, testing and final acceptance
   5. Anchor belt filter press to equipment foundation according to Manufacturer’s bolt pattern and specifications.

B. Polymer Feed System
   1. Install all components in accordance with Manufacturer’s instructions

C. Electrical and Controls
   1. Install all electrical interconnections between BFP control panel and associated equipment per Manufacturer’s instructions

D. Piping and Valves
   1. Install all piping and valves per Section 15060 and as shown on the Drawings.

3.3 MANUFACTURER'S FIELD SERVICES

A. Provide under provisions of Sections 01400 and 01700

B. Prior to start-up:
   1. Test all valves, switches, gates and gages for proper settings an operation
   2. Check completion of all electrical connections
   3. Check assembly alignment
   4. Check to ensure all rotational parts are properly lubricated
   5. Bump motors to check direction or rotation
   6. Direct Contractor in necessarily corrections for start-up
   7. Provide written approval for start-up when system is satisfactory

3.4 SYSTEM INSPECTION AND START-UP

A. Start-up shall be in accordance with Section 00315

B. Contractor shall refrain from any equipment start-up prior to Manufacturer’s inspection

C. Contractor to coordinate all Manufacturer’s field services with Owner and Engineer

D. Contractor shall notify the Owner, Engineer, and Manufacturer upon completion of installation or readiness of equipment for testing and inspection a minimum of 10 days prior

E. Contractor shall perform any necessary correction identified by Manufacturer, Owner, or Engineer after inspection and prior to start-up

3.5 PERFORMACE TESTS

A. The performance test shall consist of 2 tests that shall last four hours each. Samples shall be collected at the end of every hour. Both tests shall be averaged and the installed equipment shall demonstrate that it can meet or exceed the specified Performance Criteria. Contractor responsible for all labor and costs associated with running equipment, collecting samples, and sample testing.

B. If the equipment fails to meet the specified Performance Criteria after the second attempt to pass the test the Owner may, at their sole discretion, allow the manufacturer to perform two additional performance tests. If the equipment fails to meet the specified Performance Criteria after the final testing is completed, the installed equipment supplier shall be liable to compensate the Owner for future expenses, such as sludge cake hauling,

excess polymer dosage, throughput and solids capture due to failure to meet the Performance Criteria. The penalty amount shall be equal the extra cost, on a present worth basis, that will be incurred by the Owner, over a twenty (20) year period using the current prime interest rate, as a result of the non-conformance of the belt filter press. The equipment supplier shall be liable for the extra expenses, but not to exceed 100% of equipment price.

C. If the Owner cannot provide sludge as specified in the Conditions of Service within 90 days after the Contractor's notification of readiness to perform the performance test, the tests shall be deemed to be satisfied and the Owner shall accept the equipment.

D. Any components of the dewatering system that fails to meet specifications to the Engineer's satisfaction shall be corrected and re-tested by Contractor

E. A test log shall be submitted to Engineer and Owner upon completion of each test. Tests shall record the following:
   1. Dewatering system and all ancillary equipment model numbers and facility tag ID
   2. Serial number
   3. Date of testing with time of testing on that day (start and end)
   4. Motor hp and speed, feed rate, polymer usage, type of polymer, polymer feed rate
   5. All other performance documentation parameters specified herein

3.6 MANUFACTURER'S CERTIFICATION

A. Contractor shall provide any necessary testing certifications per Division 11.

END OF SECTION

SECTION 11635

AUTOMATIC SAMPLER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Automatic refrigerated sequential/composite sampler unit, complete with weatherproof insulated fiberglass enclosure, integral programmable controllers, and accessories as specified herein.

B. Unit shall be designed for use in highly corrosive environments and shall be corrosion resistant.

C. Unit in Headworks building shall be suitable for a Class1, Division 2 environment

1.2 RELATED SECTIONS

A. Section 01340 – Shop Drawings, Product Data and Samples

B. Section 01600 – Materials and Equipment

C. Section 01730 – Operation and Maintenance Data

D. Section 16050 – Basic Electrical Materials and Methods

1.3 REFERENCES AND STANDARDS

A. National Electrical Manufacturer's Association (NEMA)

1.4 SUBMITTALS

A. Submit under provisions of Section 01340.

B. Shop drawings: Submit complete fabrication, assembly foundation, and installation drawing for all pumps, motors and accessories to illustrate construction and assembly of components.

C. Product data: Submit sufficient data to verify compliance with specifications to include materials, parts, devices, and accessories.

D. Manufacturer's installation instructions

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730.

B. Operation data: Include manufacturer's instructions, description of system operation, start-up data, trouble-shooting check lists, and repair data for chemical metering system.

C. Maintenance data: Include manufacturer's literature, cleaning procedures, replacement parts lists, wiring diagrams, and for pumps and motors.

1.6 DELIVERY STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept chemical metering pumps and accessories on site in factory packing. Inspect for damage. Comply with manufacturer's installation instructions.

1.7 QUALITY ASSURANCE

A. Automatic sampler and all accessories shall be supplied by a single manufacturer.

1.8 MAINTENANCE MATERIALS

A. Provide spare parts as follows:
   1. Two (2) spare sample tubes
   2. Two (2) spare strainer

1.9 WARRANTY

A. Contractor shall furnish a manufacturer's warranty, in writing, for at least two (2) years for the pumping units, against defects in materials and workmanship from date of Substantial Completion

PART 2 PRODUCTS

2.1 AUTOMATIC SAMPLER

A. Refrigerator Body
   1. Double-wall Linear Low-Density Polyethylene (LLDPE)
   2. Weatherproof-insulated
   3. Sampler capable of operating in an ambient temperature range of -20 to 120 degrees Fahrenheit
   4. Dimensions: 52 x 28 x 33 inches
   5. Weight (empty): 184 lbs

B. Pump
   1. Intake suction tubing
      a. Length: Per the Drawings
      b. Material: FEP-lined PE
      c. Inside Diameter: 3/8 inch
   2. Pump Tubing Life: 1,000,000 pump counts
   3. Minimum Suction Lift: 25 ft

4. Typical Repeatability: +/-5 ml or +/-5% of the average volume in a set
5. Typical Accuracy: +/-10 ml or +/-10% of programmed value
6. Pumping Rate: Minimum pumping rate shall be 2.5 ft/s through 3/8 inch ID tubing at 15 feet of vertical lift
7. Liquid Presence Detector: Non-wetted, non-conductive sensor shall detect when liquid sample reaches the pump to automatically compensate for changes in head height

C. Controller
1. Enclosure Rating: NEMA 4x
2. Program Memory: Non-volatile ROM
3. Flow Meter Signal Inputs: 5 to 15 volt DC pulse or 25 ms isolated contact closure for ISCO flow meters. 4-20 mA input for non-ISCO flow meters
4. Digital Alarms: 4 programmable outputs; 5V, 100 mA
5. Number of Composite Samples: Programmable form 1 to 999 samples
6. Power: 115 V, 60 hz

D. Software
1. Sample Frequency: 1 minute to 99 hours 59 minutes, in 1-minute increments. 1 to 9,999 flow pulses
2. Sampling Modes: Constant time – constant volume, constant time – variable volume, variable time – constant volume (Flow modes are controlled by external flow meter signal)
3. Programmable Sample Volumes: 10 to 9,990 mL in 1 mL increments
4. Sample retries: If no sample is detected, up to 3 attempts; user selectable
5. Rinse Cycles: Automatic rinsing of suction line up to 3 rinses for each sample collection
6. Controller Diagnostics: Tests for RAM, ROM, pump, display, and electrical components

E. Bottle Configurations
1. Provide the following bottle configurations with the automatic sampler
   a. Twenty-four 1-liter PP bottles
2. Provide twenty-four (24) extra 1000 mL bottles w/ the rack
3. Provide one (1) extra five gallon polyethylene container

F. Pressurized Line Accessory
1. Include one (1) accessory kit for the existing sampler to be relocated to the Office
2. Components:
   a. Pressure Reducing Valve
   b. 3-way ball valve to be controlled by sampler/controller
   c. Valve relay interface
3. Maximum Inlet Pressure: 300 psi
4. Minimum Inlet Pressure: 10 psi
5. System Enclosure Rating: NEMA 4x
6. Electrical: 120 VAC
7. System to work with existing ISCO 4700 Refrigerated Automatic Sampler

2.2 MANUFACTURERS

A. Peristaltic Pumps:
   1. Teledyne ISCO
      a. Design Basis: ISCO 5800 Refrigerated Sampler
   2. Or Engineer Approved Equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Make electrical connections required for proper operation.

B. Provide, store and install the automatic samplers in accordance with manufacturer's recommendations

3.2 FIELD START-UP SERVICES

A. Manufacturer to inspect system before initial start-up and certify system installed per manufacturer's install instructions

3.3 SCHEDULES

A. Refrigerated Automatic Samplers:

Tag Number	Location	Notes
RAS-101	Headworks	Contractor Provided

END OF SECTION

SECTION 13122

PRE-ENGINEERED METAL BUILDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Structural main building frames and secondary framing including purlins and girts, engineered and fabricated by the building systems supplier.

1.2 RELATED SECTIONS

A. Section 01340 – Shop Drawings, Product Data, and Samples

B. Section 01400 – Quality Control

C. Section 01700 – Contract Closeout

D. Section 01730 – Operation and Maintenance Data

E. Section 03300 – Concrete

F. Section 08100 – Steel Doors and Frames

G. Section 08710 – Door Hardware

H. Section 08800 – Glass and Glazing

I. Section 09900 – Painting

1.3 SYSTEM DESCRIPTION

A. Clear span rigid frame, pinned base design

B. Dimensions as shown on the contract drawings

C. Primary Framing: Rigid frame of rafter beams and columns, end wall frames with end wall columns, and lateral load/wind bracing.

D. Secondary Framing: Purlins, girts, eave struts, bracing, and other items as required by design.

E. Lateral Bracing: Horizontal loads not resisted by main frame action shall be resisted by cable bracing, rods, diaphragms in the walls and/or roof, and/or portal frames as required by design.

F. Wall System: Metal siding with insulation and ancillary components as shown on the Drawings

G. Roof System: Metal roof sheathing with insulation and ancillary components as shown on the Drawings

H. Roof slope as shown on the contract drawings

I. Sidewall eave height as shown on the contract drawings. The eave height shall be defined as the vertical distance from the finished floor to the top of the eave strut.

1.4 DESIGN REQUIREMENTS

A. Members to withstand building system loads noted on the contract drawings.

B. Deflections shall be limited as follows:
   1. Primary Framing (rafters): L/120 for total roof load. Primary Framing (columns): H/100.
   2. Secondary Framing (purlins): L/120 for total load.
   3. Secondary Framing (girts): L/90
   4. Where L is the span of the element between support points, and H is the eave height of the building.
   5. Assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners, damage to masonry or other detrimental effects, when subject to temperature range of 120 degrees F.

C. The design roof snow load shall be 30 pounds per square foot, unreduced.

D. The design wind speed shall be 135 mph (Vult) which corresponds to a nominal design wind speed of 100 mph (Vasd)

E. Seismic Criteria:
   1. Ss: 0.250g
   2. S_1: 0.062g
   3. S_{DS}: 0.267g
   4. S_{D1}: 0.099g
   5. Soil Site Class: D
   6. Seismic Importance Factor: 1.25
   7. Seismic Design Category: B

F. Design roof for a collateral load of 5 pounds per square foot

G. Roof drainage system to withstand rainfall intensity of 3 inches per hour with 5 minute duration, or as required by the local governing building code.

H. Roof style to be monoslope (single pitch).

I. Auxiliary Loads: Coordinate any roof suspended piping or equipment with Contractor

J. Bracing: Brace frames as required and locate bracing as shown on the drawings or as required to not interfere with doors openings, window openings, or other wall penetrations.

1.5 SUBMITTALS

A. Submit under provisions of Section 01340 and 01600

B. Provide a copy of any pertinent Drawings, this specification section with all addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements

C. Submit column reactions and associated load cases.

D. Submit anchor bolt setting plan with column reactions and base plate details.

E. Shop drawings describing the primary and secondary structural components of the building system.

F. Product Data: Provide data on panel profiles and secondary component profiles and dimensions.

G. Manufacturer's Erection Drawings and Installation Instructions: Indicate preparation requirements and assembly sequence, where needed.

H. Shop drawings and calculations shall be sealed by a licensed professional engineer in the State of Colorado.

1.6 QUALITY ASSURANCE

A. Fabricate structural members in accordance with all applicable provisions and referenced standards of the 2006 International Building Code.

1.7 QUALIFICATIONS

A. Manufacturer: The Company manufacturing the products specified in this Section shall have a minimum of 5 years' experience in the manufacture of building systems. The manufacturing company shall operate under an independently verified Quality Control program or be certified by a program approved by the Engineer.

B. Structural framing and covering shall be the design of a licensed Professional Engineer experienced in design of this work.

1.8 FIELD MEASUREMENTS

A. Building contractor and/or erector shall verify that field measurements are as indicated on contract and erection drawings and as instructed by the building manufacturer.

1.9 WARRANTY

A. Building manufacturer shall provide manufacturer's standard material warranty.

B. Roof and wall panels: manufacturer's standard limited 20 year non-prorated warranty.

PART 2 PRODUCTS

2.1 STRUCTURAL FRAMING

A. Shapes and plates: ASTM A36 or manufacturer's standard

B. Anchor Bolts: ASTM A307 minimum

C. Connection Bolts: ASTM A325

2.2 ROOFING AND SIDING

A. Ribbed Roof Panel:
   1. Precision roll-formed to provide 36 inch net coverage, 0.022 inches thick minimum, 80,000 pounds per square inch minimum yield steel.
   2. 1 1/8 inch high major ribs at 12 inches on center with 2 minor ribs symmetrically spaced between major ribs.
   3. Panel sidelaps shall be formed by lapping major ribs at panel edges
   4. Underlapping rib shall have full bearing legs to support sidelap.
   5. Panel end splice laps shall be over structural member and 6 inch minimum
   6. Panel length shall minimize end splices
   7. Provide perimeter trim, ridge panel and transition flashing as required to complete roof assembly.
   8. Provide closures, sealants and fasteners as required for weathertight installation.
   9. Fasteners spacing and type to be determined by manufacturer's standard.

B. Ribbed Wall Panel
   1. Precision roll-formed to provide 36 inch net coverage from 0.022 inches thick minimum, 50,000 pounds per square inch minimum yield steel.
   2. 1 1/8 inch high major ribs 12 inches on center with 2 minor ribs symmetrically spaced between major ribs.
   3. Form panel sidelaps by lapping major ribs at panel edges.
   4. Panel length shall minimize end splices
   5. Panel end splice (when required) shall be over structural member and lap 4 inch minimum.
   6. Provide corner trim, base trim and transition flashings to complete wall assembly.
   7. Provide closures and fasteners for weathertight installation.
   8. Fastener spacing and type to be manufacturer's standard.

C. Liner Panel

1. Precision roll-formed to provide 36 inch net coverage from 0.022 inches thick minimum, 50,000 pounds per square inch minimum yield steel
2. Shallow “V’ grooves on 2 inch center
3. Form panel sidelaps by lapping at panel edges
4. Panel length shall minimize end splices
5. Panel end splice (when required) shall be over structural member and lap 4 inch minimum
6. Provide corner trim, base trim and transition flashings to complete wall assembly
7. Fastener spacing and type to be manufacturer’s standard

D. Panel Exterior Finishes
1. Ribbed roof Panel: Manufacturer’s standard 0.5 ounces per square for aluminum-zinc alloy-coating. Color as selected by Engineer
2. Ribbed wall Panel: Manufacturer’s standard G-90 galvanized coating with full 70% polyvinylidene fluoride (Kynar) finish. Color as selected by engineer.
3. Liner Panel: Mnaufacturer’s standard G-90 galvanized coating with manufacturer’s standard siliconized polyester finish. Color as selected by Engineer.

E. Panel Interior Finish
1. Manufacturer’s standard G-90 galvanized coating with manufacturer’s standard siliconized polyester finish. Color as selected by Engineer.

F. Fasteners:
1. Wall Panels: Manufacturer’s standard long-life coated No. 12 (minimum) self-drilling carbon steel screws for liner panels and exterior single skin wall panels. No. 12 (minimum) self-tapping screws for factory insulated panels. Factory color exposed fastener head to match color of panels.
2. Single Skin Ribbed Roof Panels: Manufacturer’s standard No. 12 (minimum) self-drilling screws, long-life coated, unpainted or painted with sealing washer, or No. 12 (minimum) carbon steel self-drilling screws, with stainless steel cap or zinc/aluminum alloy head and sealing washer.
3. Trim fasteners. Manufacturer’s standard plated and finish painted No. 8 (minimum) self-drilling screws with ¼ inch hex washer head.

G. Sealant:
1. Roof Panel Sealant: nonshrinking, nondrying butyl-based sealant, specifically formulated for roof application at temperatures from 20°F to 120°F

2.3 WALL AND ROOF INSULATION

A. Roof Fiberglass Insulation:
1. Manufacturer’s standard noncombustible fiberglass dual layer insulation system consisting of R-13 + R-19 insulation for the bottom and top layers respectively with thermal blocks at purlins.

B. Wall Fiberglass Insulation:

1. Manufacturer's standard noncombustible fiberglass dual layer insulation system consisting of R-13 + R-5.6 insulation with a faced interior layer located between girts and continuous unfaced layer continuous across the outside face of the girts

C. Manufacturer may use other insulation types or systems as long as the system provided meets or exceeds the requirements of the 2006 International Energy Conservation Code. Alternate insulation systems shall be supported by documentation demonstrating conformance with the requirements of the adopted energy code listed above.

D. Provide insulation and facing carrying UL fire hazard (UL 73) rating is applied to each individual component if field assembled, or to composite unit if supplied factory assembled.

2.4 FABRICATION

A. Fabricate as shown on approved submittals. Do not modify submittals or specifications

B. Welds shall be by welder certified for type of welding required.

C. Fabrication and erection welding and welding equipment shall comply with AWS

D. Electrodes for structural welds shall be E70 Series.

E. Surfaces shall be free of scale, rust, grease, paint, or other foreign matter prior to welding

F. After welding, brush welds with wire brushes. Welds shall be uniform section, smooth, without overlaps, and free from porosity and clinkers. Where necessary to achieve smooth connections, joint shall be dressed smooth

2.5 COATINGS

A. Shop prime structural steel surfaces with manufacturer's rust inhibitive primer compatible with finish coat described in Section 09900.

B. Hot dip galvanize all steel members and anchor bolts in Headworks and shed structure over scale.

C. Colors will be selected by Engineer

2.6 ACCESSORIES

A. Gutters and Downspouts:
   1. Gutters:
      a. Suspended box sections of 20 gauge minimum galvanized factory-colored steel formed to match configuration of gable trim and have minimum cross-section of 36 square inches
      b. Attach gutter to roof panel using standard fasteners as specified by manufacturer.

c. Lap gutter sections and seal splices and end closures with aluminized sealant and fasten with trim fasteners as specified by manufacturer.

2. Downspouts:
   a. 24 gauge minimum galvanized factory-colored steel with minimum cross section of 20 square inches.
   b. Locate downspouts according to design requirements.
   c. Attach to thimble installed in gutter.
   d. Attach to wall panel using 26 gauge minimum galvanized factory-colored steel straps on 10’-0” maximum centers.
   e. Provide 75-degree elbow at base of downspouts to direct water flow away from building
   f. Finish: Manufacturer’s standard siliconized polyester system. Color as selected by Engineer.

B. Man Doors, Frames, and Hardware
   1. Doors and Frames: Conform to Section 08100
   2. Hardware: Conform to Section 08710

C. Overhead Doors:
   1. Conform to Section 08331

D. Windows:
   1. Manufacturers standard window system
   2. Glazing shall conform to Section 08800

PART 3 EXECUTION

3.1 GENERAL

A. Erect metal building, accessories and interior finish, if applicable, by one of following:
   1. Dealers or builders authorized by manufacturer
   2. Building manufacturer’s crews
   3. Other erectors authorized by manufacturer as trained and qualified to erect manufacturer’s product

B. Assemble in accordance with approved erection or assembly drawings, details, and instructions. Do not make modifications to assembly drawings, details or instructions

3.2 STRUCTURAL FRAMES

A. Erect true to line, level and plumb, brace and secure with temporary bracing in each direction as required.

B. Level base plates and secure to anchor bolts to level plane with full bearing to foundation supporting structures.

C. Bracing:

1. Install permanent diagonal rod or angle bracing in roof sidewalls, and endwalls as approved by manufacturer.
2. Tighten rods to avoid excessive sag.

D. Framed openings:
1. Securely attach to building structural framing members, square and plumb.

3.3 ROOFING AND SIDING PANELS

A. General:
1. Install roof panels to permit drainage to eaves of building, with panel ends square to eave.
2. Install wall panels with vertical edges plumb.
3. Arrange and nest sidelap joints away from prevailing winds when possible
4. Apply panels and associated items for neat and weathertight enclosure
5. Avoid “panel creep” or application not true to grid lines.
6. Protect factory finishes from mechanical damage or abrasions.
7. Install approved type closures to exclude weather.
   a. Install weather seal under ridge cap. Flash and seal roof panels at eave, gable and perimeter of openings through roof and elsewhere as shown on Drawings.
   b. Flash or seal wall and liner panels at perimeter of openings, under eaves and gable trims, along lower panel edges, and elsewhere as shown on Drawings, as applicable.
8. Remove fastener or cutting shavings from roof and wall as erection is completed.

B. Wall Panel:
1. Install wall panels on exterior side of metal framing with liner panels installed on building interior in locations shown on Drawings.
2. Align bottoms of panels to proper coverage and fasten with manufacturer’s recommended and supplied fasteners.
3. Cut and fasten flashing and trims with approved type fasteners.
4. Install fasteners with power tool having adequate torque and proper rpm adjusted to seat fastener without damage to heads washers or panels.
5. Install panel sidelap away from prevailing wind or view direction when possible, maintaining proper lap without fastener dimpling or excessive overlap.
6. Wall panels for louvers shall be field-cut.

C. Roof Panel:
1. Install the metal roof panel system in accordance with the manufacturer’s instructions, installation drawings, and approved shop drawings, so that it is weathertight and allows for thermal movement.
2. Locate and space all fasteners in accordance with roof panel manufacturer’s recommendations. For required exposed fasteners, use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the sealing washer
3. Do not place utility penetrations through the panel seams.

4. Do not allow panels or trim to come into contact with dissimilar materials (copper, lead, graphite, treated lumber, mortar, etc). Protect from water run-off from these material.
5. Perform field cutting of panels and related sheet metal components by means of hand or electric shears. At no time shall a hot/friction saw be used.
6. Remove protective film immediately after installation.

3.4 ACCESSORIES

A. Install gutters, downspouts, flashings, trim, ridge covers, roof curbs, pipe flashings, closure strips, roof jacks, and other accessories and sheet metal items in accordance with manufacturer's recommendations for positive attachment to building and provide weathertight mounting.

B. Doors, Frames, and Hardware
   1. Install in accordance with manufacturer's recommendations

C. Overhead Doors:
   1. Install in accordance with manufacturer's recommendations

3.5 THERMAL INSULATION

A. Install in accordance with manufacturer's recommended procedure and concurrently with installation of wall and roof panels.

B. Roof and Wall Insulation: Install blankets straight and true. Fasten tabs together or lap and glue to provide complete vapor barrier. Place insulation with facing exposed to interior of building unless recommended otherwise.

3.6 FINISH COATING

A. Paint exposed metal framing and items such as doors and windows in accordance with Section 09900

3.7 ADJUSTMENT AND CLEANING

A. Touch up defects such as mars and abrasions to panels and framing, weld burrs in field.

B. Adjust items such as doors, windows, and louvers to operate properly.

END OF SECTION

SECTION 14620

MANUAL HOISTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hand-operated chain hoists and trolleys.

1.2 REFERENCES

A. ANSI: American National Standards Institute

B. AMSE: American Society of Mechanical Engineers

C. OSHA: Occupational Safety & Health Administration

1.3 SYSTEM DESCRIPTION

A. Design Requirements:
   2. Design and fabrication of hoists and trolleys shall be in accordance with the applicable requirements Of ASME HST 2.
   3. Operating chains of hoists and trolleys shall loop not more than 4 feet above the finished operating floor.
   4. Hoist Location: Headworks
   5. Hoist Capacity: 2 Tons
   6. Operating Lift: 20 Feet
   7. Trolley type: Plain push type

1.4 SUBMITTALS

A. Product Data:
   1. Details of hoists and trolleys.
   2. Operation and Maintenance data.

B. Submit in accordance with Section 01340.

1.5 QUALITY ASSURANCE

A. Proportion parts of mechanism for stresses that occur during continuous operation, during installation, and during fabrication.

PART 2 PRODUCTS

2.1 HOISTS

A. Lightweight chain hoist, hook suspended type, with rated capacity and operating lift as noted.

B. Compatible with trolley.

C. Provide chain container where noted.

D. Operating chain and lift chain shall be zinc plated.

E. Hoist shall have corrosion resistant finish.

2.2 TROLLEYS

A. Plain push type where noted.

B. Compatible with monorail beam.

C. Trolley shall have corrosion resistant finish.

2.3 MARKING

A. Permanently mark capacity of hoists and trolleys on each hoist and trolley.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install hoists and trolleys as shown on Drawings and in accordance with approved submittals and manufacturer’s recommendations.

3.2 FIELD QUALITY CONTROL

A. Field load test hoists and trolleys in accordance with OSHA, ANSI, and local requirements.

END OF SECTION

SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Basic mechanical requirements

1.2 RELATED SECTIONS

A. Division 15 Sections

1.3 GENERAL CONDITIONS

A. The General Conditions of the Contract and Supplementary Conditions of the General Contract apply to work under this Division.

1.4 QUALITY ASSURANCE

A. The mechanical design for this project is based on specific manufacturers and equipment as scheduled on the drawings and listed in these Division 15 Specifications with specific model number identifiers. Acceptable substitute manufacturers of equipment are listed in these specifications. If any acceptable substitute manufacturer's equipment is used, the cost of any change in design or construction required by their use shall be borne by the contractor. Contractor shall document and submit all changes to design plans and schedules as a result of the use of substituted equipment.

B. If manufacturer's material or equipment is listed in Schedules or on Drawings, they are types to be provided for establishment of size, capacity, grade, and quality. If other acceptable manufacturers are used, cost of any change in construction required by their use shall be borne by Contractor.

C. Equipment shall conform to State and/or local Energy Conservation Standards.

D. Execute and test all work per Underwriters, state and local codes, rules, and regulations applicable to trade affected. Included are recommendations of NFPA, SMACNA, OSHA, and ASHRAE. References to standards are latest revision of standard specified.

E. Comply with rules and regulations of local utility companies. Include cost of valves, valve boxes, meter boxes, meters, accessory equipment required for project.

1.5 INTENT AND INTERPRETATIONS

A. It is the intent of these Drawings and Specifications to result in a complete mechanical installation in complete accordance with all applicable codes and ordinances.

B. Drawings are diagrammatic in character and do not necessarily indicate every required pipe, offset, transition, etc. Items not specifically mentioned in the Specification or noted on the Drawings, but which are obviously necessary to make a complete working installation, shall be included.

C. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. The more stringent requirements shall govern.

D. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, take the necessary measurements and prepare the drawings.

E. Symbols used on the Drawings are defined in the Legend on the Drawings. All symbols indicated on the Legend may not necessarily be required for the project.

F. "Provide" shall mean "furnish and install." "Accepted" or "acceptable" denotes the work or equipment item is in conformance with the design concept of the project and, in general, complies with the pertinent information given in the Contract Documents.

G. Prior to ordering equipment, determine that equipment will adequately pass through building openings and passageways providing unobstructed access to final equipment location. Equipment shall be manufactured and shipped in sections for assembly in final equipment location when inadequate building openings and passageways limit access. Shop drawings and submittals shall indicate sectionalized manufacturing of equipment.

H. Before any work is installed, determine equipment will properly fit the space, required clearances can be maintained and equipment can be located without interferences between systems, with structural elements, or with the work of other trades.

I. If conflicts are discovered in Contract Documents as work progresses, submit a set of drawings marked with red pencil showing recommended modifications to the Engineer for approval prior to installation.

J. The Drawings indicate the general arrangement of mechanical systems. However, rearrangement will not be permitted without specific approval prior to installation.

K. Provide incidental equipment such as tools, scaffolding, consumable items, testing equipment, appliances and the like whether listed or not. Provide labor, fees, licenses, start-up and checkout services also.

L. In the event that any discrepancies of any kind exist or required items or details have been omitted, notify the Engineer in writing of such discrepancy or omission at least five days prior to bid date. Failure to do so shall be construed as willingness to supply all necessary materials and labor required for the proper completion of this work.

1.6 JOB CONDITIONS

A. Location, size, and type of equipment and material shown as existing are taken from existing drawings. Verify exact conditions in field prior to start of construction.

B. Before submitting bid, examine premises and become familiar with all existing conditions which may affect cost. No allowance will subsequently be made for not following this procedure.

C. Owner supplied existing equipment will be installed. Become familiar with existing rough-in requirements prior to installation. Report any difficulties or discrepancies to Engineer prior to start of work.

D. Not all piping and ductwork offsets, transitions, and multiple connections required to install the new work into the available space are shown on the drawings. Field measure for exact requirements and install accordingly.

E. Confer, cooperate, and coordinate work with other trades. Coordinate ceiling cavity space carefully with all trades. In event of conflict, install mechanical and electrical systems within cavity space in following order of priority.
   1. Building equipment piping and supports.
   2. Ductwork.
   3. Electrical conduit and lighting.

F. Where locations of devices and equipment are not specifically mentioned in the Specifications or indicated on the Drawings, verify locations with Engineer or Owner prior to rough-in.

G. Submit large scale coordinated composite layouts showing both plan and elevation, piping, ducts, and conduits in areas that appear congested. Check routing of work prior to fabrication. Report conflicts to Engineer.

H. Provide carpentry, masonry, concrete and metal work required for work of this Division where not specifically called for under other Sections.

1.7 PERMITS AND FEES

A. Arrange and pay for all inspections, permits, licenses, certificates, and fees required in connection with work.

1.8 SUBMITTALS

A. Submit under provisions of Section 01340 and the following paragraphs

B. All electronic submittal data shall be provided in separate Portable Document Format (pdf) folders for each individual Division 15 specification section.

C. All shop drawings and submittal data shall bear a unique submittal number per Division 1

1.9 SUBSTITUTIONS

A. Equipment scheduled on drawings and specifically called for in these specifications was used as the basis of the mechanical systems design; modifications to the systems design

to accommodate a substituted piece of equipment shall be the responsibility of the installing Contractor.

B. Coordinate all substituted equipment requirements with other trades prior to ordering equipment.

1.10 PROJECT RECORD DOCUMENTS

A. Keep in custody during entire period of construction, a current set of documents indication changes that have been made to the Contract Documents. Changes to be noted on the documents shall include but shall not be limited to piping or ductwork installed more than two feet from where shown on Drawings, changes in pipe and duct size, location of valves and cleanouts. Mark valve tag numbers on Drawings. Incorporate Addenda, accepted Alternates, Change Orders, and other Document revisions which occurred after the award of the General Contract or the start of construction activities into the Record Documents. Notations and changes shall be done in a neat and legible manner in accordance with Engineer's instructions. Changes shall be noted in red, deletions in green, and notes in blue.

B. Upon completion of work, submit the complete set of Record Documents to the Engineer. The Contract Documents set the standard for content and methods of presentation for the changes shown.

C. The Contract shall not be considered completed until these Record Documents have been reviewed and accepted by the Engineer.

1.11 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience

1.12 REGULATORY REQUIREMENTS

A. Conform to all municipal codes and ordinances, laws and regulations of the state

B. In case of apparent conflict, state and local requirements govern over these specifications

1.13 DELIVERY, STORAGE, AND HANDLING

A. Provide delivery and safe storage of materials and equipment. Make provisions for introduction into building of equipment too large to pass through finished openings. Provide for hoisting of equipment.

B. Deliver, store, protect, and handle products to site under provisions of Section 01600

1.14 PROTECTION OF EQUIPMENT

A. Protect materials and equipment from physical damage, construction dirt, and the elements from time of shipment to time installation is accepted by Owner.

B. Protect work against theft, injury, or damage from all causes

1.15 GUARANTEE

A. Guarantee materials, workmanship and operation of equipment installed for period of two years from date of acceptance of entire Work. Repair or replace any part of work which shows defect during that time.

B. Be responsible for damage to property of Owner or to work of other contractors during construction and guarantee period.

C. Furnish equipment warranties to Owner.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 HANDLING OF EQUIPMENT USING REFRIGERANTS

A. Technicians handling equipment with refrigerants, for removal or installation, shall be EPA (Environmental Protection Agency) certified in accordance with Regulation No. 15 of Colorado Air Quality Control Commission, Section 608 of the Clean Air Act, 1990, as amended.

B. Type of technician certification shall be compatible with the handled equipment: high, very high, or low pressure appliances.

C. Evacuated refrigerant shall be recovered and recycled in accordance with EPA's requirements at the Contractor's expense.

D. Prior to handling of equipment with refrigerants, submit proof of technical and refrigerant handling equipment certification. After handling of refrigerants, submit detailed documentation, including type of refrigerant and quantities, indicating the steps taken to comply with EPA regulations.

