FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

COMPLETE CONSTRUCTION CONTRACT PACKAGE

APRIL 13, 2021

Prepared by:

Jeff Goble

Director of Public Works

Town of Frisco, CO

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT A

INVITATION TO BID / REQUEST FOR PROPOSALS

INVITATION TO BID

Notice is hereby given that the Town of Frisco (the "Town") will receive bids for the Construction of Frisco Bay Marina Lift Station and Utilities until March 26, 2021, at 12:00 p.m.

The specifications for the construction of Frisco Bay Marina Lift Station and Utilities are currently available from The Town's Public Works Department via project folder on Google Docs. Prospective bidders will need to email Jeff Goble (JeffG@townoffrisco.com), directly, to get permission to access bidding documents.

The Town reserves the right to reject any and all bids, and to make final determination in the event of duplications.

No bid may be withdrawn for a period of sixty (60) days after the date set for opening thereof.

There will not be a pre-bid meeting. Perspective bidders are strongly encouraged to visit the site at the Frisco Bay Marina, 267 Marina Road, Frisco, CO 80443.

All requests for information from perspective bidders must be received via email to jeffg@townoffrisco.com no later than 3:00pm on Wednesday, March 17, 2021. Responses to requests for information will be completed and posted in the project folder no later than 3:00pm on Friday, March 19, 2021.

Colorado labor shall be employed to perform the work for which bids are requested herein to the extent of not less than eighty percent (80%) of each type or class of labor in the several classifications of skilled and common labor employed on such work, pursuant to C.R.S. § 8-17-101.

[The Town requires that a certified or cashier's check be deposited or that a corporate surety bond in the amount of five percent (5%) of the total bid amount be provided before the Town can accept or consider any bid.] The bid **[and the deposit or bond]** shall be filed with the Town Clerk, securely sealed and endorsed on the outside with a brief statement as to the nature of the item or work for which the bid is provided. **[Upon a bid award, such deposit or bond shall be returned to the unsuccessful bidder(s). In the case of the successful bidder, the deposit or bid bond will be returned upon receipt of the required payment and performance bonds, each in the full amount of the contract price.]**

Bids will be opened to prospective bidders at 12:30 p.m. on March 26, 2021, via Zoom. All prospective bidders will get a meeting invitation, after bid is received.

Any questions regarding the project should be in writing, via email, directed to Jeff Goble, Project Manager, at JeffG@townoffrisco.com

Bid results will be available the day after bid opening, and placed in the Google Doc project folder.

PUBLISHED IN:
Summit Daily
Bid-Net

TOWN OF FRISCO, CO

REQUEST FOR PROPOSALS (RFP)

CONSTRUCTION OF THE FRISCO BAY MARINA SEWAGE LIFT STATION AND DEEP UTILITIES

The Town of Frisco is seeking proposals from qualified firms for the construction of a new sewage lift station and installation of deep utilities, at the Frisco Bay Marina. Additional information and access to all documents and plan sets related to this project can be obtained by contacting Jeff Goble, Public Works Director, at jeffg@townoffrisco.com

There will not be a pre-bid site visit. Perspective bidders are encouraged to visit the site at the Frisco Bay Marina, 267 Marina Rd, Frisco, CO 80443

Proposals will be due no later than 12:00 PM, Friday, March 26, 2021 to Jeff Goble, Frisco Public Works Director, at jeffg@townoffrisco.com

FBM – Lift Station & Deep Utilities

RFP Schedule

The following will be the schedule for this RFP process:

3/11/21 New RFP will be released NLT 3:00pm.

3/17/21 RFI's will need to be submitted via email NLT 3:00pm.

3/19/21 RFI's will be answered via email NLT 3:00pm.

3/26/21 Deadline for submittal of proposals via email NLT 12:00pm.

3/26/21 Bid opening will be conducted via Zoom at 12:30pm.

3/29 – 3/31 The Town will review all proposals and select contractor to recommend to Town Council

4/13/21 Contract will go before Council for approval, notice of award will be sent out the next day (PENDING COUNCIL APPROVAL)

4/24/21 Notice to Proceed will be sent. This may happen sooner depending on when the Town receives required documents from the contractor. Work to begin NLT 10 days after Notice to Proceed.

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT B

BID FORM

BID FORM - MARINA LIFT STATION AND DEEP UTILITIES TOWN OF FRISCO

Item #	Description	Units	Qty	Unit Price	Total
A	Mobilization, Bonds, Insurance and Demobilization	LS	1		$ -
B	Existing Wet Well Modification	LS	1		$ -
C	Lift Station Dewatering	WKS	8		$ -
D	Utility Trench Dewatering	LF	500		$ -
E	Soils Export	CY	400		$ -
F	Duplex Lift Station	LS	1		$ -
G	Fire Hydrant Assembly	EA	1		$ -
H	3" Schedule 40 PVC Pipe	LF	150		$ -
I	4" SDR35 PVC Pipe	LF	125		$ -
J	8" C900 PVC Pipe	LF	250		$ -
K	12" C900 PVC Sanitary Sewer	LF	55		$ -
L	6" Ductile Iron Pipe	LF	125		$ -
M	8" Ductile Iron Pipe	LF	135		$ -
N	6" Gate Valve	EA	2		$ -
O	8" Gate Valve	EA	2		$ -
P	Type K Copper Water Service Line	LF	25		$ -
Q	Cap and Abandon Existing Force Main	EA	1		$ -
R	Connect to Existing (water, sanitary sewer, sanitary force main)	LS	1		$ -
S	Erosion Control, Landscape and Surface Restoration	SY	1400		$ -
T	Vehicle Tracking Pad	EA	2		$ -
U	Site Utility Coordination (Xcel)	LS	1		$ -
				LIFT STATION & DEEP UTILITIES TOTAL:	

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT C

BID SCHEDULE

BID FORM - MARINA LIFT STATION AND DEEP UTILITIES
TOWN OF FRISCO

Bid From BT Construction, Inc.

Item #	Description	Units	Qty	Unit Price	Total
A	Mobilization, Bonds, Insurance and Demobilization	LS	1	$ 42,000.00	$ 42,000.00
B	Existing Wet Well Modification	LS	1	$ 5,500.00	$ 5,500.00
C	Lift Station Dewatering	WKS	8	$ 3,500.00	$ 28,000.00
D	Utility Trench Dewatering	LF	500	$ 25.00	$ 12,500.00
E	Soils Export	CY	400	$ 22.00	$ 8,800.00
F	Duplex Lift Station	LS	1	$ 500,000.00	$ 500,000.00
G	Fire Hydrant Assembly	EA	1	$ 10,000.00	$ 10,000.00
H	3" Schedule 40 PVC Pipe	LF	150	$ 120.00	$ 18,000.00
I	4" SDR35 PVC Pipe	LF	125	$ 150.00	$ 18,750.00
J	8" C900 PVC Pipe	LF	250	$ 200.00	$ 50,000.00
K	12" C900 PVC Sanitary Sewer	LF	55	$ 180.00	$ 9,900.