3.2 EQUIPMENT WIRING AND CONNECTIONS

A. Voltage characteristics shall be as in Electrical Division of Specifications and on Electrical Drawings.

3.3 INSPECTIONS

A. Do not cover up or enclose work until inspected, tested, and approved. Any work enclosed or covered up before such approval shall be uncovered, tested, and approved.

3.1 SUPERVISION

A. Supervise work to proceed in proper sequence without delay to other contractors. Keep supervisor on premises at all times to ensure intent of Drawings and Specifications is being followed.

3.2 INSTALLATION

A. Workmanship shall be first quality. Appearance of work shall be of equal importance to its mechanical operation. Lack of quality workmanship shall be reason for rejection of system in part or in whole.

B. Complete installation shall function smoothly and noiselessly.

C. Install equipment and materials per manufacturers' recommendations and local codes or regulations

D. Flush pipes free of foreign substances before installing valves or making final connections. Notify the Owner 7 days in advance of final flushing so the Owner can verify the cleanliness of the pipe. Clean all piping and equipment.

3.3 LUBRICATION OF EQUIPMENT

A. Lubricate equipment before operation and before turning to Owner

3.4 TESTING

A. All tests specified herein and/or called for by authorities having jurisdiction shall be witnessed by Engineer or Owner. Reference other Division 15 Sections for additional requirements specific to those sections.

B. Upon completion of the work, deliver certificates of inspection and final approval to Owner.

3.5 COMPLETION

A. Replace air filters if units were operated during construction. Clean ducts, blowers, and coils if units were operated without filters during construction.

B. Instruct Owner in operation and maintenance of mechanical systems. Minimum participants shall include mechanical contractor and controls contractor representatives.

C. After tests and adjustments have been made and systems pronounced satisfactory for permanent operation, refinish damaged finish and leave everything in proper working order and appearance.

D. On completion of work, remove tools, scaffolding, debris, etc., from grounds and leave premises clean

3.6 PROJECT CLOSE-OUT

A. Refer to Specification Section 01700

3.7 OPERATION AND MAINTENANCE MANUALS

A. Prior to completion of project, submit three (3) sets of maintenance manuals covering operation and maintenance of mechanical equipment with moving or movable parts. Instructions shall be in pamphlet or typewritten form in three ring binders. Instructions for each unit shall be indicated by separate tab.

B. Include test and balance report

C. Include name, address, telephone number of party to be contacted for 24-hour service for each item of equipment

D. Include starting, stopping, lubrication, preventative maintenance schedule, and adjustment information for each piece of equipment

E. Include guarantees and warranties of all equipment

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment installation requirements common to equipment sections

1.2 RELATED SECTIONS

A. Division 15 Sections

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels

B. Exposed, Interior Installations: Exposed to view indoors, examples include finished occupied spaces and mechanical equipment rooms

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions, examples include rooftop locations

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants, examples include above ceilings and chases

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures, examples include installations within unheated shelters

1.4 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIRMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations

D. Install equipment to allow right of way for piping installed at required slope

3.1 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09 Sections for interior painting and exterior painting

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish

3.2 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment

B. Field Welding: Comply with AWS D1.1

END OF SECTION

SECTION 15060

PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping complete with all fittings, jointing materials, expansion joints, hangers, supports anchors and necessary appurtenances for interior installations:
   1. Wastewater treatment process piping
   2. Air piping
   3. Water piping
   4. Sewer and drain piping
   5. Other miscellaneous piping

1.2 RELATED SECTIONS

A. Section 02300 – Earthwork

B. Section 02616 – Site Piping

C. Section 02676 – Disinfection of Water Systems

D. Section 03300 – Cast-In-Place Concrete

E. Section 03610 – Non-Shrink Grout

F. Section 09900 – Coatings

G. Section 15090 – Supports and Anchors

H. Section 15100 – Valves, Cocks, and Hydrants

1.3 REFERENCES

A. American National Standards Institute (ANSI)
   1. B1.1 – Unified Inch Screw Threads
   2. B16.1/B16.5 – Pipe Flanges and Fittings Package
   3. B16.24 – Cast Copper Alloy Pipe Flanges and Flanges Fittings
   4. B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes
   5. B18.2 – Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
   6. B31.1/B31.3 – Power and Process Piping Package

B. American Society of Mechanical Engineers (ASME)
   1. B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings
   2. B16.22 – Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
   3. B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes

C. American Society of Testing and Materials (ASTM)

1. A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. A134 – Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and Over)
3. A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe
4. A139 – Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
5. A181 – Standard Specification for Carbon Steel Forgings for General-Purpose Piping
6. A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
7. A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
8. A234 – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
9. A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
10. A283 – Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
11. A307 – Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
12. A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
13. A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
14. A774 – Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fitting for General Corrosive Service at Low and Moderate Temperatures
15. A778 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
16. A795 – Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
17. B32 – Standard Specification for Solder Metal
18. B75 – Standard Specification for Seamless Copper Tube
19. B88 – Standard Specification for Seamless Copper Water Tube
20. D1785 – Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
21. D2464 – Standard Specification for Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
22. D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
23. D2467 – Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
24. D2996 – Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
25. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR.) Based on Controlled Outside Diameter
26. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

27. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
28. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fitting Materials
29. F104 – Standard Classification System for Nonmetallic Gasket Materials
30. F412 – Standard Terminology Relating to Plastic Piping Systems
31. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
32. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
33. F2164 – Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

D. American Water Works Association (AWWA)
1. C110 – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-Inch through 48-Inch, for Water
2. C111 – Standard for Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
3. C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
4. C150 – American National Standard for Thickness Design of Ductile-Iron Pipe
5. C151 – Standard for Ductile Iron Pipe, Centrifugally Cast, for Water
6. C153 – Standard for Ductile-Iron Compact Fittings
7. C200 – Standard for Steel Water Pipe 6 Inch and Larger
8. C203 – Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot Applied
9. C206 – Standard for Field Welding of Steel Water Pipe
10. C207 – Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 Inch Through 144 Inch
11. C209 – Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
12. C219 – Bolted, Sleeve-Type Couplings for Plain-End Pipe
13. C220 – Standard for Stainless Steel Pipe ½ Inch and Larger
14. C606 – Standard for Grooved and Shouldered Joints
15. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inch through 12 Inch, for Water Transmission and Distribution
16. C901 – Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. through 3 In., for Water Service
17. C906 – Polyethylene (PE) Pressure Pipe and Fittings 4 Inch Through 63 Inch, for Water Distribution and Transmission
18. C907 – Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 Inch through 12 Inch, for Water, Wastewater, and Reclaimed Water Service
19. C950 – Standard for Fiberglass Pressure Pipe
20. M11 – Steel Pipe: A Guide for Design and Installation
21. M23 – PVC Pipe Design and Installation
22. M41 – Ductile-Iron Pipe and Fittings
23. M45 – Fiberglass Pipe Design

E. National Science Foundation (NSF)
1. 61 – Drinking Water System Components – Health Effects

F. National Fire Protection Association (NFPA)
   1. 13 – Standard for the Installation of Sprinkler Systems
   2. 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities

G. International Plumbing Code (IPC)

H. Copper Development Association Inc. (CDA)
   1. Copper Tube Handbook

I. Society for Protective Coatings (SSPC)

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Shop Drawings:
   1. Provide piping layout fabrication and assembly drawings with fittings dimensions. Provide sufficient information to verify compliance with specification including, but not limited to, the following:
      a. Layout of pipe drawings
      b. Pipe and joint details
      c. Specials, fittings, and coupling details
      d. Specification data sheets
      e. Certificates of compliance with applicable standard and specification and testing certificates
      f. For steel pipe show weld locations and installation of pipe, fittings, specials and connections
         i) Complete data of materials proposed
         ii) Do not manufacture until approved
         iii) Show where each numbered pipe fitting or special is to be installed
         iv) Numbers correspond to those painted on pipe
   2. Provide additional detailed information including elevations, fittings, specialty materials or fabrications for special or custom features, structures, junctions and/or pipes
   3. Specifications, data sheets and affidavits of compliance for coatings and linings
   4. Provide pipe-laying and installation schedule

C. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications

D. Manufacturers Certificate and affidavits:
   1. Furnish the following prior to fabrication
      a. Details: Pipe, joint, special, fitting and coupling
      b. Shop coating
      c. Shop coatings and linings: specifications, data sheets, and compliance affidavits
   2. Furnish the following prior to shipment
      a. Compliance affidavit for applicable standards
      b. Test certificates

E. Test Reports: Submit all shop and field test reports in accordance with Division 1 Specifications as Product Data

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications

B. Accurately record actual locations of piping, valves, connections, centerline of pressure pipe elevations, and top of gravity pipe elevations

C. Identify and describe unexpected variations to building conditions or discovery of unknown utilities

1.6 REGULATORY REQUIREMENTS

A. In accordance with all local City codes and ordinances, laws and regulations of the State

B. In case of apparent conflict, State and local requirements govern over these specifications

C. In absence of State and local regulations, International Plumbing Code applies

1.7 DELIVERY, STORAGE AND HANDLING

A. For steel pipe with coal tar enamel or hot applied tape: comply with AWWA C203
   1. Handling and Storage:
      a. Use wide canvas slings and wide padded skids.
      b. Do not use bare cables, chains, hooks, metal bars, or narrow skids
      c. Do not store directly on ground, provide proper blocking
      d. Do not roll on enameled or taped surface
      e. Do not expose enameled pipe to temperature below 0°F
      f. Do not handle enameled pipe below 10°F
   2. Shipment
      a. Ship steel pipe supported on padded saddles not less than 12-inches wide, securely fasten load to prevent movement in transit. For pipes coated with fusion bonded epoxy use nylon straps
      b. Laterally support ends of pipe, fittings, special, to maintain shape during shipment
      c. Separate materials during shipment to prevent materials bearing against each other
   3. Delivery
      a. Products with dents, kinks, abrupt changes of curvature or other damages shall be rejected upon delivery
      b. Products dropped from truck or crane shall be rejected
      c. Rejected items shall be replaced or reconditioned at the expense of the contractor. Reconditioning shall only be permitted at approval of Engineer and with replacement coatings as originally specified on the reconditioned pipe

B. For all other pipe
   1. Deliver, store, protect and handle products to site under provisions of Division 1 Specifications

2. Delivery
    a. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct sunlight
3. Storage
    a. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: direct sunlight, mud, etc.
    b. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
    c. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
    d. Do not stack pipe higher than 5-feet
4. Storage: Use the following precautions for valves, during storage:
    a. Do not remove end protectors unless necessary for inspection; then reinstall for storage
        i) Protect valves from weather by storing indoors or support valves off ground and pavement in watertight enclosures when outdoor storage is necessary
5. Handling
    a. Handle so as to insure installation in sound undamaged condition
    b. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection
    c. Use hooks or straps with broad, well padded contact surfaces for lifting sections of pipe
6. Preparation for Transport:
    a. Prepare valves, for shipping as follows:
        i) Ensure that valves and pilotry are drained and dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends, flange faces, and weld ends. Set valves in best position for handling. Set valves closed to prevent rattling
7. Deliver and store valves and accessories in shipping containers with labeling in place in accordance with AWWA C500/C504/C509
8. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation
9. Seal pipe and fittings to prevent entry of foreign materials into pipe and fittings
10. During loading, transporting and unloading, exercise care to prevent damage to material
    a. Use nylon slings only
    b. Do not drop pipe or fittings
    c. Do not roll or skid against pipe already on ground
    d. Repair any damage done to coating or lining
    e. Handle per manufacturer's recommendations
    f. Store rubber gaskets in cool dark location
    g. Store all material on wood pallets or timbers
11. Adequately tag or otherwise mark all piping and fittings as to size

PART 2 PROCESS PIPING PRODUCTS

2.1 PIPE MATERIALS

A. Steel pipe and fittings shall be provided in accordance with ASTM A53/A53M, ASTM A106, or AWWA C200 as specified

2.2 STEEL PIPE – 6-INCHES AND LARGER

A. Pipe: AWWA C200
   1. Fabricated or mill type
      a. ASTM A53 Type E or S Grade B
      b. Or ASTM A134 made from:
         i) Steel plate: ASTM A283, Grade C, with maximum carbon content of 0.30 percent and maximum manganese content of 1.2 percent, or ASTM A570, Grade 30
      c. Or ASTM A139, Grade B
      d. Or ASTM A135, Grade B
   2. Wall thickness: 1/4 inch minimum continuous spiral seam welded on inside and outside of pipe
   3. Specified pipe size:
      a. 12-inches or smaller, nominal inside diameter
      b. 14-inches or larger, actual outside dimension
   4. Stab joint pipe specified diameter, nominal diameter
   5. Reinforce or increase shell thickness of pipe, fittings and specials to maintain combined stress due to internal pressure and bending below 20,000 psi
   6. Shop testing per AWWA C200
   7. For pipe with mechanical couplings, the space between pipe ends shall be at least 1/2 inch, but not greater than the manufacturer's recommendations

B. Fittings and Specials: fabricated or wrought seamless
   1. AWWA C200 or ASTM A234, Grade A (WPA), unless otherwise required
      a. Steel plate: Same as for pipe specified above
   2. Wrought seamless: short or long radius, Contractor's option

C. End of Sections
   1. Field butt welding: outside be beveled to 37-1/2 degrees $\pm$ 1/32 inch
   2. Welded bell and spigot: AWWA C200
   3. For fitting with slip on flanges: AWWA C200
      a. Slip-on flanges may be used in lieu of weld neck flanges shown on Drawings, except on short radius fittings
   4. For mechanical couplings, plain end types per AWWA C200 shall be used
      a. Welds shall be ground flush on ends without pipe stops to permit slipping the coupling in at least one direction to clear pipe joint
      b. The outside diameter and out-of-round tolerances shall be within the limits of the coupling manufacturer

5. For victaulic couplings, shall be grooved or collared type, per size and thickness of pipe, fitting, or special and maximum working pressure consistent with manufacturer's recommendations
    a. Grooving dimensions shall conform to rigid/standard grooving dimensions

D. Flanged Joints
1. Shall be flanged where indicated on Drawings and in accordance with ANSI B16.1 /B16.5
    a. Flanges: Slip-on or welding neck, except where otherwise indicated
        i) Material: ASTM A181, Grade 1 or ASTM A283, Grade B or C
        ii) Dimensions and drilling: AWWA C207, Class D, Table 1 or 2
            a) Coordinate flange dimensiosn and drillings among piping, valves,a and equipment
        iii) Bore weld neck flange to ID of pipe
        iv) Faces shall be finished to a plane surface within a maximum tolerance of 0.010 inch
        v) Diameter shall have a maximum tolerance of 0.005 inch/foot for flange faces from the normal with respect to axis of pipe
        vi) Flanges shall be tested for true plane after welding, reface if necessary
        vii) Flange dimensions and drillings shall be coordinated between piping, valves and equipment
    b. Blind Flanges
        i) Conform in diameter, drilling and thickness with flanges where they attach
        ii) Shall be reinforced as required
    c. Flange bolting
        i) Material: ASTM A307
        ii) Type: Bolt and nut, bolt-stud and 2 nuts permitted for 1 inch and larger
        iii) Bolts and bolt-studs
            a) Length: Ends project ¼ inch to ½ inch beyond nuts
            b) Ends: Chamfered or rounded
            c) Threading: ANSI B1.1, coarse thread series, Class 2A fit. Bolt studs may be threaded full length. Studs for tapped holes threaded to match holes
        iv) Bolt heads
            a) Shape: Hexagonal or square
            b) Dimensions: ANSI B18.2 heavy pattern for hexagonal, regular pattern for square
        v) Nuts
            a) Dimensions: ANSI B18.2 heavy, semi-finished pattern
            b) Threading: ANSI B1.1 coarse thread series, Class 1B fit

E. Shop Welded Joints
1. Provided joints shall be water tight and sound and free from embedded scale and slag
2. Tensile strength across the weld shall not be less than that of the thinner of connected sections
3. Yield point of the welded joint shall be tested by independent laboratory at contractor's expense
4. Butt welds shall be used for all welded joints in line pipe assemblies and in fabrication of fittings and other specials

5. For slip-on flange attachments, fillet welds shall be used per AWWA C207
6. Back-up welding strips or rings shall not be allowed for shop welds

F. Coupled Joints
1. Mechanical couplings
   a. Provide couplings with a middle ring length not less than 7-inches
   b. Where couplings are used for closures or where union connections are required omit pipestop from inner surface of middle rings
   c. Couplings shall be cleaned and shop primed with manufacturer's standard rust inhibitive primer. Couplings shall be coated in accordance with Section 09900
   d. Insulating
      i) Dresser “Style 39”
      ii) Rockwell “416”
      iii) Romac IC501
      iv) Smith-Blair
      v) Or accepted substitution
   e. Reducing
      i) Dresser “Style 62”
      ii) Rockwell “415”
      iii) Romac
      iv) Smith-Blair
      v) Or accepted substitution
   f. Transition coupling
      i) Dresser “62”
      ii) Rockwell “413”
      iii) Romac
      iv) Smith-Blair
      v) Or accepted substitution
   g. Others
      i) Dresser “Style 38”
      ii) Rockwell “411 Flexible Coupling”
      iii) Romac
      iv) Smith-Blair
      v) Or accepted substitution
2. Joint harness
   a. Bolts: ASTM A193, Grade B7, or Ryerson Stress-Proof, minimum yield point 100,000 psi
      i) Provide two (2), double nut bolts per harness
      ii) Design bolts based on 40,000 psi maximum stress at hydrostatic test pressure after installation
      iii) Threading: ANSI B1.1, Class 2A fit, coarse thread series for 1 inch and smaller and 8 thread series for 1-1/8 inch and larger
      iv) Ends: Chamfered or rounded
   b. Nuts: Hexagonal ASTM A194, Grade 2H or better
      i) Threading: As specified for bolts except Class 2B fit
      ii) Dimensions: ANSI B18.2 heavy, semi-finished pattern
   c. Washers: Hardened steel, ASTM A325

d. Provide joint harnesses as indicated on the Drawings per Figure 13-17 of AWWA M11
e. All lugs shall be shop welded to pipe, except where Drawings require a sleeve welded to the pipe and lugs welded to the sleeve
f. Provide for coupling to be slipped clear of joint in at least one direction by placing harness lugs and bolts of sufficient length

3. Flange coupling adapters
   a. Provided per coupling manufacturer's recommendations
   b. Fusion-type epoxy coating
   c. Determine adapter location and drill anchor stud holes after pipe placement
   d. Provided restraints for all flanged coupling adapters either with gripper rings or anchor studs
      i) Anchor studs to be low carbon steel, minimum 60,000 psi yield strength
   e. Stud holes diameter shall not be more than 1/8 inch larger than diameter of stud projection
      Styrene Butadiene Rubber (SBR) follower gasket and Nitrile Butadiene Rubber (NBR) flange O-ring gasket
   f. 4-inches thru 12-inches
      i) Rockwell “912”
      ii) Dresser “127” with anchor lugs
      iii) Smith-Blair “912” with anchor studs
      iv) Romac "FCA501" with anchor studs
      v) Or accepted substitution
   g. 12-inches and larger
      i) Romac "FC400" with anchor bosses and anchor studs
      ii) Or accepted substitution
4. Dismantling joint
   a. Provided per coupling manufacturer's recommendations
   b. Determine and install dismantling joint after equipment and pipe placement
   c. Provide restrained dismantling joint where indicated
   d. Nitrile (Buna N) follower gasket
   e. 4-inches thru 24-inches
      i) Smith-Blair “971” or “975” as required
      ii) Or accepted substitution
5. Victaulic Couplings:
   a. Size couplings for proper installation on ends provided
   b. Victaulic “Style 31” or "Style 155" as required
   c. After fabrication, housing clamps shall be enamel coated or hot-dipped galvanized, cleaned, and primed, per coupling manufacturer
   d. Coupling gaskets to be EPDM

G. Small branch connections
   1. Pipe nipples: Seamless black steel pipe, ASTM A53, standard weight (Schedule 40)
   2. For 2-1/2 inches and smaller, welded fittings and threaded outlets shall be provided
   3. Provide 1-inch outlet and reducers for outlets known to be less than 1-inch
   4. Three through 12 inches, provide pipe nipples or fittings welded to pipe shell and reinforced as required
   5. Connections shall be located to avoid interference with joints, supports, or other details

6. Welding fittings
    a. Threaded outlets:
        i) Bonney “Thredolets”
        ii) Porter “W-S Teelets”
        iii) Vogt “Weld Couplets”
        iv) Anvil “Threaded Anvilets”
        v) Or accepted substitution
    b. Welded outlets:
        i) Bonney “Weldolets”
        ii) Porter “W-S Teelets”
        iii) Vogt “Weld Couplets”
        iv) Anvil “Weld Outlets”
        v) Or accepted substitution

H. Gaskets
1. Ring type, 1/8-inch rubber per AWWA C200
2. Gasket compound
    a. Garlock “Compound No. 1”
    b. Titeseal T25
    c. Or accepted substitution
3. Rubber gaskets for bell and spigot pipe: Continuous O-ring, AWWA C200, except minimum tensile strength of 2100 psi and basic polymer of neoprene or other synthetic rubber. Do not use natural rubber.

I. Pipe supports, anchors, blocking and hangers
1. Provide supports, anchors, blocking and hangers as specified on Drawings and in Section 15090
2. Shall be provided with concrete bases, anchor bolts and nuts, plates, rods, and other accessories as specified
3. For longitudinal and lateral anchorage shop weld lugs shall be required
4. Modifications shall be subject to Engineer's approval
5. Anchor bolts: ASTM A307

2.3 STAINLESS STEEL PIPE

A. The following piping shall be stainless steel pipe as indicated in the Pipe Schedule

B. Pipe
1. Fabricated
    a. 3 inches to 24 inches: Schedule 10S
    b. Unless otherwise specified, stainless steel piping 3 inches and larger shall be manufactured from ASTM A240 annealed and pickled sheets and plate, Type 316L, in accordance with ASTM A778 or ASTM A409 HT-0. Only extra-low carbon (ELC) materials with 0.030 percent maximum carbon shall be used.

C. Joints
1. Shall be shop butt-welded. Field welding is not acceptable.
2. Shall be flanged where indicated on Drawings and in accordance with ANSI B16.1

3. Flanges
    a. Materials: Stainless steel, 316L to match pipe and fittings
    b. Drilled 125 lb
    c. ANSI B16.1
    d. Nuts and bolts
        i) Stainless steel, Type 316L
        ii) ASTM A193, Grade B8M
        iii) ASTM A194, Grade 8M hex nuts
        iv) Nut and bolt heads shall be hexagonal

2.4 DUCTILE IRON PIPE

A. The following piping shall be ductile iron pipe as indicated in the Pipe Schedule

B. Pipe:
1. AWWA C151, C150, and C151: As listed below except as otherwise specified or indicated on Drawings.
    a. Where fitted with push-on joints, mechanical joints or mechanical joints with joint restraint device, or restrained joints: Class 50
    b. Where fitted with flanged, grooved or restrained joints: Class 53
    c. 4-Inch to 12-Inch: Class 350
    d. Thickness (minimum) for screw-on flanges shall be in accordance with AWWA C115
    e. Pipe with grooved or shouldered joints for any restrained joint shall have wall thickness increased to provide the minimum wall thickness in accordance with AWWA C606

C. Fittings
1. Ductile iron: ANSI A21.10/AWWA C110, ASTM A536, Grade 80-60-03 or 70-50-05
    a. 24-inch and below: 350 psi rating, mechanical joint or flanged
2. Ductile iron compact fittings: ANSI A21.53/AWWA C153
    a. 16-inch and below: 350 psi rating, mechanical joint or flanged
3. Ductile iron grooved fittings: ANSI/AWWA C606, AWWA Fittings, conform to AWWA C110 for center-to-center dimensions and AWWA C153 for wall thickness,
    a. 12-inch and below: 350 psi rating, grooved joint
4. Tapping Sleeve and Tapping Valve
    a. Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine
    b. Tapping Sleeve: Cast-iron or ductile-iron 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical joint ends with rubber gaskets or sealing rings in sleeve body. Use sleeves that mate with size and type of pipe material being tapped. Outlet flange shall be of a size required for branch connection
5. Provide all specials, taps, flanges, plugs and wall fittings as required
6. Provide openings for air valve, drain, sampling, testing, sensing and all other connections with threaded bosses sized and located as indicated and specified
    a. Threaded connections:

i) Shall be in accordance with ANSI B2.1.NPT: provide boss or tapping saddle at all tapped connections

D. Joints
1. All joints shall be of restrained type unless otherwise indicated on Drawings
2. Mechanical and push-on joints
   a. Mechanical joints: ANSI A21.11/AWWA C111
      i) Bolts and nuts: High strength, low alloy steel, in accordance with ASTM A307 or accepted substitution
   b. Push-on joints: ANSI A21.11/AWWA C111, except gaskets shall be neoprene or other synthetic rubber. Natural rubber in not acceptable.Gaskets for air piping to be high temperature EPDM (Ethylene Propylenediene Monomer).
      i) Lubricant: Heavy vegetable soap solution suitable for potable water contact
      ii) Pressure rated 350 psi
3. Mechanical joints with tie rods
   a. Tie rods: ASTM A307, galvanized entire length
   b. Steel pipe spacers: ASTM A120, standard weight galvanized
   c. Washers: ANSI A27.2 plain steel, galvanized
4. Flanged joints
   a. Flanged joints shall be provided for all interior and exposed exterior pipe unless otherwise indicated or specified
   b. Flanges
      i) General use: ANSI A21.15/AWWA C115 and ANSI B16.1, Class 125
      ii) Where Class 250 indicated on Drawings or specified: ANSI B16.1, Class 250, flat faced
      iii) Effluent piping with ANSI Class 125 flanges rated for 250 psi
   c. Pipe with Victaulic-style couplings and rigid joints conforming to AWWA C606 may be substituted for Class 125 flanged pipe
   d. Hardware
      i) For locations within Digester Tanks and Pre-Equalization Tanks
         a) Stainless steel, Type 316
      ii) All other locations
         a) Hot dipped zinc galvanized steel conforming to ASTM A307, grade B (Class B & D flanges), grade B7 (Class E & F flanges)
         b) Heads and dimensions per ANSI B1.1
         c) For mechanical couplings furnish ASTM A183 or A194 bolts and nuts
         d) Provide two nuts for one-inch diameter and larger bolt applications
5. Mechanical couplings:
   a. Dresser “Style 38”
   b. Rockwell “411”
   c. Or accepted substitution
6. Flanged coupling adapters 12 inch and under:
   a. Rockwell “Type 912”
   b. Dresser “Style 127”
   c. Or accepted substitution
7. Tapping saddles:
   a. Ductile iron with double stainless steel straps and rubber sealing gasket, 250 psi pressure rating

8. Mechanical joint with restraint device
    a. Where approved by the Engineer, multiple wedging action type follower gland used in lieu of tied pipe restraint
    b. Twist off nuts used to insure proper actuating of the restraining device
    c. Working pressure rated to at least 250 psi
    d. EBAA Iron Sales, Inc., MEGA LUG or accepted substitution
    e. Restraint device is to be used in combination with conventional thrust block restraint.
9. Wall castings: Mechanical and/or flanged joints, integral weep ring, sufficient space for bolting of connection piping to joint minimum 6 inches from embedded wall or with tapped holes for follower bolts and plastic plugs to prevent holes from filling with concrete

E. Flanged Coupling Adapters:
1. Flanged end and body to be one unit conforming to AWWA C219. Coupling end to be compression gland type with follower ring
2. Adapters for joining exposed interior iron pipe may be steel or iron
3. Flanged end bolt circle, bolt size, and spacing shall conform to the applicable provisions of ANSI B16.1 and shall be drilled Class 125 for iron adapters. Flanges on steel adapters shall be AWWA C207, Class D, drilled ANSI B16.1 Class 125
4. Bolts and nuts shall be ductile iron for iron adapters and high-strength, low-alloy steel for steel adapters
5. Anchor studs shall not be used where joint restraint is required. Furnish adapters with tie rod harness assemblies where indicated
6. Lining and Exterior Coating for Steel Adapters:
    a. Two-part epoxy or nylon fuse-coated to a minimum 10 mils thickness
    b. Completely coat adapter sleeve and end follower gland plus line interior for adapters intended for exposed exterior, vault or pit installations
    c. Line interior of all adapters intended for exposed interior installations. Coat exterior with normal shop coating

F. Dismantling Couplings/Joints:
1. Consists of a mechanical joint fitting located between two pipe flanges with restraining rods across the mechanical joint section, providing a restrained system with integral space for removal of adjacent equipment
2. Shall conform to AWWA C219
3. Materials shall be steel.
4. When connected to DIP system, install insulating flange kit

G. Fabrication
1. Joints
    a. Except as indicated on Drawings
        i) Bells in wall pipe or casting: Mechanical with tapped holes for follower bolts or extended minimum 6 inches beyond wall
        ii) Exposed: Flanged or grooved
    b. 12 inch and smaller branch outlets where main line is at least twice the diameter of the branch, tee or a tapping saddle is acceptable
    c. Tie rods may be required as indicated on Drawings

d. Mark the centerline of each flange and mechanical joint piece
e. Screw flanges onto screwed-on flanged pipe so that pipe extends completely through and flush with the flange
f. Finish machine pipe ends and flange faces flat and perpendicular to pipe centerline in a single operation

2. Shop coating and lining
   a. Contractor option to shop prime and coat the interior surfaces of all process piping 16 mil thickness with high build coal tar epoxy except where used for gas and air service
   b. Cement line the interior surfaces of fittings, except for air piping
   c. Shop prime exterior surfaces of pipe and fittings to be installed in exposed interior or exterior locations
   d. Shop coat flange faces with rust preventive compound
   e. As indicated on the pipe schedule, glass-lined pipe shall follow ASTM D792
      i) Shall be vitreous material which is hard, smooth, continuous and formulated to prevent the adherence of grease inslduge and scum lines and to resist the adherence of crystalline metal salt deposits
      ii) Shall be prepared by blasting
      iii) Minimum number of two (2) coats that shall be separately applied and separately fired. Each coating shall be applied in controlled thickness after the inside surface of pipe has been prepared as required to assure a continuous unbroken bond of the coating to the pipe. Items shall be exposed to a maturing temperature of approximately 1400°F at which point the vitreous and inorganic materials metal and fuse to base metal forming an integral molecular bond with the base metal surface. Subsequent coatings shall be process in a similar manner forcing an integral molecular bond with base coat.
      iv) Total finished coating minimum thickness shall be 10 mils as tested with a micro test or other acceptable dry film thickness gauge. Finished lining shall be able to withstand a strain of 0.001 inch/inch (yield point of base metal) without damage to the glass
      v) Lining shall be of a light, bright color to allow visual detection of defects more easily prior to electronic holiday detection testing
      vi) Surface of glass shall have a dense, glazed finish non-adherent to grease, scum, wax or other sticky substances found in sludge
      vii) Lining shall have hardness of at least 6 on the MOHS scale and density of 2.5 to 3.0 grams per cubic centimeter as measured by ASTM D792
      viii) Ensure that firing of pipe and applied coating layers shall provide a complete fusion to the pipe wall
      ix) Compounding, firing and annealing technique shall assure a lining capable of withstanding thermal shock up to 350°F differential without crazing, blistering or spalling. Shall be resistant to corrosion of between pH 3 and pH 10
      x) Finish coating shall be free from carters, porosity, crazing, scaling or pinholes evident from visual inspection.
      xi) Finish coating shall be resistant to attacks from acids equivalent to a weight loss no greater than 3 milligrams per square inch as determined by the procedure for testing against citric acid, ASTM C283. Coating shall protect

against etching or loss of gloss when subjected to cleaning procedures employing a 200°F water-steam mixture

xii) Finished glass lined pipe shall not deviate more than 0.0125 inch per foot of length from a centerline perpendicular to the square pipe end or flange face

xiii) All handling and/or lifting of glass lined pipe and fittings must be done on the exterior only. Avoid lifting internally with hooks, forks, or chains at any time.

xiv) Tapping shall be performed prior to glass lining

xv) Glass lined pipe can be successfully cut for field closure pieces using an abrasive wheel type cutting device. The cut end should be cleaned and coated using epoxy repair material available from glass lining manufacturer

2.5 PVC PIPING

A. PVC Process Piping (Pressure)

1. The following piping shall be pressure PVC pipe as indicated on the drawings and as specified herein:
   a. As indicated in Piping Schedule below
2. Manufacturers:
   a. Cresline Plastic Pipe Co.
   b. North American Pipe Corp.
   c. Spears Manufacturing Co.
   d. Or accepted substitution
3. Pipe and fittings:
4. 1/2 inch to 12 inch, ASTM D1785 [verify size of pipe required for project]
   a. Pipe shall have cast iron pipe equivalent outside diameters
   b. Schedule 80
5. Fittings: Comply with ASTM D2467 (Schedule 80)
6. Joints:
   a. Shall be bell and spigot, push-on type suitable for solvent welding, threading, or flanging
   b. Flanges: Diameter and drilling per ANSA B16.5, 150 lbs
   c. Flange bolts and nuts: ASTM A307, Grade B, galvanized, install such that bolts project 1/8-inch to 3/8-inch beyond the outer face of the nut
   d. Flange gaskets: Full face, minimum 1/8-inch neoprene or plasticized PVC and shall be in conformance with ASTM F104 and F477
7. Designed to hold pipe in alignment, provide flexibility, separate the ends of pipe lengths, resist applied pressures, and provide fluid tightness
8. Solvent welding: ASTM D2672
9. Use recommended solvent primer and cement for the application of fluid to be conveyed in pipeline
10. Provide for sleeves or couplings where indicated.
    a. Expansion joint manufacturers:
       i) Resistoflex "Style R6905"
       ii) Flexicraft “Style TEFLEX-C3’
       iii) Or accepted substitution
    b. Grooved couplings:
       i) Victaulic “Style 75” Style 77” “Style 741” "Style 78"

ii) Or accepted substitution

11. Furnish pipe ends suitable for receiving style of sleeve or coupling indicated or specified.
12. Provide anchoring where restraint is required to withstand specified operating or hydrostatic test pressure and where indicated

B. PVC Drain, Waste, Vent, or Carrier Pipe (Non-Pressure)
1. Pipe and fittings: Schedule 40 in accordance with ASTM D2466, ASTM D2122, F412
2. Joints:
a. Solvent weld per manufacturer's recommendation
b. Threaded: ANSI 82.1

2.6 COPPER TUBING

A. Water tubing: ASTM B88, Type L, for exposed service

B. Instrument tubing
1. Provide 1/2-inch copper tubing for air valve actuation piping
2. Material: ASTM B75, hard-drawn, with polyethylene or PVC jacket except where buried
3. Minimum wall thickness
a. ¼ inch O.D.: 0.030 inches
b. ⅜ inch O.D.: 0.032 inches
c. ½ inch O.D.: 0.032 inches
d. ¾ inch O.D.: 0.040 inches
e. Minimum PVC jacket thickness: 0.032 inches
4. Air instrument piping shall be painted in accordance with Section 09900. PVC jacketed tubing should not be painted

C. Fittings
1. Flared: ASME B16.26
2. Solder: ASME B16.18 or B16.22
3. Compression:
a. Crawford "Swagelok"
b. Hoke "Gryolok"
c. Imperial "Hi-Seal"
d. Parker-Hannifin "CPI"
e. Weatherhead "Self Align"
f. Or accepted substitution
4. Insulating
a. Threaded:
i) PSI "Delrin Insulating Couplings"
ii) Vallet "V-Line Insulating Couplings"
iii) Or accepted substitution
b. Flanged:
i) Epco "Dielectric Flange Unions"
c. PSI "Type E Flange Insulation"
d. Or accepted substitution

D. Solder: Solid wire, ASTM B32, Alloy Grade SN95 Lead Free Solder

E. Soldering flux: Paste Type, ASTM B813

F. Brazing filler metal: ASTM C260, BCuP
   1. Engelhard “Silvaloy 15”
   2. Goldsmith “gb-15”
   3. Handy and Hardman “Sil-Foss”
   4. Or accepted substitution

G. Brazing flux: Paste Type, AWS Standard A5.31, Type FB3-A or FB3-C

H. Flanges: Cast bronze, 150 lb, brazed joints, ASME B16.24

I. Flange bolts and nuts: As specified for steel pipe

J. Flange gaskets: As specified for steel pipe, except full face

K. Expansion joints
   1. Flexonics “Model HB Expansion Compensators”
   2. Mercer
   3. Or accepted substitution

2.7 TUBING

A. Provide polypropylene resin tubing sufficient in length and diameter for transport of chemical from each metering pump to application point
   1. Natural translucent
   2. 0.062 inch wall thickness
   3. Pressure: 172 psi (at 73ºF)

B. Manufacturers:
   1. Ryan Herco Flow Solutions "Herco-Pro Polypropylene Tubing"
   2. Or accepted substitution

2.8 ACCESSORIES

A. Watertight and dust-tight pipe sleeves:
   1. O-Z Electrical Manufacturing Company
   2. Thruwall and Floor Seals
   3. Or accepted substitution

B. Modular, rubber, sealing elements:
   1. Thunder Line Corporation “Link Seal”
   2. Or accepted substitution

C. Thread tape: Teflon
   1. John Crane “Thread Tape”
   2. Garlock “Plasti-Thread”

3. Hoke “EZ Seal”
4. Or accepted substitution

D. Sealant: Silicone sealant as specified in caulking section

E. Pulsation Snubbers:
1. Operating and Maintenance Specialties “Ray Pressure Snubbers”
2. Ashcroft “Snubber Series 25-255”
3. Or accepted substitution

F. Gauge cocks: Bronze, tee handle
1. Lunkenheimer 1178
2. Powell 915
3. Or accepted substitution

G. Concrete for supports and other locations as shown on Drawings: Concrete type specified in Section 03300

2.9 PRESSURE GAUGES

A. Provide 4-1/2 inch diameter pressure gauges that are bottom connected with white laminated dials and black graduations. Accuracy of pressure gauges shall be within 1/2 percent

B. Gauges shall include a blowout disc and safety glass that is encased in phenolic, steel or cast iron

C. Stainless steel bourbon tube with welded, stress-relieved joints shall be provided for the measuring element

D. Socket shall have wrench flats

E. Pressure gauge movement shall be rotary geared and stainless steel material

F. All provided pressure gauges shall be provided with a pulsation snubber constructed of 316 stainless steel and an isolation valve. Pressure gauges on solids and polymers lines shall include diaphragm seals.

G. Manufacturers:
1. Ashcroft "1279"
2. Ametek (U.S. Gauge) “Series 1900 SOLFRUNT”
3. Or accepted substitution

2.10 FLOOR DRAINS

A. Cast-Iron Floor Drains
1. Manufacturers
a. Josam Company; Josam Div.
b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

c. Tyler Pipe and Coupling, McWane Inc.
d. Watts Drainage Products Inc.
e. Zurn Plumbing Products Group; Light Commercial Operation.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Or accepted substitution

2. Standard: ASME A112.6.3
3. Pattern: floor drain
4. Body Material: cast iron
5. Outlet: bottom
6. Sediment Bucket: 2-1/2 inches deep slotted removable sediment bucket
7. Top or Strainer Finish: Cast Iron Extra Heavy Duty
8. Top Shape: round
9. Dimensions of Top or Strainer: 8 inches
10. Top Loading Classification: heavy duty
11. Installation
    a. Install floor drains at low points of surface areas to be drained. Set grates of drains depressed as indicated below.
    b. Position floor drains for easy access and maintenance.
    c. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
        i) Radius, 30 inches (750 mm) or Less: Equivalent to 1% slope, but not less than 1/4-inch (6.35-mm) total depression.
        ii) Radius, 30 to 60 inches (750 to 1500 mm): Equivalent to 1% slope.
        iii) Radius, 60 inches (1500 mm) or Larger: Equivalent to 1% slope, but not greater than 1-inch (25-mm) total depression.
    d. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install as specified and indicated on Drawings

B. Remove dirt, rocks, debris, and other foreign materials from all pipelines

C. Keep interior of pipe and fittings thoroughly clean before installation and until work is accepted

D. Take precautions to prevent entrance of foreign material during jointing, lining repair, and inspection operation

E. Seal open end of line with watertight plug if pipe laying stopped

F. Provide and install sufficient copper tubing to run instrument air to all pneumatic actuators

G. Provide a shutoff valve and union at the water and air supply connections to each fixture and unit of equipment, whether shown on the Drawings or not

H. Provide a union within 2 feet of each threaded end valve unless other means for easy removal of the valve are available

I. Provide unions where required for equipment removal, indicated on the Drawing or specified

J. Do not install piping to obstruct openings and passageways

K. Cut pipe to measurement taken at the site, not from the Drawings

L. Layout piping to provide for expansion and contraction

M. Provide taps for pressure gauge connections with a nipple, snubber, and gauge cock

N. Securely anchor piping at the midpoints between expansion joints

O. Provide air supply piping with sectionalizing valves and valved air inlet connections to isolate portions of system for periodic testing

P. Grade all air piping to points of drainage; provide driplegs on drain valves at drainage points

Q. Uniformly grade all piping serving metering equipment and provide complete venting to eliminate air traps

R. Pipe stuffing box leakage from water sealed pumps to nearest point of drainage

S. Provide insulating fittings and dielectric isolation in all piping except air and gas piping wherever copper tubing or fittings are connected to iron or steel pipe or fittings

T. Provide expansion joints at not greater than 60-foot intervals in exposed or submerged piping

3.2 CONNECTION TO EXISTING PIPELINES

A. Make connections between new and existing piping with suitable fittings

B. Schedule connection to minimize inconvenience to the Owner

C. Undertake connections in order to disturb the system as little as possible

D. Where connection involves potable water systems, provide disinfection methods as prescribed in these Specifications

E. Once tie in to existing system is initiated, continue Work continuously until tie-in is made and tested

3.3 STEEL PIPE

A. Flanged joints
   1. During bolting avoid restraint on opposite end on opposite end that would prevent uniform pressure application on gasket
   2. Pipe or fitting shall be free to move in any direction while bolting
   3. Tighten bolts gradually, in turn, at uniform rate
   4. Stresses shall not be transmitted during installation to equipment flanges by connecting pipe
   5. Equipment shall be permanently supported to pipe to obtain accurate matching of bolt holes and uniform contact over surface of flange, before installing bolts
   6. While bolts are tightened equipment connection piping shall be free to move longitudinally
   7. To fit connecting pipe, level, align and wedge equipment into position
   8. Equipment shall not be grouted until connecting piping is properly aligned
   9. Equipment connections shall be tested by loosing flange bolts. No movement of piping relative to equipment or opening of equipment connection joints shall occur when flange bolts are loosened

B. Field welded joints:
   1. Install per AWWA C206
   2. Test specimens shall be furnished as requested by Engineer

C. Couplings
   1. Prior to installation, remove dirt or foreign material from pipe ends and couplings.
   2. Gaskets shall be kept clean during installation
   3. Only use wrenches which have been recommended by coupling manufacturer
   4. All bolts shall be tightened the same amount with parts square and symmetrical
   5. Installed couplings shall be re-primed or touched up after installation

D. Anchorage shall be provided in exposed locations and where subject to internal pressure block, anchor or harness piping with mechanically coupled, push-on or similar joints to prevent separation of joints

E. Miter cutting
   1. By cutting one end: up to 4-1/2 degrees
   2. By cutting two adjacent ends: up to 22-1/2 degrees
   3. Fabricated bends: greater than 22-1/2 degrees

3.4 JOINTS

A. Make pipe joints carefully and neatly

B. Connect piping in accordance with manufacturer recommendations

C. Threaded
   1. ANSI B2.1, NPT fully and cleanly cut with sharp dies
   2. No more than 3 threads exposed after installation
   3. Ream pipe ends after threading to remove burrs

4. Apply Teflon thread tape to joints in all plastic and stainless steel piping
5. Apply thread tape or joint compound to joints in other piping
6. Apply Teflon thread tape or litharage and glycerine paste to joints on steel piping for chlorine service

D. Compression
1. Cut pipe ends squarely, remove burrs
2. Clean contact surfaces with steel wool

E. Flared
1. Cut tubing ends squarely, remove burrs
2. Scratches or grooves in flared ends are not allowed

F. Soldered and brazed
1. Braze joints in 2 inch or larger copper tubing
2. Solder or braze lines smaller than 2 inch where solder fittings are specified
3. Thoroughly clean joint surfaces with flint paper and coat with thin film of flux
4. Install tubing to full depth of socket
5. Do not overheat metal or flux
6. Uniformly heat joint to melt filler metal on contact
7. Remove surplus filler metal and flux while joint is still hot

G. Solvent welded
1. Cut PVC pipe ends square and smooth, wipe clean
2. Remove all burrs and filings
3. Using a small brush, apply cement primer to the outside of pipe and the inside of the fitting socket
4. Using a small brush, apply solvent cement to outside of pipe and inside of the fitting socket
   a. Solvent cement to be specifically rated for use with chlorine or hypochlorite solutions for piping and fittings that will be used to convey these solutions
5. To ensure uniform cement distribution, push the coated surface snugly together and rotate approximately 1/2 turn
6. Remove excess cement by wiping

H. Grooved couplings
1. Cut grooves with grooving tool
2. Groove to rigid grooving dimensions
3. Groove cleanly and sharply without burrs or check marks
4. Form rounded bottom "radius grooves" in plastic piping

I. Welded: ANSI B31.1, and per applicable Standards for pressure piping

J. Push on
1. Per recommendations of pipe manufacturer
2. Bevel each spigot end to facilitate assembly
3. Lubricate with a heavy vegetable soap solution immediately before joint is completed
4. Store lubricant in closed containers, keep clean, suitable for use in potable water contact

K. Mechanical Joints
   1. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble
   2. Do not over tighten bolts to compensate for poor installation
   3. Carefully align holes in mechanical joints with restraint device to permit installation of the harness bolts
   4. Install flange and mechanical joint pieces so the four mechanical joint holes, as well as the flange holes, straddle the top centerline for horizontal piping, or the side centerline for vertical piping

L. Flanged joints
   1. Take care when bolting flanges to insure that there is no restraint on the opposite end of the pipe which would prevent gasket compression or cause unnecessary stress in flanges
   2. Leave one flange free to move in any direction while tightening flange bolts
   3. Do not pack or assemble bell and spigot joints until all flanges affected thereby have been tightened
   4. Tighten bolts gradually at a uniform rate to compress gaskets uniformly

3.5 PIPE SLEEVES

A. Provide for pipes passing through concrete or masonry

B. Install before concrete is placed

C. Through ceramic or vinyl-tile floors, install sleeves flush with finished floor and provide nickel or chromium plated floor plates

D. Where passing through all other floors, install so the sleeve projects between 1 and 2 inches above the floor

E. Seal sleeves passing through slabs with 1 side against soil with a modular sealing element or a watertight pipe sleeve

F. If insulated, extend insulation through sleeves

G. For future pipe installation, provide sleeves and seal ends with plastic caps or plugs

H. For piping through interior walls and floors with special finish provide pipe sleeves or holes drilled with rotary drill

I. Make dust and gas tight through room walls and floor

J. Six inch or smaller; special dust-tight sleeves

K. Greater than 6 inches, seal with modular sealing elements or caulk with backer rod and seal both sides with non-sag silicone sealant
   1. For pipe sleeves located in water bearing walls provide wall pipes or sleeves with dual modular sealing elements as shown on the Drawings

3.6 COPPER PIPING

A. Install in a neat, workmanship like manner.

B. Follow guidelines of the Copper Tube Handbook and industry practice.

3.7 CHEMICAL PIPING

A. Install so that the lines are readily accessible for cleaning

B. At each point where flexible tubing is connected to rigid piping, provide a union or quick disconnect coupling

C. Provide crosses with threaded plugged openings at changes in direction

3.8 PROTECTIVE COATING

A. Paint exposed, threaded, or submerged galvanized steel piping with zinc-rich paint that have cut ends or are nicked or gouged

3.9 CLEANING

A. General
   1. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when erected
   2. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system
   3. Flush or blow all lines thoroughly before placing in service
   4. At completion of Work and prior to final acceptance, thoroughly clean Work installed under these specifications
      a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sand and dirt which may have accumulated by operation of system, from testing, of from other causes
      b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner

3.10 FIELD QUALITY CONTROL

A. General
   1. Utilize pressures, media, and pressure test durations as specified on Piping Schedules
   2. Isolate equipment which may be damaged by the specified pressure test conditions
   3. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge range. Notify Engineer 24 hours prior to each test
   4. Completely assemble and test new piping systems prior to connection to existing pipe systems
   5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance

6. Provide all necessary equipment, materials, tools, appliances, devices, and perform all work required in connection with the tests and inspections
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination

B. Pipe leaks
1. All joints and seams whether tested or not shall be watertight and airtight
2. Inspect all exposed shop and field welded seams
3. Leaks shall be clearly marked
4. Welded joints (steel) shall be repaired by chipping out defective parts and rewelding. Welds shall not be hammered
5. Leaks discovered by Owner within 2 years of final acceptance shall be repaired by the Contractor at no additional expense to the Owner

C. Test each line at the Contractor's expense in the presence and to the satisfaction of Engineer

D. General testing methods and criteria
1. Types of pressure testing and inspection to be employed include hydrostatic pressure testing, cylinder water pumped compressed air or cylinder nitrogen testing, low pressure air testing and hydrostatic exfiltration/infiltration testing
2. Air systems
   a. Utilize the following testing medium for air systems

Pipeline Size	Specified Test Pressure	Testing Medium
2 IN and smaller	Greater than 75 PSI	Water
Greater than 2 IN	3 PSI or less	Air or water
Greater than 2 IN	Greater than 3 PSI	Water

   b. The allowable leakage rate for hazardous gas systems, insulated systems, and systems tested with water shall be zero at the specified test pressure throughout the specified test period. Hazardous gas systems shall include chlorine gas systems.
   c. The allowable leakage rate for systems tested with air shall be based on a maximum pressure drop of 5 percent of the specified test pressure for the duration of the period. Prior to starting a test interval using air, ensure air is at ambient temperature and specified test pressure
3. Liquid systems
   a. The following liquid piping systems shall have zero allowable leakage at the specified test pressure throughout the specified duration of 2 hours: exposed piping and buried or exposed piping carrying liquid chemicals or water
   b. Hydrostatic pressure testing
      i) For exposed piping: Prepare each section for testing, using adequate bracing and protect system equipment susceptible to damage by test pressures. Do not paint or insulate exposed piping until successful performance of pressure test.

E. Dielectric Testing Methods and Criteria
1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained

2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition
3. Check the integrity of each cad-welding connection using a light hammer blow at a 45 degree angle

3.11 DISINFECTION OF WATER PIPING SYSTEM

A. After favorable performance of pressure test and prior to final acceptance, thoroughly flush entire water piping system, including supply, source and any appurtenant devices and perform disinfection as prescribed

B. Flush and disinfect each segment of system in accordance with Section 02676

3.12 PIPING SCHEDULE

A. Install pipes as scheduled in the pipe schedule provided below
1. B&SP: Bell and spigot
2. DIP: Ductile iron piping
3. FL: Flange
4. GL: Glass lined
5. HH: High Head Method
6. LH: Low Head Method
7. MJ: Mechanical joint
8. psi: pounds per square inch
9. psig: pounds per square inch gauge
10. PE: Polyethylene
11. PVC: Polyvinyl Chloride

Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating
Aeration								
Submerged	<12	316L SST	SCH 10S	15060	FLG x FLG	20 psi/AM	None	None
Exposed	<24	DIP or Steel	Steel with ANSI Class 150 Flanges Rated to 285 PSI or Ductile Iron with ANSI Class 125 Flanges Rated to 250 PSI with Full Faced Flange Type Gasket	15060	FLG x FLG	300 psi/HH	GL	Section 09900
Air								
Exposed	<6	PVC	SCH 80	15060	B&SP	15 feet/GR	None	None
Dewatering Piping								
Cake Pump Piping, Exposed	<8	DIP	Ductile Iron with ANSI Class 125 Flanges Rated to 250 PSI with Full Faced Flange Type Gasket	15060	FLG x FLG	125 psi/HH	GL	Section 09900
Polymer Feed Line, Pressate Line, Potable Water Feed Line, Conditioned Sludge Transfer Line	<8	PVC	SCH 80	15060	B&SP	15 feet/GR	None	None
Decanter								
Decanter Piping, Submerged	<8	Flexible Hose???						
Decanter Piping, Exposed	<8	DIP	Ductile Iron with ANSI Class 125 Flanges Rated to 250 PSI with Full	15060	FLG x FLG	300 psi/HH	GL	Section 09900

Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating
			Faced Flange Type Gasket					
Drain								
Grit Classifier Drain, Exposed in Tank	<8	PVC	SCH 80	15060	B&SP	15 feet/GR	None	None
Grit System								
Grit Piping, Exposed	<8	DIP	Ductile Iron with ANSI Class 125 Flanges Rated to 250 PSI with Full Faced Flange Type Gasket	15060	FLG x FLG	300 psi/HH	GL	Section 09900
Pre-Equalization								
Pre-Equalization Suction, Exposed	<12	316L SST	SCH 10S	15060	FLG x FLG	20 psi/AM	None	None
Pre-Equalization Suction, Submerged	<12	DIP	Ductile Iron with ANSI Class 125 Flanges Rated to 250 PSI with Full Faced Flange Type Gasket	15060	FLG x FLG	300 psi/HH	GL	Section 09900
Potable Water								
Exposed	<6	Copper	SCH 80	15060	BF	100 psi/HH	None	None
Overflow								
Exposed in Tank	12	PVC	SDR 35	02616	B&SP	15 feet/GR	None	None

END OF SECTION

SECTION 15066

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Three phase electric motors

1.2 RELATED SECTIONS

A. Division 15 – Mechanical

B. Division 16 – Electrical

1.3 QUALITY ASSURANCE

A. Conform to NFPA 70

B. Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering

PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service:
   1. Motors 3/4 HP and Larger: Three phase, 60 Hz
   2. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected
   3. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors

B. Construction:
   1. Open drip-proof type except where specifically noted otherwise
   2. Design for continuous operation in 105 degrees F environment
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

D. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame

2.2 APPLICATIONS

A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor

B. Efficiency: EPAct approved.

C. Stator: Copper windings, unless otherwise indicated
   1. Multispeed motors shall have separate winding for each speed

D. Rotor: Squirrel cage, unless otherwise indicated

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading

F. Temperature Rise: Match insulation rating, unless otherwise indicated

G. Insulation: Class F, unless otherwise indicated

H. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G
   2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic

I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Designed with critical vibration frequencies outside operating range of controller output.
   2. Temperature Rise: Matched to rating for Class B insulation
   3. Insulation: Class H

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors

2.5 MAGNETIC MOTOR STARTERS

A. Acceptable Manufacturers
   1. Square D, Type S with Motor Logic solid state overload relay
   2. Allen Bradley, Bulletin 509 with SMTP-2 solid state overload relay
   3. General Electric, 300 line with CR324X solid state overload relay

B. Magnetic motor starters shall be NEMA ICS-2, AC General Purpose Class A, rated in horsepower for induction motors. IEC style starters, regardless of rating, are prohibited. Coil operating voltage shall be as required and a maximum of 120 volts. Include solid state overload relay, pushbutton operator in front cover with operation indicating lights.

C. Provide magnetic motor starters for all motors that are interlocked with external pilot duty devices, and for all 3 phase motors. Magnetic motor starters shall have overload protection on all current phases, and shall include low voltage release. Magnetic motor starters and overload protection shall be size coordinated with the driven motor.

D. Overload relay assemblies shall be solid state type with an adjustable dial or dip switch, settable to motor manufacturer's suggested overload amperage. Each overload unit shall be factory calibrated as a unit. Overload devices shall be fully ambient compensated. Class 10 tripping time shall be provide except where long acceleration time of a high inertia load requires the use of a Class 20 trip time. Motor overload protection shall include current sensing single phase protection which trips the starter within three seconds upon detection of a single phase condition. Overload devices which utilize bi-metal devices or melting alloy devices to sense motor overload are not acceptable.

E. Contactor, solenoid, and control circuit devices shall be supplied for operation with 120 volt control power, unless noted otherwise. Provide factory installed control transformers with UL Class CC primary fuse protection and secondary fuses, in accordance with the latest edition of the National Electric Code, within the starter enclosure for all voltage systems that do not allow for direct access to 120 volts, including 208 volt, 3 phase, 3 wire systems. Control power shall be so arranged as to de-energize the control circuits whenever the operating power supplied to the particular equipment is disconnected.

F. Furnish all motor starters with auxiliary contacts as required by the application or as shown on the drawings. In addition to auxiliary contacts for operation, furnish on normally open and one normally closed contact for future use. Provide an alarm contact, electrically separate from the trip contact, for remote annunciation of thermal overload trip condition.

G. Coordinate with Division 16 and provide auxiliary contacts as required for application of fire alarm system interface

H. UL NEMA 1 enclosures shall be used in indoor locations and dry, UL NEMA 3R enclosures shall be used in exterior or wet locations. UL NEMA 12 or 12X enclosures

shall be utilized where required. Enclosures shall be finish painted except where NEMA standards conflict.

I. Motor starters shall be fully NEMA rated for the service for which they are applied. NEMA ratings shall be used

J. Contactors shall be capable of withstanding the available short circuit current at their point of connection. Where available short circuit currents exceed the ratings of contactors, current limiting fuses and other limiting means shall be employed to protect contactors. Coordinate with Division 16 for available short circuit current values at connections.

K. Provide “Hand-Off-Auto” selector switches for automatically controlled motor starters and push button switches for manually controlled motor starters as required by control specifications. Selector switches shall be of heavy duty, 600 volt, oil tight construction, with appropriate nameplates.

L. Provide timing relays, metering, etc. as called for on all drawings or as required by this specification section and control specifications.

M. Provide engraved lamacoid nameplates, screwed on the door of each control unit for identification of equipment controlled. Do not use abbreviations for equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position

C. Check line voltage and phase and ensure agreement with nameplate

3.2 EXAMINATION

A. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation

B. Proceed with installation only after unsatisfactory conditions have been corrected

END OF SECTION

SECTION 15075

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates

B. Tags

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates

B. Thermostats: Nameplates

2.2 NAMEPLATES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment
   1. Data:
      a. Manufacturer, product name, model number, and serial number
      b. Capacity, operating and power characteristics, and essential data
      c. Labels of tested compliances
      d. Location: Accessible and visible
      e. Fasteners: As required to mount on equipment

2.3 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install equipment tags with screws or permanent adhesive on or near each item of equipment. Locate signs where accessible and visible.

END OF SECTION

SECTION 15090

SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and equipment hangers and supports

B. Equipment bases and supports

C. Flashing and sealing equipment

1.2 RELATED SECTIONS

A. Section 03000 – Concrete

B. Section 09900 – Coatings

C. Section 15060 – Pipe and Pipe Fittings

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM)
   1. F708 – Design and Installation of Rigid Pipe Hangers

B. International Building Code (IBC)

C. Manufacturers Standardization Society (MSS)
   1. SP58 – Pipe Hangers and Supports – Materials, Design and Manufacturer
   2. SP69 – Pipe Hangers and Supports – Selection and Application
   3. SP89 – Pipe Hangers and Supports – Fabrication and Installation Practices

1.4 SYSTEM DESCRIPTION

A. Provide complete system of pipe supports and anchors for all piping

B. Support all piping to prevent undue strain on any valve, fitting or piece of equipment

C. Provide support and anchors at changes in direction, change in elevation, adjacent to flexible couplings, and where valve actuators/positioners add additional weight and stresses

D. Do not install in equipment access areas

1.5 PERFORMANCE REQUIREMENTS

A. Pipe support system components to withstand total dead load

1. Dead load: Weight of pipe filled with water plus any insulation
    a. Dead load defined as weight of pipe filled with water plus any insulation
2. Factor of safety: 5 minimum

B. Pipe restraint system components to withstand thrusts created by fluid pressure within pipes
    1. Factor of safety: 5 minimum

C. Do not exceed manufacturers' recommended loads

D. Brace all piping 2½ inch and larger for Seismic Zone B forces in accordance with International Building Code

1.6 SUBMITTALS

A. Submit under provisions of Section 01340

B. Shop drawings: Indicate system layout with location and detail of trapeze hangers. Include location of pipe supports

C. Product data: Provide manufacturers catalog data including load capacity

D. Design data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers

E. Manufacturer's installation instructions: Indicate special procedures and assembly of components

PART 2 PRODUCTS

2.1 MATERIALS

A. Not submerged: Galvanized steel except where otherwise indicated or specified

B. Submerged: Stainless steel, 304L

C. Use stainless steel materials for stainless steel pipe or galvanized steel with non-conductive isolation gaskets to prevent electrolytic corrosion

2.2 PIPE HANGERS AND SUPPORTS

A. Manufacturers:
    1. Anvil International
    2. Unistrut Corporation
    3. Elcen Metal Products Co.
    4. PHD Manufacturing, Inc
    5. Or accepted substitution

B. Plumbing piping – water:

1. Conform to requirements of Section 15060
2. Hangers for pipe sizes ½ to 1½ inch: Stainless steel, adjustable swivel, split ring
3. Multiple or trapeze hangers: Steel channels with welded spacers and hanger rods
4. Wall support for pipe sizes to 3 inches: Cast iron hook
5. Vertical support: Stainless steel riser clamp
6. Copper pipe support: Stainless steel ring, adjustable, copper plated

2.3 ACCESSORIES

A. Hanger rods: ASTM A307, Grade R. Mild steel threaded both ends, threaded one end, or continuous threaded

B. Isolation pads: neoprene waffle type
   1. Manufacturers: Mason Industries "Type W", Fabreka Production Company "Fabcel", or accepted substitution

C. Insulation protection shield: ANSI/MSS SP-58

2.4 FLASHING

A. Metal flashing: 26 gauge galvanized steel

B. Metal counter flashing: 22 gauge galvanized steel

C. Flexible flashing: 0.125 inch thick sheet butyl-isoprene; compatible with roofing

D. Caps: Steel, 22 gauge minimum

2.5 SLEEVES

A. Sleeves for round ductwork: Galvanized steel

B. Sleeves for rectangular ductwork: Galvanized steel or wood

C. Sealant: Refer to Section 07900

2.6 FINISHING

A. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories: Galvanized Steel unless otherwise indicated or specified

B. For stainless steel components: none required

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer’s instructions

B. Pipe supports and anchors are not indicated on drawings in all locations; supports are indicated for most larger pipes

C. Provide system of pipe supports and anchors for all piping

D. Provide additional supports as required adjacent to couplings

E. Pipe supports shall be provided at all changes in direction and adjacent to flexible couplings

3.2 PIPE HANGERS AND SUPPORTS

A. For designated pipe supports located adjacent to equipment and other locations requiring vibration isolation, provide isolation pad

B. Support horizontal piping as scheduled

C. Install hangers to provide minimum ½ inch space between finished covering and adjacent work

D. Brace all piping 2-1/2 inch and larger for Seismic Zone B forces in accordance with local building codes

E. Place hangers within 12 inches of each horizontal elbow

F. Use hangers with 1½ inch minimum vertical adjustment

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers

H. Support riser piping independently of connected horizontal piping

I. Design hangers for pipe movement without disengagement of supported pipe

J. Piping connections to equipment: Provide pipe support adjacent to equipment. Pipes shall not be supported on equipment

K. Do not support lower pipe from pipe above

L. Support pipe 1½ inch minimum from walls and 3 inch minimum below ceilings

M. From framing strut systems, cut ends and paint exposed metal with galvanized paint

N. Prime coat exposed steel hangers and supports. Refer to Section 09900. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed

O. Do not install pipe supports in equipment access areas

3.3 EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment. Refer to Drawings for location of pads

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment

C. Construct supports of steel members. Brace and fasten with flanges bolted to structure

D. Provide rigid anchors for pipes after vibration isolation components are installed

3.4 FLASHING

A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs

B. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb

3.5 SCHEDULES

A. Maximum hanger spacing and rod size for cast iron, ductile iron, steel and PVC:

Pipe size (inches)	**Max. hanger spacing (feet)**	**Hanger rod diameter (inches)**
1½ and smaller	6	3/8
1 ½ to 2	8	3/8 to 1/2
2 ½ to 3	10	1/2 to 5/8
4	10	5/8
6 and 8	12	3/4
10 and 12	14	7/8
14 and16	16	1
18	16	1-1/8
20 and larger	18	1-1/4
PVC (all sizes)	6	Same as for steel

B. Maximum hanger spacing and rod size for copper and stainless steel piping
   1. Spacing:
      a. 1 inch and smaller: 5 feet maximum
      b. 1¼ inch and larger: 2 feet less than maximum spacing for steel pipe of same size
   2. Hanger rod size: Same as for steel

END OF SECTION

SECTION 15100

VALVES, COCKS, AND HYDRANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Valves indicated on the drawings, specified, or required for proper operation of equipment or systems

1.2 RELATED SECTIONS

A. Section 01340 – Shop Drawings, Product Data, and Samples

B. Section 01600 – Materials and Equipment

C. Section 01730 – Operation and Maintenance Data

D. Section 09900 – Coatings

E. Section 15060 – Pipe and Pipe Fittings

F. Section 16050 – Basic Electrical Materials and Methods

1.3 REFERENCES

A. American National Standards Institute (ANSI):
   1. B16.1 – Cast Iron Pipe Flanges and Flanged Fittings

B. American Society for Testing and Materials (ASTM):
   2. A48 – Standard Specification for Gray Iron Castings
   3. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
   4. A216 – Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
   5. A536 – Standard Specification for Ductile Iron Castings
   6. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

C. American Water Works Association (AWWA):
   7. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
   8. C207 – Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In.
   9. C500 – Metal-Seated Gate Valves for Water Supply Service
   10. C502 – Dry-Barrel Fire Hydrants
   11. C503 – Wet-Barrel Fire Hydrants
   12. C504 – Rubber Seated Butterfly Valves
   13. C508 – Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS
   14. C509 – Resilient-Seated Gate Valves for Water Supply Service

15. C510 – Double Check Valve Backflow Prevention Assembly
16. C511 – Reduced-Pressure Principal Backflow Prevention Assembly
17. C512 – Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
18. C514 – Air Valve and Vent Inflow Preventer Assemblies for Potable Water Distribution System and Storage Facilities
19. C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
20. C517 – Resilient-Seated Cast-Iron Eccentric Plug Valves
21. C518 – Dual-Disc Swing-Check Valves for Waterworks Service
22. C520 – Knife Gate Valves, Sizes 2 In. (50 mm) Through 96 In. (2,400 mm)
23. C530 – Pilot-Operated Control Valves
24. C541 – Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates
25. C542 – Electric Motor Actuators for Valves and Slide Gates
26. C550 – Protective Interior Coatings for Valves and Hydrants
27. C560 – Cast-Iron Slide Gates
28. C561 – Fabricated Stainless-Steel Slide Gates
29. C562 – Fabricated Aluminum Slide Gates
30. C563 – Fabricated Composite Slide Gates

1.4 SUBMITTALS

A. Submit under provisions of Section 01340

B. Product Data: Provide data on valves and accessories. Provide manufacturer's catalog information with dimensions, materials, and assembled weight. Indicate valve data and pressure ratings

C. Manufacturer's Instructions: Provide complete manufacturer's installation instruction

1.5 PROJECT RECORD DOCUMENTS

A. Record actual size, type and locations of valves

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 01730

B. Maintenance Data: Include installation instructions, spare parts list, exploded assembly views, maintenance requirements

1.7 QUALITY ASSURANCE

A. Manufacturer's name and pressure rating marked on valve body

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 10 years documented experience

1.9 REGULATORY REQUIREMENTS

A. Conform to all municipal codes and ordinances, laws and regulations of the State

B. In case of apparent conflict, State and local requirements govern over these specifications

C. In absence of State and local regulations, International Plumbing Code will apply

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01600

B. Prepare valves and accessories for shipment according to AWWA C500

C. Accept valves on site in shipping containers with labeling in place. Inspect for damage

D. Provide temporary protective coating on cast iron and steel valves

E. Seal valve ends to prevent entry of foreign matter into valve body

F. Drain valves and pilotry of water prior to shipping and storage

PART 2 PRODUCTS

2.1 GENERAL

A. Construction
   1. Actual valve length within ± 1/16" of specified or theoretical length
   2. Ends, except as otherwise specified
      a. 3" and smaller, threaded or soldered ends
      b. 4" and larger, flanges, ANSI 125 lb
      c. Wafer style valves designed for installation between ANSI 125 lb flanges

2.2 ECCENTRIC PLUG VALVES

A. Manufacturers
   1. Valves
      a. DeZurik
      b. Flowserve
      c. Henry Pratt Company
      d. Milliken
      e. Val-Matic Valve and Manufacturing Corporation
      f. Or Engineer accepted substitution

B. Valve Design
   1. Valves shall conform to design specified herein and in Valve Schedule provided in this section
   2. Quarter-turn non-lubricated eccentric plug valves

3. Resilient faced plug
4. Tight shut-off up to scheduled rating with pressure in reverse direction where scheduled
5. Valves with vane type seat rings are not acceptable
6. Valve port shall be at least 80% of full pipe area for valves through 20-inch in diameter
7. Valve ends to match connecting piping
   a. Buried: Mechanical joint, ANSI A21.11/AWWA C111
   b. Flanged: 125 lb, ANSI B16.1
   c. Screwed valve ends shall be to the NPT standard
   d. Grooved ends shall conform to AWWA C606 rigid joint specifications
8. Minimum Working Pressure Rating:
   a. 175 psig, 4 inch through 12 inch
9. Opening motion eccentric, lifting plug away from body seat
10. Valve Alignment
    a. In horizontal pipelines, valve shall be installed so that the plug is horizontal and rotates upward as the valve opens
    b. In vertical pipelines, valve shall be installed with the end marked "seat" at the top of valve
    c. Valve shall be installed with seat on low pressure side of valve
11. Provided with fully adjustable plug position stops
12. Plugs shall be eccentric type with no backing ring or frame
13. Valve body cavity shall be smooth without protrusions or baffles
14. Electric actuators shall conform to AWWA C542
15. Valve bonnet stuffing box sufficiently deep for 4 packing rings on 4" and larger valves
16. Valve body plainly marked to indicate seat end
17. Actual length within 1/16" ± of specified or theoretical length
18. Valve packing adjustment accessible without removing actuator from valve

C. Valve Materials
1. Plug and body: Cast iron, ASTM A126, Class B, or Ductile iron, ASTM A536, Grade 65-45-12
2. Resilient plug facing or replaceable style body seats shall be synthetic rubber, neoprene, or Buna N compound suitable for use with water and wastewater applications
3. Seat rings shall be threaded, or welded of corrosion-resistant stainless steel (18-8), nickel, or Monel conforming to AWWA C517
4. Sprayed or plated mating seat surfaces are not acceptable
5. Bearings shall be replaceable. Sleeve type and thrust bearings in the upper and lower journals shall be corrosion-resistant stainless steel or bronze
6. Shaft seals shall be multiple O-ring, self-adjusting U-cup or chevron type packing conforming to AWWA C517
7. Pull-down packing is not acceptable
8. Shaft seals shall be field adjustable or replaceable without valve disassembly
9. Plug seat: Chloroprene (Neoprene)
10. Packing: Acrylonitrile Butadiene V-Type Cup

a. Dual U-cup
11. Upper thrust bearing: TFE
12. Body seat: Welded-in overlay seat of no less than 90% nickel
13. Upper and lower trunnion bearings: Sleeve type, 18-8 stainless steel
14. Valves complete with epoxy coating on the interior and exterior

D. Testing
1. Each valve shall be in accordance with AWWA C517 subjected to cycle life and pressure leak test (1,034 kPa)(150 psi) and a valve body hydrostatic test (2,068 kPa)(300 psi) by the manufacturer at their facilities prior to shipping
2. Valves shall be capable of drip-tight shut-off up to the full leak test rating
   a. Test and certify pressure capacity in the reverse direction

E. Actuators
1. Manual Actuators
   a. Provide manual actuators for all valves not specified to be power actuated or designed for automatic operation
      1) Actuators shall be totally-enclosed oil or grease-lubricated worm gear or traveling nut type
         a) Worm gear actuators
            i) Shall be totally enclosed, grease sealed, gear type
            ii) Shall be furnished with AWWA nut, crank, handwheel, or chainwheel
            iii) Shall be sized to meet the torque ratings of AWWA C504
      2) Actuators shall have AWWA input stops. Actuator shall be self-locking at all variable opening positions
      3) General use: Handwheel
      4) Seven (7’- 0”) feet or more above the floor or grade unless otherwise indicated: Chain wheel with operating chain
         a) Equipped with chain guide to permit rapid chain handling of the chain without “gagging” the wheel and to permit reasonable side pull on the chain
         b) With extensions as required to prevent interference with adjacent piping or equipment
         c) Chain heavily zinc or cadmium-plated and looped to extend between 3' and 4' of the floor or grade below valve
      5) Valve box and nut operator
         a) Buried vales shall be operated through valve boxes and as indicated on drawings: Wrench nuts
         b) Non-rising stems:
            i) Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
            ii) Connected to the valve by a flexible socket coupling
            iii) All other connections pinned, keyed, or socket
         c) Stem guides
            i) Cast iron, bronze brushed, adjustable in two (2) directions

ii) If extension stem length exceeds 10' or the weight exceeds 50 lbs., design top guide to carry the stem weight and provide a collar on the stem to bear against the thrust guide

d) Max-spacing: Non-rising stems: 100 times stem O.D.

e) Provide spaces to center stem in valve box

f) Provide 2 operating keys and wrench nut

g) Valve boxes

i) Boxes shall consist of a cast iron cover, lid, and base castings. No slip type boxes shall be allowed

ii) Type: Cast iron or ductile iron, extension sleeve (screw) type

iii) Minimum thickness: 3/16" at any point

iv) Coating: Bituminous varnish

v) Cast appropriate name designation of service in cover.

vi) Shaft shall be ductile iron and minimum diameter of 5-¼"

vii) An appropriate word designating the valve service case on the cover

h) Valve box manufacturers

i) Neenah Foundry Company

ii) Tyler Company

iii) Mueller Company

iv) Or Engineer accepted substitution

b. Rotation

1) Valves shall open counterclockwise

2) The word “OPEN” and a raised cast arrow indicating the direction to open cast on each valve body or operator

3) Position indicator clearly visible from operating floor

c. Actuators and handwheels shall be located in positions indicated or as otherwise determined when manufacturer's drawings are submitted to Engineer

2. Electric Actuators

a. Provide motor actuators as indicated on Drawings and as specified herein

b. Each motor actuator to consist of motor, actuator unit gearing, handwheel, limit and torque switches, mechanical position indicator, lubricants, heating element, wiring, terminals and integral reversing controller on capacitance starter as indicated, constructed as a self-contained unit

c. Housing: Cast, weatherproof, NEMA 4 unless indicated otherwise

1) Operating time from fully open to fully closed or the reverse:

2) For open/close valves: 30 seconds

3) For modulating valves: adjustable from 15 seconds to two minutes

d. Motors

1) Mounted horizontally adjacent to or vertically above gearing

2) Do not mount with motor vertical below gearing

3) Totally enclosed, high torque, designed expressly for valve operator service

4) Service rating:

a) Open/close service motors shall be rated for 15-minute continuous duty

b) Modulating service motors shall be rated for a minimum of 600 starts/hour

c) Designed in accordance with NEMA Standards

d) Insulation: Class F or better

e) Bearings: Permanently lubricated

f) Voltage tolerance: +/- 10 percent
g) Voltage rating: 480 Volt, 60 Hz, 3 phase
h) Conform to AWWA C540

5) Gearing
   a) All grease lubricated
   b) Service factor: 2.0
   c) Effectively sealed against entrance of foreign material
   d) AGMA nameplate not required
   e) Supported by anti-friction bearings
6) Designed so motor comes up to speed before stem load is encountered in opening and closing direction
7) Self-locking worm gear drive with alloy bronze worm gear and hardened steel worm
8) Handwheel/Chainwheel mechanism
   a) Designed to handwheel/chainwheel does not operate during motor operation
   b) Designed so motor does not rotate when handwheel/chainwheel is rotated after declutching
   c) Provide declutching extensions to allow declutching of all electric actuators from floor level
   d) Actuator responsive to electrical power and control at all times, instantly disengaging handwheel/chainwheel
   e) Shall meet all requirements for manual actuator
9) Torque switches
   a) Provide opening and closing torque and thrust limit switches
   b) Micrometer adjustment on each switch
   c) Reference setting indicator
   d) Variability 40 percent
   e) Contact rating: 6 amp inductive at 120 Vac
10) Geared limit switches
   a) Space for 4 geared limit switch assemblies
   b) Each assembly with 2 sets of NO contacts and 2 sets of NC contacts
   c) Each assembly geared to driving mechanism and independently adjustable to transfer at any point between fully open and fully closed valve position
   d) Contact rating: 6 amp inductive at 120 Vac
   e) Provide three limit switch assemblies
11) Heating element
   a) Provide in actuator housing
   b) Rated 120 V ac
   c) Continuously energized
12) Terminal facilities: Provide for connection to motor leads, switches, heating elements, control and power supply
13) Controller
   a) Integrally mounted solid state reversing controller for modulating operators, integrally mounted electromechanical controller for open-close operators
   b) Motor overload protective device

c) Electrically interlocked
d) Provided with the necessary direct operated auxiliary contacts for required interlocking and control
e) Pilot devices, Modulating Service
f) In a weatherproof enclosure close-coupled to actuator housing
g) Open-stop-close maintained contact push buttons
h) Hand-Auto maintained selector switch
i) Red “Open” and green “Closed” indicating lights
j) Auto position of selector allows 4-20 ma input proportional to required valve position

14) Pilot Devices, Open/Close Service
a) In a weatherproof enclosure close-coupled to actuator housing
b) Local Open/Close maintained pushbuttons
c) Local Hand-Auto maintained selector switch
d) Local red “Open” and green “Closed” indicating light
e) Auto position of selector allows open or close operation from remote un-powered contact from maximum distance of 300 feet

15) NEMA Size 1 minimum

16) Action on loss of command signal shall be selectable to include open, close, or last position

17) Controller for modulating service shall include provisions for zero, span gain, opening and closing speed potentiometer and deadband adjustment.

2.3 BUTTERFLY VALVES (AIR SERVICE)

A. Manufacturers:
1. DeZurik
2. Milliken
3. Val-Matic
4. Or Engineer accepted substitution

B. Valve Design and Conditions
1. Bi-directional pressure rating: 150 psi for 2 inch through 24 inch valves
2. Temperature rating: 250°F
3. Bi-directional and tested to 110% of full rating
4. Shall be in conformance with AWWA C504 and C542
5. Conform to Valve Schedule in this section
6. Valve ends:
   a. Shall be ANSI B16.1 Class 125 for cast-iron body valves Class 25A through Class 150B
   b. Shall be ANSI B16.1 Class 125 for ductile iron body Class 250 valves
   c. Shall be AWWA C207 Class D with ANSI B16.1 Class 125 drilling for steel body Class 25A through Class 150B valves
   d. Shall be AWWA C207 Class E for steel body Class 250 valves
7. Joints:
   a. Shall be mechanical or push-on type rubber-gasket joint ends
   b. Shall conform to AWWA C111

8. The use of a stop or lug cast integrally with or mechanically secured to the body for the purpose of limiting disc travel by means of direct contact or interference with the valve disc (in either the open or closed position) will not be acceptable

C. Materials
   1. Body:
      a. Cast iron for Class 25A through Class 150B valves
      b. Ductile iron for Class 250
   2. Disc:
      a. Cast iron or ductile iron for Class 25A through Class 150B valves
      b. Ductile iron for Class 250
   3. Seats:
      a. EPDM for services up to 290 Deg F
      b. Shall be body mounted
      c. Shall be resilient type
      d. Mating seat surface shall be stainless steel or Monel
         1) Sprayed or plated mating surfaces are not acceptable
   4. Shaft: 316 stainless steel
   5. Shaft seals:
      a. Shall be designed for use of standard self-adjusting split-V-type packing or Viton O-ring seals
      b. Pull down packing is not acceptable

D. Valve position indicators
   1. Provide position indicators on all exposed operators
   2. Provide handwheel with an arrow with the word open on handwheel rim specifying opening direction
      a. Arrow shall be cast on rim and raised
   3. Identify open position of valve, 0 - 100%

E. Operator locking devices
   1. Modulating service: Infinitely variable locking device or a totally enclosed geared operator as indicated

F. Manual Actuators
   1. Provide manual actuators for all valves not specified to be power actuated or designed for automatic operation
      a. Worm Gear actuator
         1) Actuators shall be totally-enclosed oil or grease-lubricated worm gear
         2) Actuators shall have AWWA input stops. Actuator shall be self-locking at all variable opening positions
      b. Traveling nut actuator
         1) Travel limiting stop nuts or collars installed in the actuating mechanisms shall be field adjustable
         2) Shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device
         3) Setscrews and clamps are not acceptable
      c. General use: Handwheel

d. Seven (7’-0”) feet or more above the floor or grade unless otherwise indicated: Chain wheel with operating chain
   1) Equipped with chain guide to permit rapid chain handling of the chain without “gagging” the wheel and to permit reasonable side pull on the chain
   2) With extensions as required to prevent interference with adjacent piping or equipment
   3) Chain heavily zinc or cadmium-plated and looped to extend between 3' and 4' off the floor or grade below valve

2. Rotation
   a. Valves shall open counterclockwise
   b. The word “OPEN” and a raised cast arrow indicating the direction to open cast on each valve body or operator
   c. Position indicator clearly visible from operating floor
3. Actuators and handwheels shall be located in positions indicated or as otherwise determined when manufacturer's drawings are submitted to Engineer

2.4 GATE VALVES

A. Gate valves above grade
   1. Valves 3 inches in size and larger
      a. Resilient wedge type in accordance with AWWA C515
      b. Flange, iron body, and bonnet rated for 200 psi working pressure. Provide O-ring seal between valve body and bonnet
      c. Ductile or cast iron wedge encapsulated in nitrile rubber and capable of sealing in either flow direction
      d. Bronze stem with double or triple O-ring or braided packing stem seals
      e. Rising stem configuration with handwheel diameter sized to allow opening of valve with no more than a 40-pound pull
      f. Coat interior and exterior surfaces of valve body and bonnet with fusion-bonded epoxy in accordance with AWWA C550

B. Manufacturers:
   1. Kennedy Valve Company, Model KS-RW
   2. Mueller, 2300 Series
   3. American Flow Control, Series 2500
   4. Or Engineer accepted substitution

2.5 BALL CHECK VALVE

A. Manufacturers
   1. Flomatic Valves, Type 408
   2. Flygt Corporation, Type 5087
   3. AVK, Series 53
   4. Or Engineer accepted substitution

B. Design

1. Ball check valves shall be designed to be non-clog, fully automatic, maintenance free, and specifically suited for operation in wastewater where solids, fibers, grit or highly viscous materials are encountered
2. Ball check valves are designed to be maintenance-free and suited for installation in the horizontal or vertical position
3. Ball check valves will have one moving part, the ball, which automatically rolls out of the path of flow, thus providing an unobstructed and "full flow" equal to nominal size. Upon discontinuation of flow, the ball shall automatically roll back to the closed position providing a positive seal against back pressure or backflow
4. Ball shall have an exterior coating of vulcanized nitrile rubber resistant to grease, petroleum products, animal and vegetable fats, dilute concentrations of acids and alkalines, tearing and abrasion
5. Valve shall be constructed so that by unbolting and lifting off the cover, the ball may be removed and replaced without removing the valve from the line
6. Ball check valves will be available with either a floating or sinking ball.
7. Suitable for 150 psi working pressure (all sizes)
8. Conform to Valve Schedule criteria in this section
9. Body and Cover: Flanged iron body shall be nodular cast iron type
10. Flanges: Shall be ANSI B16.1 Class 125

2.6 SWING CHECK VALVES

A. Manufacturers
1. APCO (DeZurik), Series 6000 with Oil Control/Bottom Buffer
2. CCNE (Millikin Co), Model 9001
3. GA Industries, Model 250D
4. Val-Matic Valve and Manufacturing Corp, Series 7900
5. Or Engineer accepted substitution

B. Design
1. 175 psi working pressure (general). 250 psi working pressure (special case).
2. Conform to AWWA C508
3. Conform to Valve Schedule criteria in this section
4. Unobstructed waterway, quick-closing, spring-loaded, horizontal swing
5. Stainless steel shaft with both ends extending through bronze bushed bearings and outside stuffing boxes
6. Body and Cover: Shall be cast iron, bronze mounted, full opening
7. Flanges: Shall be ANSI B16.1 Class 125
8. Furnish with extended stainless steel hinge with outside lever and weight
9. For vertical installations, adjust lever angle accordingly

2.7 ELASTOMERIC CHECK VALVE

A. Manufacturers:
1. Red Valve Co Inc, Tideflex Series 35-1
2. Or Engineer accepted substitution

B. Check valves shall be constructed of elastomeric rubber and be flow operated check type with a flanged end connection. Port area shall contour down to a duckbill which shall allow passage of flow in one direction and prevent reverse flow
   1. Flange and flexible duckbill sleeve shall be one-piece rubber construction with nylon reinforcement
   2. Bill portion shall be thinner and more flexible than valve body and formed into a curve of 180°
   3. Bill slit height must be 1.6 times nominal pipe diameter (12” pipe), minimum

C. Flange drilling – conform to ANSI B16.1 Class 125/ANSI B16.5, Class 150
   1. Furnish with galvanized or stainless steel retainer rings for installation

2.8 BALL VALVES

A. General Manufacturers
   1. Conbraco Industries
   2. Nibco, Inc
   3. Milwaukee Valve Company
   4. Kitz Cooperation of America

B. Manufacturers for air and water service 2-inches and larger:
   1. Crane "Hiflex 81202"
   2. Jamesbury "D150F"
   3. Walworth "C4100F"
   4. Or accepted substitution

C. Manufacturers for air and water service 2-inches and smaller:
   1. Jamesbury "A-11"
   2. Lunkenheimer "707-XLB"
   3. Nibco "T-590W"
   4. Jenkins "30-A"
   5. Or accepted substitution

D. Design for 2-inches and smaller
   1. NSF-61, MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder ends with union.

E. Application
   1. Except as otherwise indicated or specified, provide ball valves for all 2-1/2" or smaller shutoff valves
   2. Provide additional ball valves as indicated on drawings or as specified
   3. Ball valves for chemical and chlorine service are specified in Section 11245 and 11355 respectively

F. Fabrication
   1. Handles showing direction of opening
   2. Ball design which does not allow media contact with stem

3. Balancing stop for all applications

2.9 AIR RELEASE AND VACUUM RELIEF VALVES

A. Manufacturer
   1. APCO (DeZurik)
   2. Val-Matic
   3. GA
   1. Crispin
   2. Or Engineer accepted substitution

B. General
   1. Provide as indicated on Drawings
   2. Water working pressure: 50 psi
   3. Provide a shutoff valve: Ball valve, gate valve, butterfly valve, eccentric action handle
      a. Manufacturers:
         1) Nibco
         2) Dyna-Quip
         3) Or Engineer accepted substitution

C. Wastewater Service
   1. Individual air release valves:
      a. Provide air release valves as indicated on the Drawings
      b. Inlet and outlet size as indicated on Drawings
      c. Manufacturers:
         1) Val-Matic "Series 48A"
         2) Crispin “S Series”
         3) Or accepted substitution
   2. Combination air release and vacuum breaker valves: 4-inch and smaller
      a. Provide integral type that functions as both an air vacuum breaker and an air release valve
      b. Inlet and outlet size as indicated on Drawings
      c. Manufacturers:
         1) Val-Matic "Series 800"
         2) Crispin “SL(A) Series”
         3) Or accepted substitution

2.10 BACKFLOW PREVENTER

A. Provide a dual check valve assembly with reduced pressure zone and inlet and outlet isolation valves

B. Manufacturers:
   1. Febco "RP Type 825"
   2. Cla-Val "RP"
   3. Or Engineer accepted substitution

C. Design
   1. Provide cast iron body, bronze mounted valves

2.11 SOLENOID VALVES

A. Solenoid Valves: Smaller than 1-inch
   1. Manufacturers:
      a. ASCO Redhat "Series 8600"
      b. Fisher “260”
      c. Hoffman “420”
      d. OPW Jordan “811 VP”
      e. Or Engineer accepted substitution
   1. Bronze bodies and bonnets
   2. Valves shall be packless construction without packing box or sliding seal
   3. 120 VAC encapsulated Class F coils in NEMA 1 enclosures, spade type terminals
   4. Enclosures for outdoors, above water surfaces, and in treatment building process area shall be NEMA 4 with conduit hubs. All areas, enclosure shall be NEMA 1 with conduit hubs
   5. Design pressure for water and air service: 125 psi
   6. Maximum required differential for 1/4 inch valves: 0 psi
   7. Maximum required differential for 3/8-inch to 1-inch valves: 5 psi
   8. Provide a bronze bodied upstream Y-strainer with monel or stainless steel screens for water service applications

B. Solenoid Control Valves: 1-inch and Larger
   1. Manufacturers:
      a. Cla-Val Company "Model 136 G-01"
      b. GA Industries "Fig. 69D" or "7100D"
      c. Or Engineer accepted substitution
   2. Provide cast iron, globe type valves with a resilient disc
   3. Horizontal or vertical installation
   4. Provide voltages as required by electrical drawings
   5. Design pressure: 125 psi

2.12 BALL AND BUTTERFLY VALVES (PVC OR CPVC BODY)

A. Use ball and butterfly valves for low pressure small diameter pipe locations
   1. 3” and less in size
   2. Type as shown on Drawings
   3. PVC or CPVC, as indicated on the valve schedule
   4. Valve ends as required by piping with ability to remove valve with unions or flanges
   5. Handle or lever operator, quarter turn

B. Manufacturers
   1. NIBCO
   2. Asahi
   3. Or Engineer accepted substitution

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly
   2. Install valves and accessories in accordance with the manufacturer's recommendation and in accordance with referenced standards and specifications and shown on Drawings
   3. Provide a union or flanged connection within 2 feet of each threaded end valve unless the valve can otherwise be easily removed from piping
   4. Set valve level and plumb. Actuator to be set plumb or actuator can be set at 90 degrees to valve body if required for proper actuation
   5. Install valve in proper orientation for flow and disc seating
   6. Test valves installed with piping for hydrostatic testing, ensure each valve is operated and able to maintain test pressure and seal tight to isolate each piping section

B. Check valves: Install ball check valves in vertical piping

C. Air release and Vacuum-Relief Valves:
   1. Provide exhaust piping to a suitable disposal point

3.2 ADJUSTMENT

A. Check and adjust valves, actuators, pilotry, and accessories for smooth operation in accordance with manufacturer's instructions

3.3 TRAINING

A. Provide manufacturer certified training on-site for valves and actuators

B. Training to consist of field training and classroom training for valves and actuators as required
   a. Minimum of 4 hours training for valves with pilotry and/or electric/pneu actuators
   b. Minimum of 4 hours training for valves with replaceable seats and seals, or are testable backflow preventers

3.4 VALVE SCHEDULE, VALVES LARGER THAN 4-INCHES

A. Install valves as shown in the Drawings provided
   1. BFP: Back-flow Preventor
   2. BFV: Butterfly Valve
   3. BCV: Ball Check Valve
   4. BV: Ball Valve
   5. C: Contractor to provide valve
   6. E: Existing
   7. FLG: Flanged Joints
   8. GV: Gate Valve

9. HW: Hand Wheel
10. Motor: M
11. NPW: Non-Potable Water Line
12. PSE: Pre-Selected Equipment to be included in scope of supply
13. PV: Plug Valve
14. PW: Potable Water
15. SCV: Swing Check Valve
16. TU: True Union
17. WAS: Waste Activated Sludge
18. S: Solenoid

Type	Size (in.)	Area Location	Service	Valve End Connection	Actuator/ Operator	Supplied By
BFP	2	Headworks	PW	FLG x FLG	HW	C
BV	2	Headworks	PW	FLG x FLG	HW	C
BV	2	Headworks	PW	FLG x FLG	HW	C
BV	2	Headworks	PW	FLG x FLG	HW	C
BV	2	Headworks	PW	FLG X FLG	HW	C
GV	2	Headworks	PW	FLG x FLG	S	C
GV	2	Headworks	PW	FLG x FLG	S	C
GV	2	Headworks	PW	FLG x FLG	S	C
PV	12	Influent Pump Room	Influent	FLG x FLG	HW	C
PV	12	Influent Pump Room	Influent	FLG x FLG	S	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
GV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
SCV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
SCV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
SCV	8	Influent Pump Room	Influent	FLG x FLG	HW	C
SCV	10	Blower Control Room	WAS	FLG x FLG	HW	C
SCV	10	Blower Control Room	Air	FLG x FLG	HW	C
SCV	10	Blower Control Room	Air	FLG x FLG	HW	C
BFV	10	Blower Control Room	Air	FLG x FLG	HW	C
BFV	10	Blower Control Room	Air	FLG x FLG	HW	C
BFV	10	Blower Control Room	Air	FLG x FLG	HW	C
BFV	10	Blower Control Room	Air	FLG x FLG	HW	C
PV	4	Aerobic Digester	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester 1	WAS	FLG x FLG	HW	C

Type	Size (in.)	Area Location	Service	Valve End Connection	Actuator/ Operator	Supplied By
PV	4	Aerobic Digester 1	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester 1	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester 1	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester 2	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester 2	WAS	FLG x FLG	HW	C
PV	4	Aerobic Digester 2	WAS	FLG x FLG	HW	C
SCV	4	Aerobic Digester 1	WAS	FLG x FLG	HW	C
SCV	4	Aerobic Digester 2	WAS	FLG x FLG	HW	C
BFV	8	Aerobic Digester 1	WAS	FLG x FLG	M	C
BFV	8	Aerobic Digester 2	WAS	FLG x FLG	M	C
SCV	E	Dewatering	WAS		HW	E
PV	E	Dewatering	WAS		HW	E
PV	E	Dewatering	WAS		HW	E
BV	E	Dewatering	WAS – Sample Tap		HW	E
BV	E	Dewatering	WAS - Drain		HW	E
BV	E	Dewatering	WAS – Sample Tap		HW	E
BV	E	Dewatering	Pressate – Sample Tap		HW	E
PV	E	Dewatering	Pressate		HW	E
PV	E	Dewatering	Pressate		HW	E
PV	E	Dewatering	Solids		HW	E
PV	E	Dewatering	Solids		HW	E
BV	E	Dewatering	PW		HW	E
GV	E	Dewatering	PW		S	E
BV	E	Dewatering	PW – Polymer		HW	E
BV	E	Dewatering	PW – Polymer		HW	E
BV	E	Dewatering	PW – Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BV	E	Dewatering	Polymer		HW	E
BCV	E	Dewatering	Polymer		HW	E

END OF SECTION

SECTION 15544

FUEL FIRED UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gas fired unit heaters

1.2 REFERENCE STANDARDS

A. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2007, Including All Addenda (ANSI/ASHRAE/IESNA Std 90.1)

B. ASHRAE Std 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1993 with 1996 Errata

C. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2009

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2009

E. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; National Fire Protection Association; 2011

PART 2 PRODUCTS

2.1 GAS FIRED UNIT HEATERS

A. Unit Heaters: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:

B. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner

C. Supply Fan: Propeller type with direct drive, variable pitch motor pulley

D. Heat Exchanger: Aluminized steel welded construction

E. Gas Burner:
   1. Separated combustion type
   2. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve

3. Electronic pilot ignition, with electric spark igniter

F. Gas Burner Safety Controls:
1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure
2. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset

G. Operating Controls
1. Room Thermostat: Cycles burner to maintain room temperature setting

H. Performance:
1. Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1; seasonal efficiency to ASHRAE Std 103.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 90A

B. Install gas fired units in accordance with NFPA 54 and applicable codes

C. Provide vent connections in accordance with NFPA 211

D. Provide connection to electrical power systems; refer to Division 16

END OF SECTION

SECTION 15810

DUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

1.2 REFERENCES

A. General and Supplementary Conditions

B. Division 01 Specifications

C. Division 15 Specifications

D. Division 16 Specifications

1.3 REFERENCE STANDARDS

A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009a.

B. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2010.

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2009.

D. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2011.

E. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

F. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

1.4 SUBMITTALS

A. Product Data: Provide data for duct materials.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports.

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.7 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Supply and exhaust air ductwork in classified areas of the headworks building shall be constructed for 2" w.c. static pressure with aluminum or stainless steel per smacna duct construction standards.

C. All Ducts: Aluminum, unless otherwise indicated.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. T's, bends, and elbows: Construct according to SMACNA (DCS).

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages,reinforcing, and sealing for operating pressures indicated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct

Construction Standards - Metal and Flexible.

B. Install in accordance with manufacturer's instructions.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system

END OF SECTION

SECTION 15820

DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors

B. Flexible duct connections

C. Volume control dampers

1.2 RELATED SECTIONS

A. Division 1 – General Requirements

B. Division 15 – Mechanical

C. Division 16 – Electrical

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Turning vanes
   2. Flexible connectors
   3. Volume Dampers

B. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:
   1. Krueger: www.krueger-hvac.com.
   2. PCI Industries, Inc; Pottorff Brand: www.portorff.com.

3. Ruskin Company: www.ruskin.com.
4. Titus: www.titus-hvac.com.
5. Metalaire, Inc.

B. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

C. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

2.2 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.3 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.4 VOLUME CONTROL DAMPERS

A. Manufacturers:
1. Louvers & Dampers, Inc: www.louvers-dampers.com.
2. Nailor Industries Inc: www.nailor.com.
3. PCI Industries, Inc; Pottorff Brand: www.portorff.com.
4. Ruskin Company: www.ruskin.com.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 15810 for duct construction and pressure class.

B. Provide duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

B. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 15835

EXHAUST FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Propeller wall fans

B. Centrifugal utility fans

C. Ceiling mounted centrifugal exhaust fans

1.2 SUBMITTALS

A. Submit under provisions of Section 01340

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements

C. Manufacturer's Instructions: Indicate installation instructions

PART 2 PRODUCTS

2.1 DIRECT DRIVE PROPELLER WALL FANS

A. Refer to plans for specifications and capacities

2.2 CENTRIFUGAL UTILITY FANS

A. Refer to plans for specifications and capacities

2.3 CEILING MOUNTED CENTRIFUGAL EXHAUST FANS

A. Refer to plans for specifications and capacities

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fan unit in wall as shown on the drawings and in accordance with manufacturer's instructions

END OF SECTION

SECTION 15850

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Combination louver dampers

B. Supply air Diffusers

C. Exhaust air Grilles

1.2 REFERENCES

A. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)
   1. Standard 70

B. Air Movement and Control Association (AMCA)
   1. 500-L

1.3 SUBMITTALS

A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level

B. Project Record Documents: Record actual locations of air outlets and inlets

C. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70

D. Test and rate louver performance in accordance with AMCA 500-L

PART 2 PRODUCTS

2.1 COMBINATION LOUVER DAMPERS

A. Type and size as specified on the drawings

2.2 SUPPLY AIR DIFFUSERS

A. Type and size as specified on the drawings

2.3 EXHAUST AIR GRILLES

A. Type and size as specified on the drawings

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement

END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
   2. HVAC equipment quantitative-performance settings.
   3. Verifying that automatic control devices are functioning properly.
   4. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. NC: Noise criteria.

E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

F. RC: Room criteria.

G. Report Forms: Test data sheets for recording test data in logical order.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. TAB: Testing, adjusting, and balancing.

K. Test: A procedure to determine quantitative performance of systems or equipment.

L. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

B. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either NEBB or TABB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
   1. Agenda Items: Include at least the following:
      a. Submittal distribution requirements.
      b. The Contract Documents examination report.
      c. TAB plan.
      d. Work schedule and Project-site access requirements.
      e. Coordination and cooperation of trades and subcontractors.
      f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."

E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 WARRANTY

A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
   2. Verify that balancing devices, such as test ports and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:
   1. Dampers and other controlled devices are operated by the intended controller.
   2. Dampers are in the position indicated by the controller.
   3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in constant volume units.
   4. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   5. Sequence of operation for control modes is according to the Contract Documents.
   6. Controller set points are set at indicated values.
   7. Interlocked systems are operating.
   8. Changeover from heating to cooling mode occurs according to indicated values.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Automatic temperature-control systems are operational.
   3. Equipment and duct access doors are securely closed.
   4. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

B. Cut insulation, ducts and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

C. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections and functioning.

I. Check for proper sealing of air-handling unit components.

J. Check for proper sealing of air duct system.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
   2. Measure static pressure across each component that makes up air-handling and -treating equipment.
   3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
   1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Efficiency rating.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

3.8 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

3.9 TERMPERATURE-CONTROL VERIFICATION

A. Verify controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.10 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply and Equipment with Fans: 0 to plus 10 percent.
   2. Air Outlets and Inlets: 0 to minus 10 percent.

3.11 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.

6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Fan drive settings including settings and percentage of maximum pitch diameter.
    d. Settings for supply-air, static-pressure controller.
    e. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.
2. Motor Data:
    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.

f. Sheave dimensions, center-to-center, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.

G. Air-Terminal-Device Reports:
   1. Unit Data:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Test apparatus used.
      d. Area served.
      e. Air-terminal-device make.
      f. Air-terminal-device number from system diagram.
      g. Air-terminal-device type and model number.
      h. Air-terminal-device size.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Preliminary airflow rate as needed in cfm.
      c. Preliminary velocity as needed in fpm.
      d. Final airflow rate in cfm.
      e. Final velocity in fpm.

H. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.13 INSPECTIONS

A. Initial Inspection:
   1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
   2. Randomly check the following for each system:
      a. Measure airflow of at least 10 percent of air outlets.
      b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
      c. Measure space pressure of at least 10 percent of locations.
      d. Verify balancing devices are marked with final balance position.
      e. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes basic electrical requirements for materials and methods applicable to electrical equipment specified under this section and other related sections.
   1. Conduit
   2. Boxes
   3. Duct Bank
   4. Wire and Cable
   5. Wiring Devices and Device Plates
   6. Maintenance Materials
   7. Grounding Materials
   8. Luminaries
   9. Power Panels

B. Related Sections:
   1. Section 01340 – Shop Drawings and Product Data
   2. Section 01500 – Construction Facilities and Temporary Controls
   3. Section 01600 – Materials and Equipment
   4. Section 01730 – Operation & Maintenance Data
   5. Section 02300 – Earthwork
   6. Section 03300 – Cast-In-Place Concrete
   7. Section 09900 – Coatings

1.2 REFERENCES

A. UL – All applicable standards

B. IEEE – All applicable standards

C. IPCEA – All applicable standards

D. NEMA – All applicable standards

E. ANSI/NFPA 70 – National Electrical Code

F. ANSI C2 – National Electrical Safety Code

G. ANSI/NEMA FB 1 – Fittings and Supports for Conduit and Cable Assemblies

H. ANSI/NEMA OS 1 – Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports

I. ANSI/NEMA OS 2 – Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

J. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 SUBMITTALS

A. Information covering all material that is to be used on this project shall be submitted.

B. Each sheet of descriptive literature shall be clearly marked to identify the material or equipment for which it pertains.

C. Equipment on submitted sheets that is not for this project shall be crossed out.

D. As a minimum the following information shall be submitted:
   1. Lamp fixture descriptive sheets identified by the fixture schedule letter
   2. Equipment sheets shall identify what the equipment refers to by calling out the name of the equipment on the sheet.
   3. Schematics and connection diagrams for all electrical equipment shall be submitted.
   4. Submit all types of conduit and cables with manufacturer and sizes as well as all appurtenances.

1.4 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by a qualified Electrical Contractor who is regularly engaged in the business of building electrical systems for water and wastewater projects. The Electrical Contractor shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

B. Coordination
   1. The electrical equipment shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the manufacturer of related equipment.
   2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
   3. The Contractor shall provide coordination with other contractors and supervision of installation as required during construction.
   4. All service entrance work shall be in accordance with the local utility standards.
   5. The electrical contractor shall coordinate all service entrance work with the local utility. The local utility is Xcel Energy.
   6. The electrical contractor shall NOT pay for the utility's work. That shall be billed directly to the owner.

7. Accurately record actual locations of conduit, duct banks, panels, and accessories.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable Building Code.

B. Electrical: Conform to latest version of NFPA 70.

C. Coordinate, obtain and pay for all permits, inspections and approvals of authority having jurisdiction.

D. Comply with local electrical codes in force or in the absence of local electrical code, the latest edition of the National Electrical Code, ANSI C1.

1.6 WARRANTY

A. The electrical contractor shall warrant the supplied equipment and labor for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The work for this project is for a functioning city building. All new work shall be done in a way that allows the existing facility to maintain its operation.

B. All equipment furnished under this Section shall be selected by the Contractor for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged, and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Conduit
      a. Minimum Size: ¾ inch unless otherwise specified, or ½ inch for luminaries pendants.
      b. Underground Installations:
         i) Over 100V: More than five feet from foundation wall: Use thick wall nonmetallic conduit.
         ii) Within five feet from foundation wall: Use rigid steel conduit
         iii) Under 100V: Use rigid steel conduit
         iv) Minimum size: 1 inch.
      c. Outdoor Locations, Above Grade: Use rigid steel conduit.
      d. In Slab Above Grade:
         i) Use rigid steel conduit for circuits that are 24V or less.
         ii) Use rigid thick wall non-metallic conduit for 120V to 480V circuits.
         iii) Maximum Size Conduit in Slab: 2 inch, 1 inch for conduits that cross over each other, or with structural engineer's approval.

iv) Conduits shall not be spaced closer than 3 conduit widths on center.
v) Aluminum conduit shall not be embedded in concrete.
vi) Conduits shall not pass through a structural concrete beam without the structural engineer's approval.

e. In or under slab on grade:
i) Use rigid steel conduit for circuits that are 24V or less.
ii) Use rigid thick wall non-metallic conduit.

f. Wet and damp locations: Use rigid steel conduit or aluminum conduit.

g. Dry locations:
i) Concealed: In walls or above ceilings, use rigid steel or aluminum conduit.
ii) Exposed: Use rigid steel conduit or aluminum conduit.

h. Rigid Steel Conduit.
i) Rigid steel conduit shall be heavy wall, hot-dipped galvanized, and shall conform to Fed Spec WW-C-581 and ANSI C80.1, and shall be manufactured in accordance with UL 6.

i. Rigid Nonmetallic Conduit (PVC).
i) PVC conduit shall be heavy wall, schedule 40, shall be UL labeled for aboveground and underground uses.

j. PVC-Coated Rigid Steel Conduit.
i) The conduit shall be rigid steel and before the PVC coating is applied, the hot-dipped galvanized surfaces shall be coated with a primer to ensure a bond between the steel substrate and the coating. The PVC coating shall be bonded to the primed outer surface of the conduit at a thickness of at least 40 mils. A two part urethane chemically cured coating shall be applied at a nominal 2 mil thickness to the interior of all conduit and fittings.
ii) Manufacturers: Ocal, PermaCote, or Robroy Industries.

k. Rigid Aluminum Conduit.
i) Rigid aluminum conduit shall be heavy wall and shall conform to Fed Spec WW-C-581 and ANSI C80.1, and shall be manufactured in accordance with UL 6.

l. Flexible connections
i) Conduit: Moisture proof vinyl jacketed, liquid-tight, hot-dipped galvanized flexible steel and shall be UL labeled.
ii) Connectors: Watertight, Appleton Type ST or STB, Crouse-Hinds Type LT or LTC, or equal.

2. Outlet Boxes
a. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, Galvanized.
i) Luminaries and equipment supporting boxes: rated for weight of equipment supported.
ii) Concealed installations.

b. Nonmetallic outlet boxes: ANSI/NEMA OS 2.

c. Cast Boxes: NEMA FB 1, Type FD, Cast Ferroalloy.
i) Provide gasketed cover by box manufacturer.
ii) Provide threaded hubs.
iii) Models VXF, GRFX as manufactured by Crouse-Hinds.
iv) Models SEH, JBDX, with mounting lugs as manufactured by Appleton.

3. Pull and Junction
    a. Sheet Metal Boxes: NEMA OS 1, Galvanized Steel.
    b. Surface-Mounted Cast Metal Box: NEMA 250, Type 4 flat-flanged, surface-mounted junction box.
        i) Material: Galvanized cast iron Cast aluminum in corrosive areas.
        ii) Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
        iii) Model: WCB as manufactured by Crouse-Hinds.
    c. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting.
        i) Material: Galvanized cast iron.
        ii) Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
        iii) Cover Legend: ELECTRIC.
        iv) Model: WPD as manufactured by Crouse-Hinds.
4. Large Junction Boxes and Wiring Gutters
    a. Indoor Locations:
        i) Steel, NEMA 12.
    b. Outdoors:
        i) Stainless steel.
        ii) Weather-tight NEMA 4.
    c. Construction.
        i) Provide rigid handles for box covers larger than 9 sq. ft. or heavier than 25 lbs.
        ii) Provide split covers for covers larger than 12 sq. ft.
        iii) Aluminum boxes in concrete not allowed.
5. Seal Fittings
    a. Model ESU with Apelco sealing cement and fiber, as manufactured by Appleton.
    b. Model EZS with Chico X Fiber and Chico A compound as manufactured by Crouse-Hinds.
6. Deflection Fittings
    a. Locations:
        i) Underground conduit runs.
        ii) Runs between concrete sections subject to relative movement.
    b. Material:
        i) Ferroalloy hubs.
        ii) Neoprene outer jacket.
        iii) Stainless steel jacket clamps.
        iv) Molded plastic inner sleeve.
        v) Tinned copper braid grounding strap.
    c. Model XD as Manufactured by Crouse-Hinds.
7. Expansion Fittings
    a. Locations:
        i) In long conduit runs, to permit linear movement caused by thermal expansion and contraction.
        ii) In long conduit runs to prevent conduit from buckling.
        iii) Indoors and outdoors, where conduit expansion occurs or where there is a wide temperature range.

iv) At structural expansion joints.

b. Material:

i) End fittings: Ferroalloy.

ii) Body: Steel conduit.

c. Provide Bonding Strap When Used Outdoors.

d. Model XJ, as Manufactured by Appleton and Crouse-Hinds.

8. Flexible Sealing Compound

a. "Duxseal" as Manufactured by Johns-Manville.

b. "Permagum" as Manufactured by In mount.

9. Coal Tar Epoxy Paint

10. Wire and Cable

a. 600 Volt Power Cable

i) General Use:

a) Conductors: Single, copper, 12 AWG minimum.

b) All conductors shall be stranded.

c) Insulation: 600V thermoplastic, UL Type THWN/THHN.

d) Suitability: Wet or dry locations at 75° C and 90° C copper temperature.

e) Or as specified for service entrances.

ii) Service entrance and 4 AWG and above:

a) Conductors: Single, stranded, copper.

b) Insulation: 600V cross-linked polyethylene, UL Type XHHW/USE or THHN.

c) Suitability: Wet or dry locations at 75°C and 90° C copper temperature.

iii) Terminations

a) Lugs, cup washers or pressure type; do not use wire nuts on stranded cable or wrap standard cable around screw type terminals

b. Lighting Circuits

i) General Use:

a) Conductors: Single, copper, 12 AWG minimum.

b) Conductors may be solid or stranded.

c) Insulation: 600V thermoplastic, UL Type THWN/THHN.

d) Suitability: Wet or dry locations at 75° C and 90° C copper temperature.

ii) Terminations:

a) Lugs, cup washers or pressure type; do not use wire nuts on stranded cable or wrap stranded cable around screw type terminals.

c. Control circuits

i) General Use:

a) Conductors: Single, tinned copper, 14 AWG

b) All conductors shall be stranded

c) Insulation: 600V thermoplastic, UL Type THWN/THHN.

ii) Millivolt or Milliampere Instrumentation and Control.

a) Conductors: 18 AWG stranded copper, 2 or 3 as required.

b) Insulation: 15 mils, minimum, 90°C PVC.

c) Shield: Mylar aluminum tape with 20 AWG copper drain wire, fully covering conductors.

d) Jacket: 20 mils, minimum, 80°C PVC.

e) Suitability: Wet or dry steel conduit.

iii) Manufacturers: Belden "UL Instrumentation Cable – 1032A", Samuel Moore "Dekoron ICMX" No. 1852-686 and 1862-686, or equal.

d. Telephone and Networking

i) Cable.

a) The cables shall be rated for use in communications circuits.

b) The cables shall be rated for riser applications.

c) The cables shall be rated for 75 degrees Celsius applications.

d) The cables shall be free of defects and splices.

e) The cables shall be rated for outdoor applications.

f) The cables shall be rated for P-MSHA applications.

g) The cables shall pass a -40 degree Celsius cold bend test per UL 1581.

h) The cables must be UL third party verified to ANSI/TIA/EIA-586-B.2 Category 5e.

i) The cable shall be ROHS compliant.

j) The cable shall be CE compliant.

k) Conductors

1) The conductors shall be solid, bare copper per ASTM B-3.

2) The conductors shall be #24 AWG (.20 sq mm).

l) Insulation

1) The insulation shall be polyolefin.

2) The insulation shall be free of defects and splices.

m) Pairs

1) The cable shall contain four pairs.

2) The insulated conductors shall be bonded together down the entire length of the pair.

3) The pairs shall be marked with a permanent, extruded stripe identification of tip and ring insulated conductors.

4) Each pair shall have a unique twist length to minimize pair to pair coupling.

n) Shielding

1) Shielding shall be an aluminized foil with the foil facing inward, where required.

2) Unshielded cables shall be acceptable except where shielding is required for the system.

o) Jacket.

1) All cables shall have a continuous jacket of Polyvinyl Chloride (PVC).

2) Jacket thickness: The jackets shall be .030" (.75 mm) nominal thickness.

3) The jackets shall be ultraviolet (UV) radiation and sunlight resistant per UL 1581.

4) The jackets shall be oil resistant per UL 1581 Class 43.

p) Manufacturer: Belden "Industrial Data Solutions – 7923A" or equal.

q) Fiber Optic Cable

1) For fiber optic cable communication distances 1km or more, the Fiber Optic cable shall have a total of 12 OS2 single-mode fibers in the cable. The cable shall be loose tube gel-free riser cable that

are flame-retardant, and indoor/outdoor rated. The cables shall be protect against water penetration. The cable design shall be National Electric Code (N.E.C) listed (OFNR and FT-4).

2) For fiber optic cable communication distances of less than 1km, the Fiber Optic cable shall have a total of 12 OM4 multi-mode fibers in the cable. The cable shall meet IEC 60793-2-10 and have an attenuation of less than 2.3 dB/km.
3) Underground fiber shall be installed a minimum 30" below grade in a minimum of two (2) inch smoothwall Schedule 80 HDPE conduit meeting ASTM F2160 requirements. The conduit shall be made from high-density polyethylene (HDPE) resin per ASTM D3035 with tracer wire installed in industry standard Orange for Fiber Optic Cable.
4) Fiber optic connections shall match existing, noted in electrical drawings, or engineer approved equal.
5) Manufacturer: Corning "Freedm" or engineer approved equal.

r) Wall mounted Fiber Optic Patch Panel
1) Enclosure shall have at a minimum of two modules for fiber optic interconnections.
2) Enclosure shall be lockable with transparent jumper side door and segregated cable and fiber slack routing protection.
3) Manufacturer: Corning "CH-0_P" or approved equal.

s) Rack mounted Fiber Optic Patch Panel
1) Enclosure shall have a minimum of two modules for fiber optic interconnections.
2) Enclosure shall be designed for rack mounting in 19in. (48cm) racks with 1.75in. EIA hole spacing.
3) Manufacturer: Corning "CCH-0_U" or approved equal.

ii) Arc-Proofing Tape: Irvington "77 Arc-Proofing Tape", Slipknot No. 50 or Slipknot No. 3, or approved equal.

11. Wiring Devices
a. General:
i) Industrial Specification grade.
ii) White.
b. Receptacles:
i) 120 V duplex outlets: NEMA 5-20R, 3 wire, grounding, 20A, 125 V, Leviton 5362, or approved equal.
ii) 120 V duplex GFCI outlets: NEMA 5-20R, 3 wire, grounding, 20A, 125 V, Leviton 7899, or approved equal.
iii) 240 V duplex outlets: NEMA 6-20R, 3 wire, grounding, 20A, 250 V, Leviton 5462, or approved equal.
iv) Welding outlets: 50A, 125/250V, 3 pole, 4 wire, grounding, NEMA 14-50R, Leviton 55050, or approved equal.
c. Light Switches:

i) 277 V lighting circuits: 20 amp, 120/277 V, Leviton 1221-2W to 1224-2W, or approved equal.

12. Device Plates
    a. General:
        i) Mounting hardware countersunk and finished to match plate.
        ii) Provide over-sized plates where standard plates do not cover wall opening.
        iii) Provide engraving as indicated on drawings.
    b. Indoors:
        i) Surface mounted devices: Galvanized or cadmium-plated steel.
        ii) Flush mounted devices in other finished areas: Phenolic plastic, white.
        iii) All other flush mounted devices: Type 302 stainless steel.
    c. Outdoors and Indoors when identified on Drawings as Weatherproof:
        i) Weatherproof with spring doors for receptacles and with provisions for padlocking switches on and off.
        ii) Provide an adaptor plate for flush mounted device plates, Crouse-Hinds FS031, or equal.
13. Grounding and Bonding
    a. Provide rod electrodes, exothermic connections and mechanical connections.
    b. Building perimeter ground cable shall be minimum of 4/0 AWG bare copper.
    c. Duct bank ground cable shall be minimum of 4/0 AWG bare copper.
    d. Other ground cable shall be as noted on the drawings.
14. Luminaries
    a. Furnish products as specified on drawings.
    b. Install ballasts, lamps, and specified accessories at factory.
    c. Accessories:
        i) Provide swivel-type box covers.
        ii) Provide threaded conduit pendants.
    d. Provide all lamps and required mounting hardware.
15. Power Panels
    a. General:
        i) Circuit breaker panel board.
        ii) With neutral.
        iii) Dead front.
    b. Enclosure:
        i) NEMA 12, surface in unfinished areas, NEMA 1 flush in finished areas or as indicated on the drawings.
        ii) Door with latch and lock.
        iii) Typewritten circuit directory.
        iv) Ground stud bolt through cabinet with removable 1/0 AWG bond to the panel ground bus and an external clamp connector for a station ground conductor.
    c. Circuit Breakers:
        i) Molded case thermal magnetic.
        ii) Multiple pole breakers shall be common trip.
        iii) Bolt-in.
        iv) Individually front replaceable.
        v) Indicating “On”, “Off”, and “Tripped”.
        vi) RMS symmetrical interrupting capacity shall be as indicated on the drawings.

vii) Breakers, trip ratings, and number of poles as indicated on the drawings.

d. Buses:
   i) Three phase and neutral bus insulated from cabinet.
   ii) Ground bus.
      a) Connected to cabinet.
      b) Clamp type lug for supply circuit and each load circuit.
      c) Removable bond to neutral bus.
   iii) Copper bussing.
   iv) Ampere and voltage ratings as indicated on the drawings.
   v) Bracing coordinated with circuit breakers interrupting capacity.

16. Lighting Panels
   a. General:
      i) Circuit breaker panel board.
      ii) With neutral.
      iii) Dead front.
   b. Enclosure:
      i) NEMA 1 or as indicated on the drawings.
      ii) Door with latch and lock.
      iii) Typewritten circuit directory.
      iv) Ground stud bolt through cabinet with removable 1/0 AWG bond to the panel ground bus and an external clamp connector for a station ground conductor.
   c. Circuit Breakers:
      i) Molded case thermal magnetic.
      ii) Multiple pole breakers shall be common trip.
      iii) Bolt-in or plug-in.
      iv) Individually front replaceable.
      v) Indicating “On”, “Off”, and “Tripped”.
      vi) 10,000 amp RMS symmetrical interrupting capacity at 240 V.
      vii) Handle clips to prevent casual operation for circuit breakers indicated on drawings.
      viii) Ground fault interrupting breakers with a sensitivity of 5mA for receptacle branch circuit and where indicated on drawings.
      ix) Breakers, trip ratings, and number of poles as indicated on the drawings.
   d. Buses:
      i) Two phase and neutral bus insulated from cabinet.
      ii) Ground bus.
         a) Connected to cabinet.
         b) Clamp type lug for supply circuit and each load circuit.
         c) Removable bond to neutral bus.
      iii) Copper.
      iv) Ampere and voltage ratings as indicated on the drawings.
      v) Bracing coordinated with circuit breakers interrupting capacity.

17. Dry-Type Specialty Transformers.
   a. Phase, voltage current ratings as indicated on drawings.
   b. Two 2½% full capacity taps below normal voltage.
   c. Dry type, wall floor or MCC mounted as indicated on the drawings, enclosed for wiring in conduit.

d. Self air-cooled.
e. Suitable for indoor NEMA 4.
f. Insulation system and average winding temperature rise for rated KVA as follows:
   i) 1-15 KVA: Class 185 with 115°C rise.
   ii) 16-500 KVA: Class 220 with 115°C rise.
g. Sound Levels: NEMA ST20.
h. Ground core and coil assembly to enclose by means of a visible flexible copper grounding strap.
i. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise

18. Control Stations.
    a. Enclosures:
       i) Indoors: NEMA 4X.
       ii) Outdoors: NEMA 4X
    b. Pilot Devices:
       i) Refer to specification section 16900.
    c. Nameplates:
       i) Pilot devices: Laminated plastic nameplates, white surface with a black core, engraved to identify controlled motor or equipment.
       ii) Control station: Laminated plastic nameplates, white surface with a black core, engraved to identify controlled motor or equipment.
19. Equipment Disconnects
    a. General:
       i) Heavy-duty safety switches.
       ii) Square D or Cutler-Hammer.
    b. Enclosure:
       i) Indoor dry areas: NEMA 12.
       ii) Outdoor: NEMA 4X.
       iii) Corrosive Areas: NEMA 4X.
       iv) Use above guidelines unless otherwise noted on drawings.
       v) Padlocked external operating handle.

    c. Switch:
       i) 25,000 amp symmetrical withstand.
       ii) Poles to match equipment served.
       iii) 600 VAC.
       iv) Continuous current rating not less than the serving branch circuit over current protection.
       v) Non-fusible except where fusing is required by the served equipment or as noted on the drawings.
20. Separately Enclosed Motor Starters.
    a. General:
       i) Starters shall have a disconnecting means.
       ii) 3 phase: NEMA size 1 minimum size or as indicated on the drawings.

iii) Dry type control power transformer for 120VAC control power sized to handle all loads simultaneously, both primary leads fused and one secondary lead fused and one secondary lead grounded.
iv) Two spare NO and NC auxiliary contacts.
v) Pilot devices.
vi) Nameplates to identify the starter and all the items in the starter.
vii) Square D or Cutler-Hammer.

b. Enclosure:
i) Indoor dry areas: NEMA 12.
ii) Outdoors & corrosive areas: NEMA 4X.
iii) External operating handle to be interlocked with the door to prevent opening door when handle is in the closed position.
iv) Padlocked external operating handle.

c. Contactor:
i) 3 phase: NEMA size 1 minimum size or as indicated on the drawings.
ii) 1 phase: NEMA size 0 minimum size or as indicated on the drawings.
iii) Rated for the voltage being provided.
iv) 120 VAC coils.
v) Non-reversing NEMA rated magnetic starters.

d. Overloads:
i) One solid state overload relay in each phase.
ii) External manually reset push button for reset of the overload relay.
iii) Overloads shall provide phase loss tripping capability.

e. Disconnecting Device:
i) 3 phase: MCP type disconnect rated at 25KAIC minimum.
ii) 1 phase: MCP or fused type disconnect rated at 10KAIC minimum.

21. Reduced Voltage Solid State Starters

a. Starter shall be provided with:
i) Phase loss, phase unbalance and phase reversal protection.
ii) Shorted SCR protection.
iii) Bypass contactor:
a) Provide a bypass contactor to bypass the SCRs of the starter once the motor is up to speed.
b) The bypass contactor may be built into the starter, or if it is not, there shall be an external bypass provided.
iv) Diagnostic module shall be provided which shall include:
a) Control power
b) Shorted SCR
c) Start inhibit
d) Trip
e) Phase loss
f) Phase unbalance
g) Phase reversal
v) Independently adjustable acceleration and deceleration current limit adjustable from 150 to 400 percent of motor full load current.
vi) Adjustable current ramp to provide breakaway torque to the motor adjustable from 0-150 percent of motor full load current.

b. Starter shall be rated for a minimum of 115 percent of the full load current of the motor that is installed.
c. Each starter shall be provided with a motor run contact and a starter fault contact.

22. Surge Protective Device (SPD).
    a. General:
        i) SPD units shall be installed as shown on the drawings.
        ii) SPD units shall be appropriate for the voltages indicated on the drawings.
        iii) Approved manufacturers: Cutler Hammer, Square D, LEA, or equal.
        iv) SPD units shall comply with UL 1449 and 1283.
        v) SPD units shall comply with IEEE C62.41 and IEEE C62.45.
        vi) SPD units shall have a 30 amp disconnect directly before the TVSS unit.
        vii) SPD units shall have indication for trouble alarms and surge count.
        viii) For assembled equipment the SPD unit shall be of the same manufacturer as the assembled equipment.
    b. Ratings:
        i) Maximum let through voltage shall be:

Mode	120/208	277/480
L-N or L-G	400V	800V
L-L	800V	1800V

        ii) Minimum total surge current capability:

Location	Per Phase	Per Mode
Switchgear	250 KA	125KA
MCC	160KA	80KA
Panelboards	120KA	60KA

2.2 SPARE PARTS

A. The Supplier shall furnish and deliver the following spare parts.

B. The following spare parts to be furnished as a minimum:
1. 25% replacement lamps for lighting fixtures.
2. 25% replacement lamps for pilot light.
3. Two (2) sets of each type of fuse used in the project.
4. Two (2) spare ballast of each type specified.

C. All of the above parts shall be provided as spare parts and shall be packaged new in the original manufacturer's packaging. A list of spare parts shall be provided.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
1. The instrumentation equipment shall be installed by the Contractor or his subcontractors in accordance with the manufacturers' instructions. The services of the system supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.

B. Inspection
   1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
      a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation
   1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
      a. Separate sheet metal junction boxes, equipment enclosures, sheet metal raceways, etc., mounted on water or earth-bearing walls or wall-mounted outdoors ¼" from wall be corrosion resistant spacer.
      b. Seal the base of all outdoor switchgear, motor control center, and similar equipment with grout.
      c. Screen or seal with flexible sealing compound all openings into outdoor equipment to prevent the entrance of rodents, wasps, and mud-daubers.
      d. Electrical work shall conform to the construction schedule and progress of other trades.
      e. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
      f. Perform all work in accordance with manufacturer's instructions.
         i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
         ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
      g. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.

D. Identification:
   1. Conduit. All conduits shall be provided with identification tags. Tags shall be brass nameplates with 3/8" high lettering and attached to the conduits by means of stainless steel wire. Conduits shall be identified at both ends with the same identification number.
   2. Cable. Except for lighting and receptacle circuits, each individual wire in power, control, indication, and instrumentation circuits shall be provided with identification markers at the point of termination. Power wires without individualized identification numbers shall be color coded with electrical tape or colored wire jacket. The wire markers shall be of the heat-shrinkable tube type.
   3. Control Stations. Control stations shall be provided with nameplates identifying the related equipment. Pilot controls and indicating lights shall have engraved or etched legends ("start", "stop", etc.) as indicated on the drawings. Nameplates shall be laminated plastic, with 1/8 inch engraved letters, and shall be securely fastened to the control stations.

4. Circuit Breakers. Circuit breakers shall be provided with nameplates identifying related equipment. Nameplates shall be laminated plastic, with 1/8 inch engraved letters, and shall be securely fastened to the circuit breakers.

E. Raceways:
1. General:
   a. Except as otherwise indicated on drawings, conduit shall be concealed in finished areas and exposed in unfinished areas.
   b. Rigid steel conduit and aluminum conduit connections and terminations shall be reamed, de-burred, threaded and provided with bushings.
   c. Securely fasten conduit connections to sheet metal enclosures with locknuts inside and out. Conduit hubs outdoors and in wet locations.
   d. Provide deflection fittings across structural joints where structural movement is allowed.
   e. Keep conduit clear of structural openings and indicated future openings.
   f. Provide flashing and seal watertight conduits through roofs and metal walls.
   g. Neatly grout conduit into any opening cut into structure.
   h. Cap or plug conduits during construction to prevent the entrance of trash, dirt and water.
   i. Minimum conduit size shall be ¾", except ½" for luminaries pendants or as noted on drawings.
   j. Seal conduits with flexible sealing compound forced to a minimum depth equal to the conduit diameter after cable is installed.
      i) At handholes, manholes, and vaults.
      ii) Building entrance junction boxes.
      iii) One inch or larger connections to equipment.
   k. Provide flexible conduit where flexible connections are necessary, including each motor without flexible cord.
      i) Keep length to a minimum, not to exceed 6' maximum.
      ii) No sharp bends.
   l. Provide suitable pull string in each empty or spare conduit.
2. Conduit exposed in structures:
   a. Install parallel to structural members and surface.
   b. Install conduits of the same general routing parallel with symmetrical bends.
   c. Arrange supports to prevent misalignment during wiring installation.
   d. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
   e. Group related conduits; support using conduit rack. Construct rack using steel channel provide space on each for 25 percent additional conduits.
   f. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.
   g. Provide suitable pull string in each empty conduit except sleeves and nipples.
   h. Maintain 6" clearance to ducts, piping and flues.
   i. Support rigidly with galvanized or cadmium-plated hardware and framing materials, including nuts and bolts.

j. Provide expansion fittings at 100’ centers outdoors, 200’ centers indoors; in each conduit run longer than 100’ outdoors, 200’ indoors.
k. Provide galvanized pipe caps on conduit stubs for future use.
l. Allow 7’ headroom for horizontal conduit runs, except along structures, piping equipment or where not possible.
m. Except as otherwise indicated, do not install exposed conduit in water chambers.
n. Where allowed, coat conduit exposed in water chambers with 2 coats of coal tar paint with paint injuries repaired or use PVC coated conduit.

3. Conduit concealed in structure:
   a. Install between reinforcing steel in slabs with reinforcing in both faces.
   b. Install under reinforcing steel in slabs where only a single layer is provided.
   c. Terminate conduit for future use in equipment or by galvanized couplings and conduit plugs flush with structural surfaces. Seal plugs with self-leveling caulk.
   d. Maximum of two conduits crossing each other in slab.
4. Underground:
   a. One inch minimum.
   b. Encased in concrete.
      i) Two inches between conduits.
      ii) Three inches over conduit where not reinforced.
      iii) Three inches over reinforcing.
      iv) Reinforced at and 5’ past portion on disturbed earth or subject to traffic.
      v) Reinforced within 5’ of a structure, manhole or vault.
      vi) Reinforced for entire length and 2’ beyond each adapter to steel conduit if non-metallic is used in duct bank.
      vii) Where capped underground, reinforce the last 2’ and extend steel and conduit 2’ past end of duct bank. Paint all un-encased metal with 2 coats of coal tar paint.
      viii) Continue encasement on outdoor risers to 3” above grade and crown and chamfer top.
   c. Two foot minimum bend radius at vertical risers, 3 foot elsewhere.
   d. Install underground conduit so that it does not drain to cable pulling access in buildings; where necessary, provide a handhole or manhole near or adjacent to building.
   e. Provide 3 foot minimum earth cover.
   f. Install underground conduits through buildings, manhole, handhole and vault walls in box outs as indicated on the drawings.
   g. All steel inside manholes, handholes and vaults shall be galvanized with bared spots treated with zinc rich paint.
   h. Provide ¾” galvanized steel pulling eyes on opposite walls below the centerline of each duct bank.
   i. Provide end bells at wall terminations and adapters for steel conduit continuations for non-metallic duct systems.
   j. Isolate intercommunication and milliampere level instrumentation circuits from all power wiring raceways, conduits, boxes, vaults, manhole and handhole.
   k. Provide a full-size extension for each underground conduit entering a building.
   l. Rigid nonmetallic conduit (PVC) shall be fastened no less than every 4 feet.
5. Junction boxes and wiring gutters:

a. Install electrical boxes as shown on drawings and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
b. Install pull boxes and junction boxes to maintain headroom and to present neat mechanical appearance.
c. Install level and plumb.
d. Where indicated, provide a removable side opposite underground duct banks.
e. At least code size including space for full size continuation of any conduit not originally continued.
f. Arrange conduit for maximum space for future conduits.
g. Support boxes independently of conduit except cast box that is connected to rigid metal conduits both supported within 12 inches of box.

F. Wire and Cable
1. General:
a. Protect the cable and avoid kinking conductors, cutting or puncturing jackets, contaminating by oil or grease or damaging in any manner.
b. Terminate stranded cable with lugs, cup washers, or pressure type connectors; do not wrap stranded cable around screw type terminals.
c. Splice stranded cable with pressure type connectors; do not use wire nut type connectors on stranded cable.
d. Splice cables only at readily accessible locations.
e. Do not pull cable tight against bushings or press heavily against enclosures.
f. Use cable pulling lubricants as recommended by the cable manufacturer.
g. Use swab to clean conduits and ducts before pulling cables.
h. Install cable and accessories in accordance with manufacturer's instructions.
i. Where necessary to prevent heavy loading of cable connectors due to cable weight, support cables in vertical risers with woven cable grips.
j. Coil and tape spare cable ends.
k. Support each 250 MCM or larger cable, and each conduit group of smaller cables from manholes, handholes or vault walls.
l. Use Stranded conductor for feeders and branch circuits.
m. Use stranded conductors for control circuits.
n. Use conductor not smaller than 12 AWG for power and lighting circuits.
o. Use conductor not smaller than 16 AWG for control circuits.
p. Use 10 AWG conductors for 20 ampere, 120 Volt branch circuits longer than 100 feet.
q. Pull all conductors into raceway at same time.
r. Use suitable wire pulling lubricant for building wire 8 AWG and larger.
s. Protect exposed cable from damage.
t. Neatly train and lace wiring inside boxes, equipment, and panel boards.
u. Clean conductor surfaces before installing lugs and connectors.
v. Make splices, taps, and terminations to carry full ampacity of conductors.
2. Special cables:
a. Isolate networking and milliampere level instrumentation cables from all power circuits.
b. Isolate telephone cables from all other circuits.

3. Conductor identification:
   a. Color code all service, feeder, and branch circuit conductors, 277/480 VAC and above as follow:
      i) Phase A: Brown
      ii) Phase B: Orange
      iii) Phase C: Yellow
      iv) Neutral: White
      v) Ground: Bare or Green
   b. Color code all feeder, and branch circuit conductors, 120/208 VAC as follows:
      i) Phase A: Red.
      ii) Phase B: Black.
      iii) Phase C: Blue.
      iv) Neutral: White.
      v) Ground: Bare or Green.
   c. Identify single control conductors by color coding orange and by labeling each end of conductors by color coding orange and by labeling each end of conductor with heat shrink-tube type wire markers.
   d. Identify multi-conductor instrumentation and control cables with heat shrink-tube type wire markers.
   e. Contractor shall establish a control and instrumentation conductor and cable identification system acceptable to Engineer.

G. Wiring Devices:
1. Flush mount wiring devices in concealed conduit system.
2. Surface mount wiring devices in exposed conduit systems.
3. Provide extension rings to bring outlet boxes flush with finished surface.
4. Clean debris from outlet boxes.
5. Install products in accordance with manufacturer's instructions.
6. Install devices plumb and level.
7. Install switches with OFF position down.
8. Install receptacles with grounding pole on bottom.
9. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
10. Connect wiring devices by wrapping conductor around screw terminal.
11. Use jumbo size plates for outlets installed in masonry walls.
12. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
13. Install wall switch 48 inches above finished floor.
14. Install convenience receptacle 24 inches above finished floor.
15. Inspect each wiring device for defects.
16. Operate each wall switch with circuit energized and verify proper operation.
17. Verify that each receptacle device is energized.
18. Test each receptacle device for proper polarity.
19. Test each GFCI receptacle device for proper operation.
20. Adjust devices and wall plates to be flush and level.

H. Grounding Materials:

1. Coordinate installation with other disciplines.
2. Verify that final backfill and compaction has been completed before driving rod electrodes.
3. Install Products in accordance with manufacturer's instructions.
4. Install rod electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
5. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.
6. Provide bonding to meet Regulatory Requirements.
7. Install ground cable through building walls within 3' below finish grade and prepare a water stop.
8. Install ground rods and cables as deep in earth as possible and as far from structure as possible, not closer than 6".
9. All branch circuit and feeder circuits to include a copper ground conductor in addition to the conduit ground connection.
10. Connect ground conductors to equipment by ground lugs or clamps.
    a. If no ground bus or terminal is provided and enclosure is not explosion-proof or submersible provide a clamp type lug under a permanent assembly bolt or by grounding locknuts or bushings.
    b. If an explosion-proof or submersible enclosure is not provided with grounding means, provide an adjacent junction box with a ground lug.
    c. Bond grounding system to station piping by connection to the first flange inside the building on either a suction or discharge pipe which will form a good ground connection:
        i) Drill and tap the flange.
        ii) Provide a bolted connection.
        iii) Bond with a copper bar or strap.
    d. Form ground conductors on equipment to the contours of the equipment.
    e. Install main ground cables with encased underground conduit banks in earth at least 3" below 1 corner of the duct bank.
    f. Bond ground cables in underground circuits to main ground cables at each manhole, handhole, and vault.

I. Luminaries
1. Install in the general locations and arrangement indicated on drawings.
2. Align luminaries in rows vertically and horizontally except as otherwise required.
3. Install clear of pipes, mechanical equipment, structural openings, indicated future equipment and structural openings, and other obstructions.
4. Adjust luminaries location as required by field conditions.
5. Examine each luminaries to determine suitability for lamps specified.
6. Install in accordance with manufacturer's instructions.
7. Install suspended luminaries using pendants supported from swivel hangers. Provide pendant length required to suspend luminaries at indicated height.
8. Support luminaries larger than 2x4 foot size independent of ceiling framing.
9. Locate recessed ceiling luminaries as indicated on reflected ceiling plan.
10. Install surface mounted luminaries and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

11. Install recessed luminaries to permit removal from below.
12. Install accessories furnished with each luminaire.
13. Bond products and metal accessories to branch circuit equipment grounding conductor.
14. Install specified lamps in each luminaire emergency lighting unit and exit sign.
15. Operate each luminaire after installation and connection. Inspect for proper connection and operation.
16. Aim and adjust luminaries as directed.
17. Relamp luminaries that have failed lamps at Substantial Completion.
18. Clean electrical parts to remove conductive and deleterious materials.
19. Remove dirt and debris from enclosure.
20. Clean photometric control surfaces as recommended by manufacturer.
21. Clean finishes and touch-up damage.

J. Lighting Panel
1. Wall mount in unfinished areas, flush mount in finished areas.
2. Install lighting panel in accordance with NEMA PB 1.1.
3. Install lighting panel plumb. Provide supports. Height: 6 ft. to top of lighting panel; install lighting panel taller than 6 ft. (2M) with bottom no more than 4 in. above floor.
4. Provide filler plates for unused spaces in lighting panels.
5. Provide typed circuit directory for each branch circuit in lighting panel. Revise directory to reflect circuiting changes required to balance phase loads.
6. Measure steady state load currents at each lighting panel feeder; rearrange circuits in the lighting panel to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.
7. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

K. Networking – EtherNet/IP cabling
1. Install sufficient networking cable, as shown in the contract drawings, to provide a complete networked system.
2. Terminate all wiring with RJ-45 connectors rated for Cat 5e cable transmissions.
3. Test every communication cable, and provide a testing certificate with the results.

L. Fiber Optic cabling
1. Install sufficient fiber optic cable, as shown in the contract drawings, to provide a complete networked system with terminations.
2. Terminate all fiber optic strands with approved connectors rated for fiber optic transmission.
3. Cables shall be pulled with swivel pulling eyes to prevent causing a twist in the cable.
4. Conduit may require lubrication to reduce frictional loads and/ or intermediate pulls.
5. Intermediate pulls require pulling the cable to a point, laying on the ground in a “figure 8” pattern to prevent twisting the cable.
6. A minimum bend radius of 20 times of the cable diameter under tension.
7. A minimum bend radius of 10 times of the cable diameter under no tension.
8. All splices shall be fusion spliced.

9. The contractor shall label all fiber optic cabling in a permanent consistent manner. All tags shall be of a material designed for long term permanent labeling and shall be marked with permanent ink on non-metal types, or embossed lettering on metal tags. Metal tags shall be constructed of stainless steel. Non-metal label materials shall be approved by the engineer. Labels shall be affixed to cable per the manufacturer's recommendations and shall not be affixed in any manner that shall cause damage to the cable. Handwritten labels shall not be allowed.
10. After installation, every fiber and every splice shall be tested with an Optical Time-Domain Reflectometer (OTDR). Written and electric documentation of the test shall be provided to customer.
11. If maximum loss values are not met or exceeded, re-termination of fiber shall be required until maximum loss values are met or exceeded.

    a. Single mode fiber maximum loss values

Single mode OS2 @1300nm	
Fiber Attenuation	.4dB/km
Connector Loss	.75dB/Connector
Fusion Splice Loss	.75dB/Splice

    b. Multimode fiber maximum loss values

Multimode OM4 @ 850nm	
Fiber Attenuation	3.5dB/km
Connector Loss	.75dB/Connector
Fusion Splice Loss	.75dB/Splice

3.2 FIELD QUALITY CONTROL

A. Low Voltage Cable Testing
   1. Test 600 V power cables for continuity and freedom from short circuits and ground, except where grounding is intentional immediately after installation.
   2. Test all circuits with a 500 V megger or its equivalent.
   3. Replace conductors which read less than 1.5 Megohms between conductors and ground.

3.3 PROTECTION AND STORAGE

A. Protection of equipment during storage:
   1. During construction, all electrical equipment shall be protected against absorption of moisture, and metallic components shall be protected against corrosion. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously. Any means necessary shall be used to protect the equipment at the Contractor's expense.

END OF SECTION

SECTION 16150

VARIABLE FREQUENCY DRIVES AND CONTROL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing of variable frequency drives (VFDs) with all associated labor, material, tools, equipment, appurtenances, and service in accordance with the contract documents.

1.2 SUBMITTALS

A. Submittals shall be required as noted in Section 16900.

1.3 QUALITY ASSURANCE

A. VFD Supplier's qualifications
   1. Acceptable Manufacturers.
      a. Square D "Model 71".
      b. Allen Bradley Model 700 Series.
      c. Cutler-Hammer, SVX9000 Series.
      d. Cutler-Hammer, DG1 Series.
      e. Without exception.
      f. Where a listed manufacturer's standard product does not meet the requirements of this specification, the standard unit shall be modified to meet all the requirements of this specification.

B. Coordination
   1. Verify all motor sizes and specifications from approved mechanical, process, and instrumentation shop drawings, contract drawings, and contract documents. It is the Contractor's responsibility to fully coordinate the VFDs with the provided driven equipment. All equipment provided under this section shall comply with the requirements of the general project requirements (Materials and Equipment – Section 01600), Section 16050, and Section 16900 of these specifications.

C. The VFD Supplier shall be the same as the Instrumentation Supplier for the equipment in section 16900.

D. Warranty
   1. The VFD supplier shall warrant the hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMNTS

A. All equipment furnished under this section shall be selected by the VFD supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Interchangeability. All VFDs shall be products of the same manufacturer and of the same series or product line.

2.2 MATERIALS AND EQUIPMENT

A. The following specifications shall apply to the VFDs.
   1. The variable frequency drives shall consist of a 480 V adjustable frequency inverter with integral control, sequence logic, and self diagnostics as specified herein. The drives shall be of "pulse width modulated inverter" (PWM) type employing semi-conductor technology. The VFD shall limit harmonic distortion reflected onto the system to a voltage and current distortion level as defined by the latest version of IEEE 519 for general system application.
   2. VFD enclosures:
      a. The enclosure ratings shall be as noted on the drawings
      b. All devices noted on the drawings shall be installed in the VFD enclosure.
   3. Each VFD of 50 HP or more shall be provided with a line side filter for mitigation of harmonic noise.
      a. The filter shall be a passive harmonic filter capable of limiting the harmonic distortion from this drive to meet the requirements of IEE-519 1992.
      b. The filter shall be as manufactured by TCI HG7 Series, Mirrus Filter AUHF, or approved equal.
      c. The filter shall mount in the VFD enclosure.
      d. Fans shall be as required for both the VFD and the filter.
   4. Each VFD under the size of 50 HP shall be provided with a 5% line side filter.
   5. The VFD shall be rated:
      a. As shown on the drawings
      b. Constant torque
      c. 480 V, 3 phase, 60Hz
      d. Microprocessor based static adjustable frequency controller designed to provide continuous speed adjustment of 3 phase motors
      e. Provide energy-efficient, low loss speed control in the range from 4 to 70 Hz.
      f. Provide the Owner receipts and required information for all VFDs to enable energy rebate through Delta Montrose Electric Association (DMEA).
   6. The VFDs shall operate in an ambient temperature range of 10C to 30C at an altitude of 7,500 feet above sea level.
   7. The following microprocessor-based, door-mounted operator controls and status indication shall be provided:
      a. Run/stop selection with LED indication.
      b. Speed control selection with LED indication.
      c. Current limit indication.

d. Microprocessor fault.
e. Reset button.
f. Manual speed adjustment.
g. Frequency indication.
h. Amp-meter.
i. Output voltage meter.
j. Elapsed time meter.
k. Error and Fault log.

8. The following basic control functions and features shall be provided:
   a. Interface for external hand-off-auto switch and control signals as shown on the drawings.
   b. Interface for external 4-20mA speed reference signal.
   c. 4-20mA output signal for VFD speed indication.
   d. Output relays with dry contacts wired to terminals for functions shown on the drawings.
   e. Control power transformer and power supplies as required.
9. The following standard protective functions shall be provided on the VFDs:
   a. Input AC circuit breaker with an interlocked, padlockable handle mechanism.
   b. Electronic instantaneous over-current protection.
   c. DC bus under-voltage protection.
   d. DC bus over-voltage protection.
   e. DC bus over-voltage protection.
   f. Overload warning.
   g. Controlled over-temperature protection.
   h. Over-frequency protection.
   i. Phase loss protection.
   j. Output terminal short circuit protection.
10. The following standard independent adjustments shall be provided on the VFDs:
    a. Minimum frequency.
    b. Maximum frequency.
    c. Four preset speeds initiated by contact closures.
    d. Adjustable acceleration times.
    e. Voltage boost.
    f. Volts-to-hertz ratio.
    g. Current limit.
    h. Critical frequency avoidance zones.
    i. Jog input.
    j. Selectable auto restart.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
   1. It shall be the Supplier's responsibility to ensure that the entire electrical equipment is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection.
   1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
      a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation.
   1. VFDs shall be installed in individual VFD cabinets that shall contain all the devices shown on the drawings as being part of the VFD system.

D. Adjustment and Cleaning
   1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
   2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

3.2 CUSTOMER TRAINING

A. The Supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of this equipment. The training sessions shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of a 2-hour session; the schedule shall be arranged and coordinated with the Engineer.

END OF SECTION

SECTION 16200

ELECTRIC MOTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section covers single and three phase, alternating current motors rated 500 horsepower and less (NEMA MG1).

B. Motors shall be designated and coordinated with the driven equipment.

C. This section covers inverter duty motors for all applications with variable frequency drives.

D. Submittals

E. Quality assurance and qualifications

F. Delivery, storage and handling

G. Environmental conditions

H. Factory testing

I. Warranty

J. Accessories

K. Equipment Identification

1.2 RELATED SECTIONS

A. Section 01600-Materials and Equipment

B. Section 01400-Quality Control

C. Section 01650-Starting of Systems

D. Section 01730-Operating and Maintenance Data

1.3 REFERENCES

A. NEMA MG1

B. NEMA MG 10

C. IEEE 112, Test Method B

1.4 GENERAL REQUIREMENTS

A. The section covers all motors provided under this contract.

B. The requirements of detailed specifications take precedence over this section in the event of an apparent conflict.

C. Motors shall be fabricated and assembled in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the engineer.

D. All motor nameplate data shall conform to NEMA MG 1 standards.

E. Contractor to coordinate equipment with other parts of the Work.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01340

B. All submittals for each unit shall be compiled and submitted through the Contractor to the Engineer by the responsible manufacturer.

C. Inverter duty motors: Include motor manufacturer's certification that motor is compatible with variable frequency controllers to be used with motor as specified in Section 16150.

D. Submittals shall include complete assembly, foundation, installation drawings, and complete engineering data covering the materials used, parts, devices, and accessories forming the complete motor.

E. The submittal information shall include, but shall not be limited to:
   1. Name of manufacturer
   2. Type of motor
   3. Type of bearing and method of lubrication
   4. Type of model of bearing insulation
   5. Rated size of motor, hp, and service factor
   6. Temperature rise and insulation rating
   7. Full load rotative speed
   8. Net weight
   9. Efficiency at full, ¾, and ½ load
   10. Full load current
   11. Locked rotor current
   12. Space heater voltage and wattage, where applicable
   13. Motor temperature switch data, where applicable

1.6 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be supplied.

B. Operation and maintenance manuals shall include:

1. Assembly, installation, alignment, adjustment, and checking instructions
2. Lubrication and maintenance instructions
3. Guide to troubleshooting
4. Parts list and predicted life of parts subject to wear
5. Assembly drawings, engineering data, and wiring diagrams
6. Test data and performance curves, where applicable

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

A. The site elevation is: 7,500 ft

B. Ambient temperature is: 20 C

C. Unless otherwise specified, all motors shall be designed for full voltage starting and to operate from an electrical system that may have a maximum of 5 percent voltage distortion according to IEEE 519.

D. Motors utilizing a reduced voltage solid state starter shall be capable of starting at 50 percent of the specified voltage.

E. Motors powered by variable frequency drives (VFD), shall be inverter duty and specifically selected for service with a VFD and shall be derated as required to compensate for the harmonic heating effects and the reduced self-cooling capability at lower speeds.

2.2 ACCEPTABLE MANUFACTURER'S

A. All motors shall be the product of Baldor,US Motors, or engineer approved.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

A. Motor voltage ratings shall be:
   1. 460 V, 3 phase for ½ horsepower and larger
   2. 120V, single phase for smaller than ½ horsepower

B. Frequency: 60 Hz

C. Service Factor: 1.15

D. Enclosure: Totally enclosed fan cooled

E. Nameplate horsepower shall be equal to or greater than the maximum load imposed by the driven equipment.

F. All motors shall be self-ventilated. The fan covers of totally enclosed fan cooled motors shall meet NEMA MG 1 requirements for a fully guarded machine.

G. Motors shall be rated for the starting duty that they will be subject to.

H. Motors shall be designed for satisfactory operation at any voltage within plus or minus 10 percent of rated voltage.

2.4 TOTALLY ENCLOSED MOTORS

A. Provided with drain holes and rotating shaft seals

2.5 OUTDOOR MOTORS

A. Outdoor motors shall be totally enclosed fan cooled

B. All exposed metal surfaces shall be protected, where practical, with a corrosion resistant polyester coating. Exposed uncoated surfaces shall be of a corrosion resistant metal.

C. Enclosure exterior and interior surfaces, air gap surfaces, and windings shall be protected with a corrosion resistant polyester, polyurethane, or epoxy coating.

2.6 HAZARDOUS LOCATION MOTORS

A. Motors for hazardous locations shall be in accordance with the NEC and of the correct type enclosures for the particular service as specified by NEMA MG 1.

2.7 FABRICATION

A. All motors shall be furnished with a ground connection.

B. All bearings shall be self-lubricating, shall have provisions for relubrication, and shall be designed to operate in any position or at any angle.

C. All inverter duty motors rated 50 hp or larger shall be provided with insulated bearing journals on the non-drive end to prevent circulating currents.

D. All inverter duty motors rated 50 hp or larger shall be provided with a maintenance-free, circumferential, conductive, microfiber shaft grounding ring mounted on the drive end of the motor to discharge any shaft currents to ground.

E. Two or more items ofthe same type shall be identical by the same manufacturer and interchangeable.

F. All motors shall be completely assembled with the driven equipment, lubricated, and ready for operation.

2.8 EFFICIENCY

A. Motors shall be premium efficiency type and shall have a NEMA nominal efficiency nameplate value equal to or greater than the values indicated in the following table.

MOTOR	NOMINAL EFFICIENCY VALUES					
	OPEN DRIP PROOF			TEFC		
HP	3600 RPM	1800 RPM	1200 RPM	3600 RPM	1800 RPM	1200 RPM
1	83.5	85.0	82.0	76.5	85.0	82.0
1.5	83.5	85.0	82.0	76.5	85.0	82.0
2	85.0	85.0	82.0	76.5	85.0	82.0
3	85.0	85.0	82.0	76.5	85.0	82.0
5	86.0	85.0	82.0	76.5	85.0	82.0
7.5	88.0	85.0	82.0	76.5	85.0	82.0
10	89.0	85.0	82.0	76.5	85.0	82.0
15	90.0	85.0	82.0	76.5	85.0	82.0
20	91.2	85.0	82.0	76.5	85.0	82.0
25	91.9	93.1	92.5	91.5	93.1	92.5
30	92.5	93.6	93.1	91.9	93.1	92.5
40	92.5	93.6	93.6	91.9	93.6	93.6
50	92.5	94.0	93.6	92.5	94.0	93.6
75	93.5	94.5	94.0	93.1	94.5	94.0
100	94.0	94.9	94.5	93.6	94.9	94.5
125	94.0	94.9	94.5	94.5	94.9	94.5
150	94.5	95.3	94.5	94.5	95.3	95.3
200	94.9	95.3	94.9	94.9	95.7	95.3
250	94.5	95.3	94.9	95.3	95.7	95.3
300	94.9	95.3	94.9	95.3	95.7	95.3
350	94.9	95.3	94.9	95.3	95.7	95.3
400	95.3	95.3	95.3	95.3	95.7	95.3
500	95.3	95.7	95.7	95.3	95.7	95.3

B. Contractor shall provide the Owner receipts and required information for all premium efficiency motors to enable energy rebate through Delta Montrose Electric Association (DMEA).

2.9 ANTI-REVERSAL HOLDBACK

A. All pumps 5 hp or larger shall be provided with anti-reversal holdback designed to prevent reversal of flow when the pump is not operating:

2.10 ACCESSORIES

A. Special Tools and Accessories:
   1. Provide all special tools, instruments and accessories required for proper maintenance
   2. Provide all special lifting and handling devices required

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. Install all equipment, accessories and materials in accordance with the manufacturer's written recommendations unless otherwise specified in the individual equipment detailed technical specifications

3.2 FIELD QUALITY CONTROL

A. Handle, install, connect, clean, condition, and adjust products in strict accordance with manufacturer's instructions and in conformity with specified requirements:
   1. Maintain one set of complete instructions at job site during installation and until completion
   2. Perform Work in accordance with manufacturer's instructions.
   3. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for further instructions

B. Install all equipment in strict accordance with manufacturers written instructions unless otherwise specified in individual equipment specification sections

3.3 CLEANING

A. Perform under provisions of Section 01700

B. Repaint all painted surfaces which are damaged prior to final equipment acceptance to Owner's satisfaction

END OF SECTION

SECTION 16250

ENGINE GENERATORS: DIESEL

PART 1 – GENERAL

1.1. Section Includes:

A. Engine-generator set

1. Idaho Springs WWTP Upgrade Standby Generator

B. Provide engine generator set including but not necessarily limited to the following:

1. Engine.
2. Cooling system.
3. Exhaust system.
4. Starting system.
5. Generator.
6. Fuel tank and associated fuel system
7. Control equipment and accessories.
8. Housing.
9. Output circuit breaker.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electrical Manufacturer's Association (NEMA).
2. National Fire Protection Association (NFPA)
3. Underwriter's Laboratories, Inc. (UL).

B. Testing:

1. Prototype Test: The manufacturer shall have successfully tested a prototype of each engine/generator set series offered. The tests performed shall include the following:

a. Maximum power test.

b. Maximum motor starting kVA.

c. Transient response, steady state governing, and voltage regulation.

d. Single step load pick-up per NFPA 110.

e. Three-phase short circuit test for mechanical and electrical strength.

f. Fuel consumption.

g. Cooling system test.

h. Endurance run test.

2. Factory Tests: Prior to shipment, each unit shall be factory performance tested under load. Test results shall be certified and documented on a strip chart recorder. The tests shall be performed in accordance with the Manufacturer's standards and NFPA Standard 110. The following tests shall be performed:

   a. Stepped load test at 1/2, 3/4, and full load for 5 minutes each step.

   b. Full single step block load.

   c. Results documented shall include steady-state voltage and frequency analysis, transient response, maximum power analysis, and fuel consumption.

3. Field Tests: Each complete installation shall be tested for compliance with the plans and specifications following completion of all site work. Testing shall be conducted by a representative of the supplier. The Contractor shall supply fuel, and other equipment required for the test. The Owner and Engineer shall be notified in advance and shall have the option to witness the tests. The tests shall be repeated until the equipment performs as specified. The tests to be conducted on site shall be as follows:

   a. Cold Start Test: Perform a cold start test on the generator using the generator's actual load as a test load. A power failure shall be simulated by opening the normal power disconnect and the following information shall be recorded:

      1) Cranking on time.

      2) Time required to come up to speed.

      3) Voltage and frequency overshoot.

      4) Time to achieve steady state.

      5) Voltage, frequency, and amps at standby state.

      6) Oil pressure, water temperature, and battery charge rate at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter for 2 hours.

   b. Crank Cycle Test: Disable the generator from starting by a method approved by the Manufacturer and test the crank cycle by switching the generator to run.

   c. Safety Shutdowns: Test all the generator safety shutdowns.

1.3 SUBMITTALS

A. Verify dimensions, coordination and applicability of equipment furnished.

B. Full detail for performing of engine testing required. Upon completion of engine testing prepare and submit final results along with all new data.

C. Upon satisfactory completion of startup, secure a written statement from manufacturer that each engine generator is installed in accordance with manufacturer's recommendations, properly started up and is ready for operation by the Owner's personnel. Also certify that required operation and maintenance training has been fully satisfied.

D. Wiring diagrams for each engine-generator set. Indicate clearly factory versus field wiring connections.

E. Generator fault current at full rpm and main circuit breaker trip curves and fault interrupting rating.

F. Operation and Maintenance Manuals

1.4 WARRANTY

A. Minimum of one year warranty on all parts and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Cummins/Onan.
2. Generac.
3. Caterpillar

B. Assure engine, generator and accessories are provided by the engine manufacturer and its authorized dealer.

C. Assure local availability of service and replacement parts.

2.2 PERFORMANCE AND OPERATING REQUIREMENTS

A. Operating Conditions: Provide complete generator sets, controls and accessories rated for the following conditions:

1. Location: Idaho Springs, CO.
2. Altitude: 7,500 FT AMSL.
3. Fuel: Diesel.
4. Enclosure rating: Outdoors.

B. Performance: Establish net rating of each generator set under operating conditions specified when equipped and fully loaded with all necessary operating accessories. Substantiate ratings with manufacturer's standard published curves and data.

1. Minimum ratings:

a.	Standby rating (at 0.8 PF):	400 kW
b.	Frequency:	60 Hz
c.	Voltage and phase:	480/3
d.	Engine speed, max (rpm):	1800
e.	Maximum voltage dip:	20%

2. The unit shall be required to maintain the above noted parameters while starting and running the loads listed at the end of this section. The loads will not be started simultaneously.

C. Fuel: Engines requiring special or premium fuel will not be acceptable.

2.3 ENGINE

A. Engine Construction: Provide diesel-type engine of heavy-duty construction, full compression ignition diesel, radiator and fan cooled.

1. Engines solid-state designed for cold quick start, capable of delivering full load output in 30 seconds.
2. Engine must meet scheduled performance without turbo-charging or after-cooling.
3. Provide exhaust manifolds.

B. Lubrication:

1. Provide pressure-type lubrication system with gear-type oil pump and full flow filters fitted to engines. Provide level indicator or dipstick.
2. Locate filter for convenient servicing.
3. Oil drain piped to edge of skid with valve or cap.

C. Air Cleaner:

1. Provide one or more dry-type replaceable element air cleaners suitable for high dust load operation.
2. Equip each air cleaner with service indicator.

D. Governor:

1. Provide a fully enclosed electronic governor.
2. Frequency at any constant load shall not deviate more than plus or minus 0.5 percent of rated frequency.

3. The governor to provide adjustable frequency regulation from isochronous to 5 percent drop.

E. Fuel System: Dual replaceable element filter, engine supply and return line, solenoid, shut off valve, and engine driven fuel pump.

2.4 GENERATOR

A. Construction: Provide brushless, revolving field type, synchronous generator coupled directly to engine flywheel through a flexible driving disc for positive alignment.

1. Bolt generator housing directly to engine flywheel housing.
2. Provide volts-per type voltage regulator of solid state 3-phase sensing, construction matching characteristics of each unit. Provide no load to full load regulation within ±0.5 percent at rated voltage during steady state conditions.
3. Provide permanent magnet generator to provide excitation power to the automatic voltage regulator.
4. Provide shock-resistant mounting of regulators.

2.5 COOLING SYSTEM

A. Provide unit-mounted radiator cooling system with sufficient capacity for cooling generator set at full rated load and operating conditions specified.

1. Equip engine with engine-driven centrifugal-type water circulating pumps and thermostatic valve to maintain coolant temperature below 200 DegF.

B. Coolant:

1. Flush and drain cooling system.
2. Fill with minimum 50 percent ethylene glycol and water solution.
3. Assure radiator, engine block and related items protected to minus 50 DegF.
4. Coolant drain piped to edge of skid with valve or cap.

C. Jacket Water Heaters: Furnish one or more engine mounted thermal circulation type water heaters to maintain engine jacket water at 70 DegF at minimum ambient temperature specified.

1. Include integral thermostatic controls to maintain desired temperatures.
2. Rate heaters for 240 V, 1 PH, 60 HZ.

2.6 EXHAUST SYSTEM

A. Exhaust Silencer. Provide a Critical-grade silencer and related hardware to include side inlet, standard 125-150 LB flange connections, companion-flanges, cleanouts, Type E

support arrangement, and stainless steel bellows type flexible exhaust connectors at least 24 IN long.

1. Ensure silencers and related hardware are properly sized and installed according to the manufacturer's recommendation.
2. The silencer shall be mounted horizontally such that its weight is NOT supported by the engine.
3. Furnish and install exhaust pipe constructed of schedule 40 steel pipe with standard 125-150 LB flange connections as shown on the Drawings. Exhaust pipe size shall be sufficient to ensure that measured exhaust back pressure does not exceed 20 IN of water.

B. Install insulation so that it does not interfere with the functioning of the flexible exhaust fitting.

C. Provide a 20 foot flexible connection hose for connecting the generator exhaust to on outside port when the generator is running in a building.

2.7 STARTING SYSTEMS

A. Starting Motors: Provide 24 V DC starting system with solenoid operated positive engagement drive.

B. Batteries: Furnish lead acid batteries with each engine generator with sufficient capacity to crank engines for three 20-second cranking periods with a 30-second rest period between cranks without recharging.

1. Provide battery rack appropriately sized for the batteries furnished, painted with alkaline-resistant paint.
2. Provide constant voltage, current limiting, full wave rectifier type battery chargers using silicon controlled rectifiers as the power controlling elements.
3. Provide float and equalize charge rates. Rate charger for 120 V, 1 PH, 60 HZ with output current rating to recharge the battery from a 70 percent discharged condition to 95 percent charged condition in 12 HRS.
4. Battery charger shall be 120V and shall be hardwired.
5 Provide malfunction alarm contacts for actuation of alarm in the event of malfunction in the battery charging system.
6 Provide DC voltmeter and ammeter, ac input and dc output circuit breakers.
7. Provide cables, clamps and all other necessary connections.
8. Size main cables to exhibit total circuit resistant of 0.005 ohm or less.
9. Batteries and charger located in generator enclosure.
10. Starting shall be initiated by a normally open, dry contact closure.

2.8 CONTROLS

A. Control Panel:

1. Provide NEMA 1 enclosed control panel mounted on each generator terminal box with vibration isolators.
2. Construct dead front panel with 14 GA steel.
3. Include the following devices in panel:
   a. Engine coolant temperature gage.
   b. Engine lube oil pressure gage.
   c. Engine lube oil temperature gage.
   d. Engine running hour meter.
   e. Battery charging indicators.
   f. Voltmeter.
   g. Ammeter with true RMS output, supplied by 3 CT's at generator output leads.
   h. Ammeter and voltmeter phase selector switch or switches.
   i. Frequency meter.
   j. Manual and automatic starting controls.
   k. Panel illumination lights and switch.
   l. Voltage level adjustment rheostat.
   m. Fault indicators including low oil pressure, high water temperature, overspeed and overcrank. Provide dry contacts for common annunciation of fault conditions.
4. Multifunction digital device incorporating all above functions will be acceptable.

B. Main Line Circuit Breaker: Provide main circuit breaker for generator set, sized for appropriately to protect the generator.

1. Breakers are to operate both manually for normal switching function and automatically during overload and short circuit conditions.
2. The trip unit for each pole of each breaker is to have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection.
3. Provide breakers to interrupt bolted 3 PH fault from generator at full rpm at load terminals.
4. Provide a NEMA 1 enclosure for circuit breakers and mount on generator using suitable vibration isolators.

2.10 SPARE PARTS

A. Furnish Owner the following extra parts and supplies for each generator set:

1. One set of filters, i.e., fuel, oil, and air for each unit.

3. Oil for one complete oil change for each unit.

4. Complete replacement set of all fuses.

B. Spare parts shall be packaged with labels indicating contents of each package.

PART 3 - EXECUTION

3.1 MOUNTING, FUEL TANK AND ENCLOSURE

A. Base: Mount engine, generator and cooling system on a common structural steel subbase capable of maintaining unit alignment suitable for mounting unit on a base fuel tank. Equip subbase with spring-type vibration isolators between subbase and fuel tank.

B. Fuel Tank: Provide double-wall welded steel UL listed base tank assembly designed and supplied by the generator manufacturer.

1. Size tank for minimum 24 HRS of continuous engine operation at 3/4 load.

2. Provide mounting and anchoring means suitable for installation on the trailer

3. Provide double wall construction with leak detection and alarm contact.

4. Provide low fuel level alarm contact.

5. Provide fuel fill spill containment box.

6. Provide overfill prevention valve.

7. Provide liquid tight fill connection system.

8. Provide fuel fill drop tube.

C. Flexible Connections: Provide stainless steel flexible fittings on all engine piping and electrical conduits.

1. Engine control conduit.

2. Fuel connection: Braided metallic.

3. Exhaust connector bellows: Stainless steel.

4. Coolant water pipes: Braided metallic.

D. Enclosure:

1. Equip engine generator set with a factory assembled ventilated sheet steel enclosure.

2. Provide weatherproof enclosure with an external critical grade silencer with rain cap.

a. Provide housing with hinged side-access doors and a rear control door.

b. All access doors to be lockable.

c. Treat entire enclosure and skid tank assembly with an electro deposition primer process prior to finish painting for maximum durability.

d. Equip the set with lifting eye.

e. Enclosure shall be a sound attenuating enclosure and shall reduce the sound to a Level 1 sound attenuation. The level 1 sound attenuation shall reduce the sound to a maximum of 89dB at 7 meters distance with the generator fully loaded.

3.2 FIELD QUALITY CONTROL

A. Employ and pay for services of equipment manufacturer's field service representative(s) to:

1. Inspect equipment covered by these Specifications.
2. Supervise any adjustments and installation checks.
3. Conduct initial start up of equipment and perform operational checks at jobsite. Conduct field tests as specified.
4. Provide instruction to Owner's personnel on training in operation and maintenance of equipment for a 4 hours period.

Load List:

Idaho Springs WWTP Upgrade #1 3-PHASE LOAD LIST				
Description	HP/KW	Volts	Amperes	KVA
Headworks Area				
SCR-101 - Mechanical Fine Screen (2 motors?)	5	480	7.60	6.3
WCP-102 - Compacter 2 motors, 1/4, 3/4	4	480	3.40	2.8
GRM-103 - Grit Removal	2	480	3.40	2.8
GC-104 - Classifier Washer	0.5	480	1.10	0.9
GP-105 - Grit Pump	7.5	480	11.00	9.1
Transformer - Lighting Panel HD	30 KVA	480	18.00	14.9
EQP Pumps Motorized Valve 1	0.5	480	1.10	0.9
EQP Pumps Motorized Valve 2	0.5	480	1.10	0.9
HVAC - Unknown	30	480	40.00	33.2
CUH-1	3KW	480	4.00	3.3
MAU-2	5KW	240	6.00	2.5
MAU-1		480	15.00	12.5
Totals			111.7	90.3

Digester/Dewatering **Area - MCC-D**				
BLWR-XXX - Solids Blower #1	75	480	40.00	33.2
BLWR-XXX - Solids Blower #2 - Standby	75	480	40.00	33.2
P-XXX - Sludge Transfer Pump #1	5	480	7.60	6.3
P-XXX - Sludge Transfer Pump #2	5	480	7.60	6.3
MXR-XXX - Digester No. 1 Mixer	20	480	27.00	22.4
MXR-XXX - Digester No. 2 Mixer	20	480	27.00	22.4
DEC-XXX - Digester #1 Decanter Valve	2.7	480	5.00	4.2
DEC-XXX - Digester #2 Decanter Valve	2.7	480	5.00	4.2
Heater D-1 - Digester Blower Room	5KW	480	6.00	5.0
Sludge Feed Pump Control Panel		480	20.00	16.6
Screw Press Control Panel		480	30.00	24.9
Air Compressor M500	5	480	7.60	6.3
Cake Pump Control Panel		480	10.00	8.3
UH-1 Heater	5	480	6.00	5.0
Transformer - LP-DG	30KVA	480	18.00	14.9
Totals			256.8	213.2
Grand Totals			368.5	303.5

END OF SECTION

SECTION 16280
480 VOLT AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing and installation of a 480 volt automatic transfer switch (ATS) for use with the generator. The ATS shall be provided by the contractor. The ATS enclosure shall be rated NEMA 3R for installation outside. The ATS current rating shall be as noted on the drawings.

1.2 SYSTEM DESCRIPTION

A. This equipment will be connected to a 480 volt, 1 phase, 4 wire, solidly grounded system. A fully rated neutral lug shall be included in the ATS enclosure for connection of all the neutral conductors.

1.3 REFERENCES

A. All equipment to be furnished under this section shall be designed, constructed, and tested in accordance with the latest applicable requirements of the standard specifications and codes of ANSI, NEMA, IEEE, and other such regularly published and accepted standards, as well as state and local codes and the USERC standards required by the local utility.

1.4 SUMBMITTALS

A. Submittals shall be required as noted in section 16050 and 16900.

1.5 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by a qualified Supplier who is regularly engaged in the business of ATS equipment. The Supplier shall meet the following qualifications.
      a. The Supplier shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
      b. The Supplier shall have the physical plant and fabricating personnel to complete the work specified.
      c. The Supplier shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
      d. The Supplier shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

1.6 WARRANTY

A. The Supplier shall warrant the hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment furnished under this section shall be selected by the Supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Acceptable Manufacturers. Subject to compliance with Contract Documents, the following manufacturers are acceptable.
      a. Generac Power Systems.
      b. Kohler Power.
      c. Cummins Power Generation.
      d. Or accepted substitution
   2. The ATS shall be supplied by the engine generator supplier who shall be responsible for the design, manufacture, coordination, and proper installation and operation of the automatic transfer switch.

2.2 MATERIALS AND EQUIPMENT

A. Automatic Transfer Switch
   1. Each automatic transfer switch shall consist of a power transfer module and a control module, interconnected to provide complete automatic operation. The ATS shall be mechanically held and electrically operated by a single solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double throw. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.
   2. The automatic transfer switch shall conform to the requirements of NEMA Standard ICS 2-447 and UL's UL 1008 and shall be UL listed for use in standby systems in accordance with Articles 517, 700, 701, and 702 of the NEC.
   3. The automatic transfer switch shall be rated as shown on the drawings.
   4. All main contacts shall be of silver composition. They shall be protected by arcing contacts. The operating transfer time in either direction shall not exceed 1/6 of a second.

B. Control.
   1. The automatic transfer switch shall be controlled by a microprocessor-based programmable controller specifically designed for this function to provide rapid, reliable transfer of power between emergency and normal power conditions. The programmable controller shall be programmable from buttons on the front of the unit

with an alphanumeric display for indication of entered values and any fault conditions.

2. Manual operation of the switch shall also be possible, as well as manual lockout.
3. The following control shall be incorporated into the transfer switch:
   a. Voltage sensing shall be provided on all phases. The pickup voltage shall be adjustable from 85% to 100% of nominal, and the dropout voltage shall be adjustable from 75% to 90% of the pickup value. The transfer to the emergency power supply will be initiated upon reduction of normal source to 85% of nominal voltage, and the retransfer to normal shall occur when normal source restores to 90% of nominal.
   b. A time delay shall be provided to override momentary normal source outages to delay all transfer switch and engine starting signals. The time delay shall be field adjustable from 0.5 to 30 seconds and factory set at 10 seconds.
   c. A time delay on retransfer to normal source shall be provided. The time delay shall be automatically bypassed if the emergency source fails and normal source is available. The time delay shall be field adjustable from 0 to 30 minutes and factory set at 10 minutes.
   d. A timer shall be provided for the unloaded running time delay for emergency generator cool down. The time delay shall be field adjustable from 0 to 10 minutes and factory set a 5 minutes.
   e. A contact shall be provided that closes when the normal source fails. This contact is for initiating the engine starting sequence. The contact shall be rated 10 amperes at 32 volts dc.
   f. A white signal light shall be provided to indicate when the automatic transfer switch is connected to the normal source. A red signal light shall be provided to indicate when the automatic transfer switch is connected to the emergency source.
   g. Two auxiliary contacts shall be provided that are closed when the automatic transfer switch is connected to normal and two auxiliary contacts shall be provided that are closed when the automatic transfer switch is connected to emergency. Contacts shall be rated 1 ampere, 240 volts, 60 Hz.
   h. In phase monitoring to allow for in-phase switching controls shall be provided to delay transfer from one active power source to another until the transfer can be done without causing nuisance tripping of circuit breakers and damage to the equipment.
   i. A selector switch shall be provided for selecting manual or automatic retransfer to normal.
   j. An engine generator automatic exercising timer shall be provided with the option of selecting to exercise under load or no-load conditions.

C. Switching Components. The automatic transfer switch shall be rated to withstand 30,000 RMS symmetrical short circuit current at the automatic transfer switch terminals with the type of overcurrent protection and voltage as shown on the drawings.
   1. Automatic transfer switches utilizing components of molded case circuit breakers, contactors, or parts thereof are not acceptable.

D. Control Pad Cover. The ATS control display shall be covered with a stainless steel box that is hinged on one side to prevent the sun from deteriorating the display. The box shall be lockable and easily opened with the lock removed.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
   1. It shall be the Contractor's responsibility to ensure that the entire electrical equipment is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection.
   1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
      a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation.
   1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
      a. Separate sheet metal junction boxes, equipment enclosures, sheet metal raceways, etc., mounted on water or earth-bearing walls or wall-mounted outdoors ¼" from wall be corrosion resistant spacer.
      b. Seal the base of all outdoor switchgear, motor control center, and similar equipment with grout.
      c. Screen or seal with flexible sealing compound all openings into outdoor equipment to prevent the entrance of rodents, wasps, and mud-daubers.
      d. Electrical work shall conform to the construction schedule and progress of other trades.
      e. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
      f. Perform all work in accordance with manufacturer's instructions.
         i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
         ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
         iii) Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.

3.2 OPERATION AND TRAINING

A. Step-by-step detailed instructions shall be furnished by the ATS supplier for the operation of the transfer switch. A minimum of 2 hours of training on the operation and maintenance of the ATS shall be provided at the site at a time mutually agreeable to the owner's personnel and the manufacturer during normal business hours.

3.3 FIELD SUPERVISION AND TESTS

A. The Contractor shall furnish the services of a competent manufacturer's technical representative to check the installation, make all necessary adjustments, and in the presence of the Owner's representative, test the transfer switch to determine whether the equipment conforms to specified requirements and properly controls the engine generator.

END OF SECTION

SECTION 16480

MOTOR CONTROL CENTERS AND CONTROL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing of motor control centers (MCC) and all associated equipment.

1.2 SUMBMITTALS

A. Submittals shall be required as noted in section 16900.

1.3 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by a qualified system supplier who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The Contractor's intended instrumentation supplier shall meet the following qualifications.
      a. The supplier shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
      b. The supplier shall have the physical plant and fabricating personnel to complete the work specified. The supplier's fabrication capabilities and arrangements shall be acceptable to the Engineer.
      c. The supplier shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
      d. The supplier shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.
   2. Coordination
      a. All equipment provided under this section shall comply with the requirements of the general project requirements (Materials and Equipment – SECTION 01600), section 16050, section 16150, and section 16900 of these specifications.

1.4 WARRANTY

A. The supplier shall warrant the hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Equipment and materials used shall be subject to review and shall comply with the following requirements. All new MCCs for this project shall be the product of one manufacturer. Different manufacturers for the different new MCCs shall not be allowed.

B. Acceptable Manufacturers
   1. Approved manufacturer for the MCCs shall be:
      a. Square D Series 6.
      b. Cutler-Hammer Series 2100 Freedom Style.
      c. Allen Bradley Series 2100
      d. Without exceptions.
   2. Existing MCC-1 is: Westinghouse Five Star Motor Control Center, G.O. DN-52662-FVC, 460V 3PH, 3W, 60HZ, Horizontal Bus 1000A, Section 1-5-300A, Section 6-1000A, Neutral 500A, Main HNCG BKR 900A.

C. MCC physical size
   1. The MCC shall be designed and constructed to fit the allotted space in the electrical room.

2.2 MATERIALS AND EQUIPMENT

A. MCC
   1. The MCCs shall be rated for the following service conditions unless otherwise indicated on the drawings:
      a. 480 VAC, 3 phase, 4 wire, w/ neutral bus, 60 hertz
      b. Main horizontal bus ratings as indicated on drawings
      c. Minimum vertical bus ratings of 300A
      d. Short circuit withstand rating as noted on the drawings
      e. Provide main horizontal bus in all sections
      f. Provide full length vertical bus in all sections with horizontal bussing
      g. Bussing shall be tin-coated copper
      h. A continuous copper ground bus shall be provided
   2. Construction
      a. The MCC shall be constructed to the following service conditions unless otherwise indicated on the drawings:
         i) NEMA Class II, Type B
         ii) NEMA 1 gasketed, free standing
         iii) Nominally 90 inch tall, 20 inch wide, and 20 inch deep sections
         iv) All iron and steel surfaces shall be shop painted with the manufacturer's standard coating
   3. Combination Starters
      a. The combination full voltage starters in the MCC shall be provided with the following:
         i) A motor circuit protector type circuit breaker
         ii) Full size NEMA rated contactors with a minimum size of 1. IEC type starters will not be permitted
         iii) Plug in type buckets for the starters

iv) Operating handle clearly marked whether circuit breaker is ON, OFF or TRIPPED
v) Means to lock each circuit breaker in the OFF position with up to three padlocks
vi) Interlocked door so circuit breaker must be in the OFF position for door to open
vii) Provide an interlock defeat capability for use by authorized personnel
viii) Overloads:
a) Ambient compensated, external manually resettable solid state type overload relays.
b) Size to be coordinated with the actual motor full load current.
c) Overloads to include phase loss protection.
ix) Provide each starter with two NO and NC auxiliary contacts
x) Provide each starter with a control power transformer for 120VAC control power

4. Circuit Breakers
   a. MCC disconnects shall be three pole, single throw 600 volt molded case air circuit breakers. Main and feeder circuit breakers shall be thermal-magnetic type only. These breakers shall be manually operated with quick-make, quick-break, trip-free toggle mechanisms. Where a compartment contains a breaker only, the access door of the compartment shall be interlocked with the circuit breaker so that the door cannot be opened with the breaker in the closed position. An interlock override shall permit the door to be opened with the breaker in the closed position
5. Surge Protective Device (SPD)
   a. TVSS units shall be provided as indicated on the drawings. TVSS units shall comply with the requirements of section 16050.
6. Variable Frequency Drives (VFD)
   a. VFDs shall be provided as indicated on the drawings. VFDs shall comply with the requirements of section 16150.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
   1. It shall be the SYSTEM SUPPLIER'S responsibility to ensure that the entire MCC is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection.
   1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
      a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation.
   1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
      a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
      b. Perform all work in accordance with manufacturer's instructions.
         i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
         ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.

D. Adjustment and Cleaning
   1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
   2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

E. Wiring and Miscellaneous Devices
   1. All internal control wiring and all devices shall comply with the requirements of specification section 16900.

3.2 CUSTOMER TRAINING

A. The supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training sessions shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of a 4-hour training session, and the schedule shall be arranged and coordinated with the Engineer.

END OF SECTION

SECTION 16900

INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing and installation of metering and control equipment which shall include the following principal items:
   1. Metering and Control Systems. Principal components of the metering and control systems shall be as listed on the "Instrument List" at the end of this section and shall include the PLC system as is shown on the Drawings.
   2. Miscellaneous. One lot of test equipment, spare parts, and miscellaneous devices as set forth herein. Supplementing this section, the drawings indicate locations and arrangement of panels and instruments, and provide functional diagrams and schematics regarding connection and interaction with other equipment.

B. Related Sections
   1. Section 01600 – Materials and Equipment
   2. Section 16050 – Electrical
   3. Section 16150 – Variable Frequency Drives

1.2 REFERENCES

A. Codes & Permits
   1. All work and materials shall comply with the National Electrical Code, the National Electrical Safety Code, and applicable local regulations and ordinances. All panels shall be listed by Underwriters Laboratories or other testing organizations acceptable to the governing authority. The Contractor shall, at his own expense, arrange for and obtain all necessary permits, inspections, and approval by the proper authorities in local jurisdiction of such work.

1.3 SUBMITTALS

A. Complete fabrication, assembly, and installation drawings: wiring and schematic diagrams: and details, specifications, and data covering the materials used and the parts, devices, and accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. Submittal data shall be grouped and submitted in two separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Instrument tag numbers indicated on the contract drawings shall be referenced where applicable. Submittal data for multifunctional instruments shall include complete descriptions of the intended functions and configurations of the instruments.
   1. First-stage Submittal. The first-stage submittal shall include the following items.
      a. Product catalog cut sheets clearly marked to show the applicable model number, operational features, and intended service of the device.

b. A detailed list of any exceptions, functional differences, or discrepancies between the Supplier's proposed system and the contract requirements.
c. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall include overall dimensions, metal thickness, door swing, mounting details, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.
d. System wiring and installation drawings for all interconnecting wiring between components of the systems furnished and for all interconnecting wiring between the related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections.
e. If panel terminal designations, interdevice connections, device features and options, or other features are modified as a result of the fabrication process or factory testing, revised drawings shall be resubmitted.
f. A total of seven (7) copies for the submittal shall be provided.

2. Second-stage Submittal. Complete system documentation, in the form of operation and maintenance manuals, shall be provided. Manuals shall include complete product instruction books for each item of equipment furnished.
   a. Where instruction booklets cover more than one specific model or range of instrument, product data sheets shall be included which indicate the instrument model number, calibrated range, and all other special features. A complete set of "as-built" wiring, fabrication, and interconnection drawings, calibration and startup sheets shall be included with the manuals.
   b. A copy of all final O&M manuals shall be provided in PDF format in a CD-ROM or DVD. All AutoCAD drawings shall be provided in PDF and DWG formats.
   c. A total of five (5) printed copies, and ten (10) softcopies of final O&M manuals shall be provided.

1.4 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by a qualified system integrator (Integrator) who is regularly engaged in the business of designing and building instrument and control systems for water and wastewater projects. The Contractor's intended Integrator shall meet the following qualifications.
      a. The Integrator shall have and shall maintain a qualified technical staff and design office. The qualifications and experience of key project personnel shall be acceptable to the Engineer.
      b. The Integrator shall have the physical plant and fabricating personnel to complete the work specified. The Integrator's fabrication capabilities and arrangements shall be acceptable to the Engineer.
      c. The Integrator shall employ competent service personnel to service the equipment furnished. The geographic location of service personnel for this project shall be acceptable to the Engineer.
      d. The Integrator shall provide a "Statement of Qualifications" indicating that they have successfully provided similar work for at least 5 years.

B. Coordination.
   1. Instrument and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All instruments and control devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufactured and the manufacturer of related equipment.
   2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
   3. The Integrator shall provide coordination with other contractors and supervision of installation as required during construction.
   4. Coordination shall be provided between the Integrator and the process system supplier.
   5. Instrument and control systems shall be designed and coordinated for proper operation with other sections of these specifications. These shall include but not be limited to Materials and Equipment – Section 01600, Electrical – Section 16050, Variable Frequency Drives – Section 16150, and Programmable Logic Controllers – Section 16950.

1.5 WARRANTY

A. All suppliers shall warrant their hardware for a period of one year from the date of system acceptance.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Power and Instrument Signals. Unless specified otherwise, electrical power supply to the instrumentation equipment will be unregulated 120 VAC at the locations noted on the one-line and functional diagrams. All transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.
   2. Metering Accuracy. System metering accuracy, as compared to the actual process value, shall be determined from the value read at the principal readout device such as the recorder or totalizer. System requirements shall not preclude any requirements specified herein for individual devices.
      a. For systems where the primary measuring device, transmitter, and receiver are furnished under this section, the accuracies shall be within the following limits:
         i) Level: 1.0% percent of measured span.

ii) Flow Rate: magnetic or transit time ultrasonic metering: 1.5 percent of full scale between 1.0 and 100 percent of scale.

3. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation requirements shall be furnished and installed as required for proper performance of the equipment.
4. Interchangeability and Appearance. Instruments used for the same types of functions and services shall be of the same brand and model line insofar as possible. Similar components of different instruments shall be from the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished. Recorders, process indicators, control stations, and similar panel-mounted instruments shall be of the same style and shall be products of the same major instrument manufacturer.
5. Programming Devices. A programming or system configuring device shall be provided for systems that contain any equipment which required such a device for routine calibration, maintenance, and troubleshooting. The programming device shall be complete and in like-new condition and shall be turned over to the Owner at completion of the startup.
6. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the instrument device schedules and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanels, and rack-mounted devices shall have laminated plastic identification tags securely fastened to the device. Hand lettered labels or tape labels will not be acceptable.
7. Special Tools and Accessories. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2.2 PANEL FABRICATION

A. General Fabrication Requirements. All panels furnished hereunder shall conform to the requirements of NEMA ICS-6-1988. The following paragraphs describe general fabrication requirements for the instrument panels, consoles, enclosures, and subpanels:
   1. Wiring.
      a. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded tinned copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90°C.
      b. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 VAC. Surge protectors shall be of a non-faulting and non-interrupting design, with a response time of not more than 5 nanoseconds. Surge protectors shall be Cutler Hammer AEGIS Powerline Filters, or equal.
      c. Panels that are over 15 cubic feet in total volume shall have panel lighting above each door of the panel.
      d. Power distribution wiring on the line side of the panel's protective devices shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 16

AWG. Wiring for control circuits shall be minimum 16 AWG. Electronic analog circuits shall be 18 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color coding legend on the system supplier's panel wiring diagrams.

e. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with a marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 20% percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fused or circuit breakers shall be clearly labeled and located for easy maintenance. Terminal block shall be Phoenix Contact UT 4-MTD series.

f. All wiring shall be grouped and firmly supported inside the panel. Wiring shall be routed in nonmetallic slotted wire duct or similar. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables. Wire duct shall be Thomas & Betts Ty Duct or approved equal.

g. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams.

h. All analog input signals coming from external from the building where the panel is located shall have surge protection.

i. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.

j. All wires in the panel shall be identified at both ends of the wire. These labels shall agree with the labels shown on the wiring diagrams. The wire labels shall be of the heat-shrink tube type of wire marker as manufactured by Brady thermal labels.

k. All instruments that require 120vac power that have the signal from the instrument going to a panel, shall be provided 120vac from that panel. The 120vac circuit to these instruments shall be individually fused.

2. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends, as indicated on the drawings, letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified herein under the Device Tag Numbering System paragraph.

3. Painting. Interior and exterior surfaces of all panels shall be thoroughly cleaned and painted with rust-inhibitive primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the

manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils.

4. Factory test. Panels shall be factory tested electrically by the panel fabricator before shipment.

2.3 METERING & CONTROL SYSTEMS

A. Principal components for the metering and control systems are indicted on the "Instrument List" at the end of this specification.

2.4 MATERIALS & EQUIPMENT

A. Panel Front-Mounted Devices

1. SELECTOR SWITCHES. Selector switches shall be a minimum 30 mm, heavy-duty, oil-tight type with gloved-hand or wing lever operators. Position legends shall be engraved on the switch faceplate. Switches for electric circuits shall have silver butting or sliding contacts, rated 10 amperes continuous at 120 volts ac. Contact configuration shall be as indicated on the drawings or as required for the application. Switches used in electronic signal circuits shall have contacts suitable for that duty. Switches shall be Cutler-Hammer "Series 10250T", Square D "Class 9001", or approved equal.
2. INDICATING LIGHTS. Indicating lights shall be a minimum 30 mm, heavy-duty, oil-tight type, Push-to-Test, which uses a low voltage lamp. A built-in transformer shall be used for AC service. Legends shall be engraved on the lens or on a legend faceplate. Lamps shall be easily replaceable from the front of the indicating light. Indicating lights shall be Cutler-Hammer "Series 10250T", Square D "Class 9001", or approved equal.
3. PUSH BUTTONS. Push buttons shall be a minimum 30 mm, heavy-duty, oil-tight type. Legends shall be engraved on push button faceplate. Contacts shall be rated 10 amperes continuous at 120 VAC. Push buttons shall be Cutler-Hammer "Series 10250T", Square D "Class 9001", or approved equal.
4. TOTALIZERS. Totalizers shall have miniature, rectangular, semi-flush counters, designed for use in conjunction with miniature indicators and recorders, and shall be of such a design that only the counter is flush-mounted and the associated integrating mechanism is located in the rear of the panel. The counter shall contain not less than seven digits; with a multiplier of a power of 10 plainly engrave on the face of the counter, or on a nameplate below the counter, so that a full range of 9,999,999 is reached before repeating. Totalizers actuated by DC powered coils shall be equipped with a reverse voltage protection device. Totalizers shall not reset upon power failure. Totalizers shall be as manufactured by Red Lion CUB7T series or Action Instruments.
5. RUN TIME METERS. Run time meters shall have miniature, rectangular, semi-flush counters. The counter shall contain not less than seven digits, with a nameplate plainly engraved on the face of the counter, or below the counter identifying it as a run time meter. Run time meters shall not reset upon power failure. Run time meters shall be as manufactured by Red Lion "CUB7" series or Action Instruments.
6. DIGITAL PANEL DISPLAYS. Digital panel displays shall be designed for semi-flush mounting in a panel. The display shall be a 3-1/2 digit LED or gas-discharged

type, with digit height of not less than 0.5 inch. The display shall be easily read at a distance of 10 feet in varying control room lighting environments. Operating temperature range shall be 0 to 40 C. Accuracy shall be plus or minus 0.1 percent. The display shall be scaled in engineering units, with the units engraved on the display face or on the associated nameplate. The display shall have selectable decimal point and shall provide red indication. Digital displays shall be as manufactured by Red Lion "PAXP" series or Action Instruments.

B. Panel Interior-Mounted Devices
   1. POWER SUPPLIES. Regulated DC power supplies for instrument loops shall be provided as needed. Power supplies shall be suitable for input voltage variation of plus or minus 10 percent. The DC power supplies shall be Idec "PS5R Slim line", or Phoenix Contact "UNO".
   2. RELAYS. Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL listed. Relays shall have a minimum rating of 10 amperes at 120 VAC. Time-delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of +/- 2.0 percent of setting. Latching and special purpose relays shall be as required for the specific application. Relays shall have a light to indicate when coil is energized. Relays shall be Idec "RH or RTE Series" or approved equal.
   3. ELECTRONCI SIGNAL BOOSTERS AND ISOLATORS. Electronic Signal Boosters and Isolators shall have all solid-state circuitry and complete electrical isolation between the power supply and the input and output signals. Accuracy shall be +/-0.15 percent of span. Isolators shall be manufactured by Acromag, Moore, or Phoenix Contact.

C. Flow Instrumentation
   1. Magnetic Flow Meters
      a. The Magnetic Flow Meter shall be a completely obstructionless, in-line flow meter with no constrictions in the flow of fluid through the meter. The meter shall consist of a metallic tube with flanged ends and with grounding rings. Flange diameter and bolt drilling pattern shall comply with ANSI/ASME B16.5, Class 150. Meters shall be suitable for the maximum range of working pressures of the adjacent piping. Electrode materials shall be fully compatible with the process fluid and shall comply with the requirements specified in the instrument device schedules. Each meter shall be factory calibrated, and a copy of the calibration report shall be submitted as part of the operation and maintenance manual submittal.
      b. The meter shall be capable of standing empty for extended periods of time without damage to any components. The meter housing shall be of a splash-proof and drip-proof design
      c. Power supply to the meter shall be 120 VAC, 60 Hz, single phase.
      d. Meters shall be Rosemount Type 8750W or approved equal.

   2. Magnetic Flow Meter Signal Converters
      a. Magnetic Flow Meter Signal Converters shall be separately mounted, microprocessor-based signal converters. They shall be provided for the magnetic

flow meters. The signal converters shall include output dampening, self-testing, integral digital indicator, built-in calibration capability, and an "empty pipe zero" contact input. The overall accuracy of the magnetic flow meter transmitter and signal converter shall be +/-1.0 percent of actual flow rate for full-scale settings of 0.3 to 30 fps. The signal cable between the converter and the magnetic flow meter shall be furnished by the meter manufacturer. The signal converter shall be housed in NEMA Type 12 housing and shall be suitable for operation over an ambient temperature range of -30° to +140°F, and relative humidity of 10 to 100 percent. The converter shall have an analog output of 4-20 mA DC.

b. The signal converter shall have a seven-digit, non-reset totalizer on the face of the enclosure. Local electronic indicators shall be provided. Indicators shall be mounted on or near the flow meter signal converters in weatherproof NEMA Type 4 housings. Indicators shall be four-digit LCD type and shall read in engineering units.

3. Open Channel Ultrasonic Flowmeters
   a. Each ultrasonic flowmeter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical- and corrosion-resistant material such as keener or CPVC, and shall be suitable for operation over a temperature range of -20 to +150° F and a relative humidity of 10 to 100 percent. The sensor shall be compatible with the process media being measured. The sensor shall be an explosion-proof design suitable for use in all hazardous areas. Sensors mounted in areas subject to freezing shall be provide with special transducers or protected against icing by heaters. Sensors mounted in direct sunlight shall be provided with sunshades.
   b. The supplier shall furnish drawings complete with dimensions and elevations for the sensor mounting.
   c. The ultrasonic flowmeter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 0.5 inch. The transmitter shall be designed to ignore momentary level spikes or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The transmitter output shall be an isolated 4-20 mA DC signal linearly proportional to the measured level range. Where specified, the output shall be characterized to be proportional to the tank volume instead of to the tank level. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be +/-0.5 percent of the flow range.
   d. The transmitter shall contain a minimum of three (3) independently adjustable alarm contact outputs. Contacts shall be single-pole, double-throw, rated not less than 5 amperes at 120 VAC.
   e. A sufficient length of sensor-to-transmitter signal cable shall be furnished with the instrument to locate the sensor 25 to 200 feet from the signal converter. The signal converter electronics shall be housed in a NEMA Type 12 enclosure suitable for wall mounting and for operating temperatures of -15 to +125°F and a

relative humidity of 10 to 100 percent. The signal converter shall be powered from 120 VAC, 60 Hz. The ultrasonic flowmeter shall be Siemens "HydroRanger 200" or approved equal.

f. The transducer shall be Siemens "XRS-5", or equal.

4. Thermal Air Flow Meter
   a. Each flow meter shall utilize a thermal dispersion type stainless steel sensing element installed in the process piping. The element insertion length shall be approximately one-half the pipe diameter with all mounting accessories provided. The element shall be installed through a full port ball valve with an isolation valve to permit removal while the air line is in service.
   b. The electronic transmitter shall be integral to the sensing element. The electronics assembly shall convert the temperature resistance difference to an air flow value with a maximum error of two percent of calibrated range. The electronics assembly shall include an alphanumeric display with a backlit LCD flow indicator calibrated in the process engineering units.
   c. The electronics shall be housed in a NEMA 4X enclosure.
   d. The electronics shall provide a 4-20mA signal output that shall be linear to the scaled air flow.
   e. The flow meter shall be Fluid Components Model "ST50."
5. Pressure and Level Instrumentation
   a. Pressure and Pressure Sensing Level Transmitters.
      i) Transmitters used to measure process pressure, or inferred level from process pressure such as a bubbler system or other source, shall have all solid-state electronic circuitry and shall be of the two-wire type which requires no direct power connection to the transmitter. Transmitters shall have self-diagnostics and electronically adjustable span, zero, and damping. Transmitters shall be enclosed in a NEMA Type 4X housing and shall be suitable for operation at temperatures from 0 to 180 F. All transmitter parts shall be of a corrosion-resistant material. Vents shall be provided on the sides of the diaphragm housing body. Transmitter shall have over-range protection to maximum process line pressure. Accuracy shall be plus or minus 0.5 percent of calibrated span, with repeatability of 0.1 percent. Transmitter output shall be 4-20mA dc without the need for external load adjustments and shall have an elevated or suppressed zero as required by the application. Transmitters shall be furnished with integral indicators with 0-100 percent linear scales.
      ii) Differential type transmitters shall be used if required to meet the input range, elevation, or suppression requirements.
      iii) Each transmitter shall be provided with a process shutoff valve and a bracket for mounting as required. Transmitters shall be factory calibrated to the required range. Transmitters shall be Rosemount "Model 2088" or approved equal.
   b. Hydrostatic Level Transducers
      i) Each transducer shall be a hydrostatic pressure sensor for level measurement of fresh water and wastewater applications. The sensor shall be a permanently sealed submersible probe and cable combination. The transducer shall be a of the two-wire type which requires no direct power connection to the transducer. Transducer output shall be 4-20mA DC. The transducer shall be capable of the ranges and pressures for which the application will require. The

sensor shall be mounted as shown on drawings or as required for application. The transducer shall be an Endress-Hauser "WaterpilotFMX21", GE Sensing (Druck) "PDCR/PTX- 1730", or approved equal.

c. Ultrasonic Level Transmitters

i) Each ultrasonic level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical- and corrosion-resistant material such as keener or CPVC, and shall be suitable for operation over a temperature range of -20 to +150^{0}F and a relative humidity of 10 to 100 percent. The sensor shall be compatible with the process media being measured. The sensor shall be an explosion-proof design suitable for use in all hazardous areas. Sensors mounted in areas subject to freezing shall be provide with special transducers or protected against icing by heaters. Sensors mounted in direct sunlight shall be provided with sunshades.

ii) The supplier shall furnish drawings complete with dimensions and elevations for the sensor mounting.

iii) The ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 0.5 inch. The transmitter shall be designed to ignore momentary level spikes or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The transmitter output shall be an isolated 4-20 mA dc signal linearly proportional to the measured level range. Where specified, the output shall be characterized to be proportional to the tank volume instead of to the tank level. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be +/-0.5 percent of the level range.

iv) The transmitter shall contain four independently adjustable level alarm contact outputs. Contacts shall be single-pole, double-throw, rated not less than 5 amperes at 120 volts ac.

v) A sufficient length of sensor-to-transmitter signal cable shall be furnished with the instrument to locate the sensor 25 to 200 feet from the signal converter. The signal converter electronics shall be housed in a NEMA Type 12 enclosure suitable for wall mounting and for operating temperatures of -15 to +125^{0}F and a relative humidity of 10 to 100 percent. The signal converter shall be powered from 120 volts ac, 60 Hz. The ultrasonic level transmitter shall be Siemens "Multiranger", Endress Hauser, or approved equal.

d. Radar Level Transmitters

i) Each radar level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical- and corrosion-resistant material such as keener, PVDF or CPVC, and shall be suitable for operation over a temperature range of -40 to +140^{0}F and a relative humidity of 10 to 100 percent. The sensor shall be compatible with the

process media being measured. Sensors mounted in areas subject to freezing shall be provide with special transducers or protected against icing by heaters. Sensors mounted in direct sunlight shall be provided with sunshades.

ii) The supplier shall furnish drawings complete with dimensions and elevations for the sensor mounting.

iii) The radar level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter output shall be an isolated 4-20 mA dc signal linearly proportional to the measured level range. Where specified, the output shall be characterized to be proportional to the tank volume instead of to the tank level. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be +/-0.5 percent of the level range.

iv) A sufficient length of sensor-to-transmitter signal cable shall be furnished with the instrument to reach PLC, up to 300 ft. The radar level transmitter shall be Endress Hauser Micropilot FMR10 or FMR20 or approved equal. Contractor responsible for providing correct transmitter based on distances required for measurement. Contractor responsible for provided proper length of transmitter cabling.

e. Weighted Float Level Switches

i) Each level switch shall consist of a single-pole, double-throw switch, rated not less than 3 amperes AC, sealed and housed in a chemical-resistant polypropylene casing. The switch assembly shall be weighted and suspended on its own cable. The flexible support cable shall be waterproof, three-conductor, synthetic covered cable with 18AWG conductors, and shall be of sufficient length so that no splice or junction box is required in the wetwell. Switches shall be suitable for operation up to 150 volts within an ambient temperature range of 0° to 60° C. Switches shall be suitable for use in a sanitary or wastewater wetwell environment. Installation hardware shall be provided as shown on the drawings or as necessary for application. Switches shall be Flygt "Type EMN-10", Siemens Water Technologies "Model 9G-EF", or approved equal.

f. Pressure Switches

i) Pressure switches shall be field adjustable and shall have a trip point repeatability of better than 1 percent of actual pressure. Contact rating shall be 10 amperes at 120 volts ac.

ii) Switches shall have over-range protection to maximum process line pressure. Switches shall have NEMA type 4X housings.

iii) Switches shall be as manufactured by Ashcroft, Mercoid, United Electric, or equal.

g. Conductance Relay Level Switch

i) Each level switch shall consist of a single-pole, double-throw relay with contacts rated not less than 5 amperes ac at 120 VAC. The relay primary power shall be 120 VAC. The electrodes shall be flexible wire suspension type with shielded stainless steel electrode tips. The electrode holder shall be the manufacturer's standard holder appropriate for the application. Electrodes

and conductance relay shall be as manufactured by Gems Sensors (B/W Controls) or Ametek (Warrick Controls), or approved equal.

h. Combination Pressure Gauges
   i) Combination pressure gauges shall have a built-in pressure snubber and 4-1/2 inch minimum diameter faces and be turret style, black phenolic case with clear glass face. The movement shall be rotary, of 400 Series stainless steel with teflon coated pinion gear and segment. The gauge shall be bottom connected and accept a 1/4" NPT female thread. Combination pressure gauge range and scale graduations shall be in psi and feet of water as follows:
   ii) Pressure - 0 to 50 psi, 5 psi figure intervals, with graduating marks every 1/2 psi (0-115 feet).
   iii) Gauges will be direct mounted or panel mounted as required. Panel mounted gauges shall be off the piping and be flexible connected to their respective sensing point. The gauge trim tubing shall be complete with both isolating and vent valves and the tubing shall be so arranged as to easily vent air and facilitate gauge removal. Gauges mounted directly to the pipeline or at the sensing point will not be accepted. Gauges shall be Ashcroft "Duragauge Plus model 1279XLL" or approved equal.

6. Analytical Instruments
   a. Chlorine Residual Analyzer
      i) The analyzer shall be micro-processor based unit to provide a 4-20mA signal. The micro-processor shall provide self-diagnostic functions accessible through an alphanumeric, menu-driven keyboard. The analyzer shall be powered by 120 vac power source. The unit shall be based on the DPD colorimetric method of measurement using DPD indicator and a buffer solution. Analyzer shall operate with a continuous sample flow through the analyzer sample cell to drain. The analyzer shall measure free or total chlorine up to 5mg/L with an accuracy of +/-5%. Analyzer shall be provided with all parts and accessories for a complete and operational system. This shall include at a minimum, pressure reducing valve, shutoff valve, and all tubing and fittings. Analyzer shall be a Hach Model CL17 and no equal.
      ii) The analyzer shall be provided with a minimum of one-year's supply of reagents.
   b. Low Range Turbidity Analyzer
      i) Analyzer shall operate with a continuous sample flow through the analyzer sample cell to drain. A stable lazer light that utilizes 360° x 90° detection technology for optimal measurements.
      ii) The sample cell shall utilize a lamp which operates below rated voltage to extend operating life and a silicon photocell which detects the reflected light intensity.
      iii) Sample flow rate shall be approximately 0.2 gpm. The sample cell shall be constructed of all corrosion-resistant materials and shall have an integral bubble trap. The sample cell shall be standardized by inserting a glass reflectance rod or calibration cube into the cell directly in front of the light path. Standard reflectance rods or calibration cubes shall be furnished with the analyzer. One calibration cube shall be provided for each 10 analyzers.
      iv) The analyzer shall have a master indicator mounted near the sample cell and connected to the sample cell with a special cable. The unit shall have an auto-

ranging 6-digit display which indicates turbidity in nephelometric turbidity units from 0.001 to 100.0. The master indicator shall be housed in a NEMA type 4 moisture-resistant enclosure and shall be powered from 120 volts ac.

v) The master indicator shall have a linear 4-20mA dc output signal which corresponds to the preselected turbidity range.

vi) Each controller shall be capable of monitoring 2 analyzers and providing an individual 4-20mA signal to the PLC for each analyzer.

vii) The turbidity analyzer shall be Hach "TU5300". The turbidity with an SC-200 controller. Units shall be provided with all appurtenances as needed for the application in order to provide a complete system.

c. Dissolved Oxygen Analyzer

i) The dissolved oxygen probe shall be micro-processor based unit to provide a 4-20mA signal. The micro-processor shall provide self-diagnostic functions accessible through an alphanumeric, menu-driven keyboard. The analyzer shall be powered by 120 vac power source. The unit provide 0-2-ppm, 0-20.0 mg/L, or 0-200% air saturation. Analyzer shall operate with an accuracy of +/-0.05 ppm below 1 ppm, +/-0.1 ppm below 5 ppm, and +/-0.2 ppm above 5 ppm. Analyzer shall be provided with all parts and accessories for a complete and operational system. This shall include at a minimum, transmitter, probe and the pole mounting kit. Analyzer transmitter shall be a Hach "SC200" and the probe shall be "Model 2" or approved equal.

7. Miscellaneous Instrumentation.

a. Limit Switch

i) The limit switch shall be of the lever operated limit switch type and shall be enclosed in a NEMA 4 housing. The switch shall be furnished with one NO and one NC contacts and screw type wiring terminal. The switch shall be heavy duty, oil tight type. Limit switches shall be Square D model "9007C54B2" with adjustable type roller lever arm "9007HA1" or approved equal.

b. Magnetic Door Switch

i) The magnetic door switch shall be a two piece switch rated 100V ac/dc. Switch shall be Edwards 60 Series or approved equal.

c. Temperature Switch

i) Temperature switches shall be constructed with an all metal case. Switches shall have contacts rated 10A at 120VAC. Switches shall be Dayton Model 2E206 or approved equal.

d. Intruder Detection System

i) The intruder detection system shall include motion detectors and access keypads equivalent to systems at the owner's other sites. Any deviation from other sites shall be approved by owner prior to procurement and install.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
   1. The instrumentation equipment shall be installed by the Contractor or his subcontractors in accordance with the manufacturers' instructions. The services of the system Supplier's technical representative shall be provided as necessary to calibrate, test, and advise others of procedures for adjustment and operation.

B. Inspection.
   1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
      a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation.
   1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.
      a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
      b. Perform all work in accordance with manufacturer's instructions.
         i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
         ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.
      c. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.
      d. Field Piping. Field piping materials and installation shall conform to the requirements of the miscellaneous piping section.
      e. Field-Mounted Instruments. Instruments shall be mounted so they may be easily read and serviced and all appurtenant devices are easily operated. Installation details for some instruments are indicated on the drawings. Unless otherwise indicated on the drawings, instruments which include local indicators shall be mounted approximately 5 feet above the floor and shall be oriented for ease of viewing. Transmitters shall be mounted on corrosion-resistant pipe supports suitable for floor, wall, or bracket mounting.

D. Field Calibration. A technical representative of the system supplier shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final tuning adjustment settings. The adjustment of each calibrated instrument shall be sealed or marked, insofar as possible, to discourage tampering. Instruments shall be calibrated before checkout of the operation of the system.

E. Systems Check. A technical representative of the system supplier shall participate in the checkout of metering and control systems. If interrelated devices furnished by other suppliers, such as valve actuators, motor controls, chemical feeders, or primary measuring devices, do not perform properly when placed in service, the technical representative shall use suitable test equipment to introduce simulated signals to verify or

measure signals from such devices as required to locate the source of trouble or malfunction. A written report stating the results of such tests shall be furnished, if requested by the Engineer, to assign responsibility for corrective measures.

1. Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by the Contractor for the duration of the testing work. Unless specified otherwise, test equipment will remain the property of the Contractor or the system Supplier.

F. Adjustment and Cleaning

1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

3.2 CUSTOMER TRAINING

A. The coordinating supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training session shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of one 4-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 INSTRUMENT LIST

Idaho Springs WWTF Upgrade Project #1
Instrument List
(This list does not include instruments provided by the packaged systems)
Preliminary

Tag #	Description	Service	Scale	Provided Under Specification
LSH-100	Influent Channel Level Switch	Weighted Float Level Switch		16900
FE/FIT-100	Pre-Equalization Influent Flow	Open Channel Ultrasonic Flowmeters	CUT THROAT FLUME	16900
LSLL-201	Pre-Equalization LowLow Level Switch	Weighted Float Level Switch		16900
LSL-201	Pre-Equalization Low Level Switch	Weighted Float Level Switch		16900
LSH-201	Pre-Equalization High Level Switch	Weighted Float Level Switch		16900
LSHH-201	Pre-Equalization High High Level Switch	Weighted Float Level Switch		16900
AI-200	Pre-Equalization Dissolved Oxygen	Dissolved Oxygen Analyzer		16900
LE/LIT-200	Pre-Equalization Tank Level	Radar Level Transmitter		16900
LSLL-202	Wet Well LowLow Level Switch	Weighted Float Level Switch		16900
LSL-202	Wet Well Low Level Switch	Weighted Float Level Switch		16900
LSH-202	Wet Well High Level Switch	Weighted Float Level Switch		16900
LSHH-202	Wet Well High High Level Switch	Weighted Float Level Switch		16900

FE/FIT-204	EQ Pump Flow Meter	Magnetic Flow Meter		16900
LE/LIT-501	Digester Tank 1 Level	Radar Level Transmitter		16900
LSL-501	Digester Tank 1 Low Level	Weighted Float Level Switch		16900
LSH-501	Digester Tank 1 High Level	Weighted Float Level Switch		16900
LE/LIT-502	Digester Tank 2 Level	Radar Level Transmitter		16900
LSL-502	Digester Tank 2 Low Level	Weighted Float Level Switch		16900
LSH-502	Digester Tank 2 High Level	Weighted Float Level Switch		16900

END OF SECTION

SECTION 16950

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes the items listed below and all other components necessary for a complete system as noted herein and indicated on the drawings
   1. Programmable Logic Controllers (PLCs)
   2. Communication equipment
   3. HMI software
   4. Programming
   5. Spare parts

B. Related Sections
   1. Section 01600 – Materials and Equipment
   2. Section 16050 – Electrical
   3. Section 16150 – Variable Frequency Drives
   4. Section 16900 – Instrumentation & Controls
   5. I/O list

1.2 REFERENCES

A. ISA 5.1 – Instrumentation Symbols and Identification

B. NEMA ICS 1 – General Requirements for Industrial Control and Systems

C. NEMA ICS 2 – Standards for Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts

D. DEMA ICS 3 – Industrial Control and Systems: Factory Built Assemblies

E. NEMA ICS 6 – Industrial Controls and Systems: Enclosures

1.3 DESIGN REQUIREMENTS

A. Discrete input/output signals shall all be 24VDC

B. Analog input/output signals shall all be 4-20mA

C. Analog signal isolators shall be independently powered units capable of driving two 4-20mA signals

D. All required buffers, isolators, signal converter, and amplifiers for coordination with other equipment furnished under other sections, and between items of equipment needed

for a complete system shall be furnished under this section of the specifications whether indicated on the Drawings or not or detailed in these specifications or not

1.4 SYSTEM DESCRIPTION

A. Equipment furnished and installed 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, unless exceptions are noted by Engineer.
   1. I/O List. An I/O list is attached at the end of this section

1.5 SUBMITTALS

A. Submittals shall be required as noted in Section 16900.

1.6 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The entire system shall be designed, coordinated, and supplied by the system integrator supplier.

B. Coordination
   1. The PLCs and PLC system shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications. All devices shall be applied in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the instrument or device manufacturer and the manufacturer of related equipment.
   2. Installation drawings shall be prepared for interconnecting wiring and piping between the related equipment and the equipment furnished under this section. All interconnecting wiring shall be appropriate for the service and shall result in a properly functioning system.
   3. The Contractor shall provide coordination with other contractors and supervision of installation as required during construction.

1.7 WARRANTY

A. The Supplier shall warrant the hardware, software, and configuration related to the operational performance of the facility for a period of two years from the date of system acceptance. The Supplier shall provide a two-year software service agreement to include any and all minor and/or major releases and upgrades, and shall correct any problems or "bugs" which prohibit the SCADA system from performing process operations in accordance with these specifications.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMNTS

A. All equipment furnished under this section shall be selected by the system supplier for its superior quality and intended performance. Unless indicated otherwise, all equipment and material shall be new, undamaged and meet the requirements of UL. Where UL requirements are not applicable, equipment and material shall be identified as such by the supplier and approved by the Engineer before purchase and installation. Equipment and materials used shall be subject to review and shall comply with the following requirements.
   1. Interchangeability. All PLC systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules shall be interchangeable among all I/O panels and systems.
   2. Installed I/O requirements. Each PLC shall have I/O modules installed to accommodate requirements shown on drawings and the I/O List at the end of this section and with a minimum of 20% spares installed.
   3. Acceptable Manufacturers.
      a. PLC - Allen Bradley Compactlogix series system and no equal.
      b. Exsiting PLC's include Main PLC-1 – SLC5/05 series and Remote PLC (PLC-2) Micrologix 1400, contractor is responsible for provided additional IO cards for existing PLC's as necessary.
   4. Modules shall be added as needed to provide for all the I/O required on the project plus the spares.
   5. All Analog signals shall be logged in the Historian Software
   6. Autodialer (WIN-911) alarms shall be selected and configured per the owner's requirements

2.2 MATERIALS AND EQUIPMENT

A. Programmable Logic Controller (PLC)
   1. The new PLC systems shall include, but are not limited to, the following components:
      a. Input/Output Modules
         i) Digital Input Modules
            a) Number of Inputs: 16
            b) Voltage Category: 120VAC
            c) Module shall be Allen Bradley 1769-IA16.
         ii) Digital Output Modules
            a) Number of Outputs: 16
            b) Voltage Category: 120VAC
            c) Module shall be Allen Bradley 1769-OA16.
         iii) Analog Input Modules
            a) Number of Inputs: 8
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley 1769-IF8.
         iv) Analog Output Modules
            a) Number of Inputs: 4
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley 1762-OF4CI.

2. The existing Main PLC is a SLC 5/05, shall include, but are not limited to, the following components:
    a. Input/Output Modules
        i) Digital Input Modules
            a) Number of Inputs: 16
            b) Voltage Category: 120VAC
            c) Module shall be Allen Bradley 1746-IA16.
        ii) Digital Output Modules
            a) Number of Outputs: 16
            b) Voltage Category: 120VAC
            c) Module shall be Allen Bradley 1746-OA16.
        iii) Analog Input Modules
            a) Number of Inputs: 8
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley 1746-NI8.
        iv) Analog Output Modules
            a) Number of Inputs: 4
            b) Signal Range: 4-20mA
            c) Module shall be Allen Bradley 1746-NO4I.
    b.

B. PLC Programming Software
    1. The PLC programming software shall be Allen Bradley Studio/RSLogix 5000, no equal. Existing PLC's will require RSLogix 500 for programming updates.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General Requirements
    1. It shall be the Supplier's responsibility to ensure that the entire PLC system and HMI system is installed in a satisfactory condition per these specifications and the manufacturer's requirements.

B. Inspection
    1. Inspect materials and equipment for signs of damage, deterioration or other deleterious effects of storage, transportation, handling, or defects in manufacture or assembly.
        a. Replace with identical new materials or equipment or repair to like new condition any materials or equipment showing such effects to the satisfaction of the Engineer and Owner.

C. Equipment Installation
    1. Handle, install, connect, clean, condition, align and adjust products and equipment in strict accordance with manufacturer's instructions and in conformity with specification requirements.

a. Maintain one complete set of manufacturer's installation instructions at the jobsite during installation and until installation is accepted by the Engineer and Owner.
b. Perform all work in accordance with manufacturer's instructions.
   i) Do not omit any preparatory step or installation procedure unless specifically modified or exempted by contract documents.
   ii) Should job conditions or specification requirements conflict with manufacturer's instructions, consult with Engineer prior to proceeding.

D. Adjustment and Cleaning
1. Perform all required adjustments, tests, operational checks, cleaning and other start-up activities required.
2. Take precautions, as necessary, to properly protect all equipment from damage. Installed equipment to be protected from further construction operations.

E. PLC and HMI Programming
1. The Contractor shall be responsible for all PLC and HMI programming. Programming modifications to Existing Main PLC (PLC-1) are required by systems integrator. Programming modifications to Existing Remote PLC (PLC-2) are required by systems integrator.
Digester & Headworks Remote IO panels to be programmed by systems integrator.
All HMI and alarming modifications and additions to be performed on Systems Integrator.

3.2 CUSTOMER TRAINING
1. The system supplier shall provide a qualified representative at the job site to train the Owner's personnel in operating and maintenance of the equipment. The training sessions shall include a technical explanation of the equipment and an actual hands-on demonstration. The training session shall consist of two consecutive 4-hour working days, and the schedule shall be arranged and coordinated with the Engineer.

3.3

I/O LIST IDAHO SPRINGS WWTP PROJECT #1
I/O List
Preliminary
(Only I/O points other than the packaged systems are shown here)
New – Headworks Remote IO Panel

Tag #	Description	DI	DO	AI	AO	Scale	Notes
LSH-100	Influent Channel High	x					
YL-103	Grit Classifier Run Status	x					
YA-103	Grit Classifier Fault Alarm	x					
YL-104	Grit Washer Run Status	x					
YA-104	Grit Washer Fault Alarm	x					
YS-104	Grit Washer HOA Auto Position	x					
YL-105	Grit Pump Run Status	x					
YA-105	Grit Pump Fault Alarm	x					
YS-105	Grit Pump HOA Auto Position	x					

YA-101	RAS-101 Auto Sampler Alarm	x					
YY-103	Grit Classifier Enabled		x				
YY-104	Grit Washer Enabled		x				
YY-105	Grit Pump Enabled		x				
FIT-100	Pre-Equalization Influent Flow			x			
SC-101	RAS-101 Flow Pacing				x		

Existing – Main PLC

Tag #	Description	DI	DO	AI	AO	Scale	Notes
LSHH-201	Pre-Equalization Tank HiHi Level Alarm	x					
LSH-201	Pre-Equalization Tank Hi Level Alarm	x					
LSL-201	Pre-Equalization Tank Lo Level Alarm	x					
LSLL-201	Pre-Equalization Tank LoLo Level Alarm	x					
LSHH-202	Wet Well HiHi Level Alarm	x					
LSH-202	Wet Well Hi Level Alarm	x					
LSL-202	Wet Well Lo Level Alarm	x					
LSLL-202	Wet Well LoLo Level Alarm	x					
YL-201	EQP-201 Run Status	x					
YA-201	EQP-201 Fault Alarm	x					
YH-201	EQP-201 HOA In Hand Position	x					
YS-201	EQP-201 HOA In Auto Position	x					
YL-202	EQP-202 Run Status	x					
YA-202	EQP-202 Fault Alarm	x					
YH-202	EQP-202 HOA In Hand Position	x					
YS-202	EQP-202 HOA In Auto Position	x					
YL-203	EQP-203 Run Status	x					
YA-203	EQP-203 Fault Alarm	x					
YH-203	EQP-203 HOA In Hand Position	x					
YS-203	EQP-203 HOA In Auto Position	x					
ZSC-204	SV-204 Close Indication	x					
ZSO-204	SV-204 Open Indication	x					
YY-201	EQP-201 Run Command		x				
YY-202	EQP-202 Run Command		x				
YY-203	EQP-203 Run Command		x				
CC-204	SV-204 Close Command		x				
CO-204	SV-204 Open Command		x				
AI-200	ORP – Disolve Oxygen Levels			x			
LIT-200	Pre-Equalization Tank Level			x			
FIT-204	Eq Pump Flow			x			

New - Digester PLC

Tag #	Description	DI	DO	AI	AO	Scale	Notes
YL-501	Solids Blower #1 Run Status	x					
YA-501	Solids Blower #1 Fault Alarm	x					
YH-501	Solids Blower #1 In Hand Position	x					
YS-501	Solids Blower #1 In Auto Position	x					
YL-502	Solids Blower #2 Run Status	x					
YA-502	Solids Blower #2 Fault Alarm	x					
YH-502	Solids Blower #2 In Hand Position	x					
YS-502	Solids Blower #2 In Auto Position	x					
LSH-501	Aerobic Digester #1 Hi Level Alarm	x					
LSL-501	Aerobic Digester #1 Lo Level Alarm	x					
LSH-502	Aerobic Digester #2 Hi Level Alarm	x					
LSL-502	Aerobic Digester #2 Lo Level Alarm	x					
YL-511	Dewatering Blower #1 Run Status	x					
YA-511	Dewatering Blower #1 Fault Alarm	x					
YH-511	Dewatering Blower #1 In Hand Position	x					
YS-511	Dewatering Blower #1 In Auto Position	x					
YL-512	Dewatering Blower #2 Run Status	x					
YA-512	Dewatering Blower #2 Fault Alarm	x					
YH-512	Dewatering Blower #2 In Hand Position	x					
YS-512	Dewatering Blower #2 In Auto Position	x					
YY-501	Solids Blower #1 Run Command		x				
YY-502	Solids Blower #2 Run Command		x				
YY-511	Dewatering Blower #1 Run Command		x				
YY-512	Dewatering Blower #2 Run Command		x				
SI-501	Solids Blower #1 Speed Indication			x			
SI-502	Solids Blower #2 Speed Indication			x			
LIT-501	Aerobic Digester #1 Level			x			
LIT-502	Aerobic Digester #2 Level			x			
SI-511	Dewatering Blower #1 Speed Indication			x			
SI-512	Dewatering Blower #2 Speed Indication			x			
SC-501	Solids Blower #1 Speed Command				x		
SC-502	Solids Blower #2 Speed Command				x		
SC-511	Dewatering Blower #1 Speed Command				x		
SC-512	Dewatering Blower #2 Speed Command				x		

END OF SECTION

SECTION 16951

CONTROL DESCRIPTIONS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes the items listed below and all other components necessary for a complete system as noted herein and indicated on the drawings
   1. General Programming Requirements
   2. PLC Programming
   3. HMI Programming

B. Related Sections
   1. Section 16900
   2. Section 16950
   3. I/O list

C. PLC programming services shall be provided by a single firm with sufficient experience to complete this scope of work.

D. HMI programming shall be completed by system integrator (SI) as outlined below. SI shall utilize existing Iconics Genesis 32. Screens shall contain information to be displayed for the following process areas:
   1. Headworks (1 screen)
   2. Decant Wetwell and Flow equalization (1 screen)
   3. Disinfection (1 screen)
   4. Digesters (1 screen)
   5. Navigation Menu (modify Xylem main navigation screen)

E. Scope of work shall also include, but is not limited to:
   1. Review of vendor supplied control panels for coordination with PLC and, OIT, and HMI programming.
   2. Develop and test new PLC program based on control descriptions provided in this specification section.
   3. Collect all Package System Tags to use in OIT's and HMI screens.
   4. Develop and test OIT and HMI screens and add new screens to the existing system.
   5. Loop test all PLC input and output points for proper operation. The electrical contractor will terminate I/O points based on control panel drawings.
   6. Verify new instrument setup and calibration.
   7. Verify Fiber and Ethernet communication between all PLCs, OIT's switchboard power meter.
   8. Provide training to Town of Idaho Springs personnel on new system.

1.2 REFERENCES

A. ISA 5.1 – Instrumentation Symbols and Identification

B. NEMA ICS 1 – General Requirements for Industrial Control and Systems

C. NEMA ICS 2 – Standards for Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated 600 Volts

1.3 SYSTEM DESCRIPTION

A. All the programming performed under this section shall be done in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the software manufacturer, unless exceptions are noted by engineer.

1.4 SUBMITTALS

A. Submittals shall be required as noted in section 16900.

1.5 QUALITY ASSURANCE

A. Supplier's qualifications
   1. The Package Systems shall be programmed to interface with new and existing systems.
   2. All network equipment required to complete a fully functional package system shall be provided by supplier.
   3. Programming and passwords for all PLC's and OIT's shall be provided to the Town of Idaho Springs with-in Two (2) weeks of substantial completion.
   4. All available Tags shall be provided to SI.
   5. These control descriptions are provided for informational purposes and for coordination between the system supplier and the system integrator.

PART 2 EXECUTION

2.1 SYSTEM DESCRIPTION

A. The network diagram found in the drawings shall provide a basic overall description of the PLC system.

2.2 GENERAL PROGRAMMING REQUIREMENTS

A. Tag database structure and configuration.
   1. The process control system tag naming convention shall include the definition of all devices, derived and soft tags, and the required alarm processing and data logging definitions for each tag.
   2. Tag naming convention.
      a. The tag naming convention shall be:
         i) Tag numbers shall be grouped as follows:
            a) 100's – Headworks area
            b) 200's – Pre-Equalization
            c) 500's – Digester
            d) 800"s – Dewatering

ii) Tag names shall minimally consist of two distinct components. The leading component shall be an abbreviated description of the associated process variable or the function of the tag it represents. The trailing component shall be the tag equipment number.

3. All logic and control shall be done in the PLC

B. PLC Programming standards.

1. General Considerations

a. Program Documentation

i) Documentation for all PLC programs shall include comments, tag/register descriptions, or any other programming tags. All PLC programs shall be documented with comments provided for each subroutine, function and/or section. Use of abbreviations in comments and subroutine/section titles should be avoided. At the completion of the project, copies of programming, I/O list, memory map and communications map shall be provided in both printed and electronic format.

b. Motors

i) All motors shall have runtime totalizers and start counters. Both values shall be totalized regardless of whether the motors are in auto and manual control modes.

ii) Every motor that has PLC control shall have a manual or automatic operation for the motor. If manual is selected then the operator shall be able to start or stop the motor. If the motor is controlled from a VFD then the operator shall be able to enter a speed set point for the VFD. In automatic operation the control logic shall start and stop the motor as well as control the speed.

iii) The following signals shall be determined for all motors.

a) HOA switch in Auto

b) Run Indication

c) Fault Indication.

d) Motor fail to start. PLC calling the motor to run but no run signal report for 20 sec. if the motor is in auto.

e) Motor fail to stop. PLC not calling the motor to run but a run signal report for 20 sec. if the motor is in auto.

c. Analog signals

i) All analog inputs shall be scaled in Engineering units to be used in the logic.

ii) A low level and high level alarm shall be generated for each analog signal. Each alarm shall have separate alarm and reset set points that shall be operator programmable from the HMI screen.

d. All control to any devices will be stopped if there is a phase failure condition. After a time delay when the phase failure is normal, then normal operation shall proceed.

C. Human Machine Interface (HMI) standards.

1. General Considerations

a. In general, when the term HMI is used it indicates the local operator terminal displays.

b. All alarms will be displayed and logged on the HMI.
c. All analog signals will be trended and logged and displayed on the HMI in engineering units.
d. Motors
   i) All motors shall be displayed on the HMI and have dynamic graphical indication whether they are on or off. The motors shall be green for running and red for off.
   ii) All motors shall have runtime totalizers and start counters displayed near the motor's graphical display.
   iii) Every motor that has PLC control shall have the associated set points and control criteria entered at the local operator terminal displays. This shall also allow the operator to select manual or automatic operation for the motor. If the motor is controlled from a VFD then the operator shall be able to enter a speed set point for the VFD when the motor is in the manual control mode.
e. The control signals for all motors shall be displayed on the HMI. They shall include but not limited to:
   i) HOA Switch status: "In Auto", "In Hand" or "Off"
   ii) Run Indication
   iii) Fault Indication
   iv) Motor fail to start. PLC calling the motor to run but no run signal report for 20 sec while the HOA is in Auto.
   v) Motor fail to stop. PLC not calling the motor to run but a run signal report for 20 sec while the HOA is in Auto.
f. Alarming
   i) All alarms shall be displayed and logged on the HIM screens.
   ii) All alarms shall be displayed on the local operator terminal at the WWTP.
   iii) Selected alarms shall have a visual and audible alarm.

2.3 SPECIFIC DEVICE CONTROL CRITERIA

A. Plant Power Usage: The power usage for the plant shall be monitored and displayed. The power shall be displayed as an instantaneous KW display on the screen and shall be totalized to show a running KWH total.

B. Automated Bar Screen:
   1. The automated bar screen is controlled by a manufacturer provided control panel.
   2. HMI provides monitoring only of motor status and alarm conditions.
   3. Alarm on high level conditions in influent channel based on operator entered set-points.
   4. High level alarm for manual barscreen based on float setting (float set to activate upon bypass of automated bar screen).

C. Grit Removal System:
   1. The grit removal system (including but not limited to grit basin mixer, solenoid flush valves, grit pump and grit classifier) is controlled by a manufacturer provided control panel.
   2. HMI shall provide monitoring and control for this supplier provided system

3. The grit classifier shall be hardwire interlocked with the grit pump to run when the grit pump is on.
4. The grit removal system shall run anytime a grit pump is on.

D. Flow Monitoring
1. Influent flow shall be monitored on a continuous basis.
2. Flow display shall include current flow rate and daily flow total.
3. Flow total shall be reset at midnight every night.
4. Record previous day flow total in PLC. Display previous day flow total on HMI screen.

E. Automated Samplers
1. The influent flow automated sampler (provided by Owner) is a standalone unit that is not integrated into the HMI.
2. The effluent flow automated sampler (by contractor) is a standalone unit that is not integrated into the HMI.

F. Digester system
1. The Digester System is controlled by a manufacturer provided control panel.
2. HMI shall provide monitoring and control.
3. HMI Screen shall be similar layout and function to supplier provided OIT

G. Emergency Generator
1. Run status, general fault and ATS position shall be monitored and displayed on HMI screen.

END SECTION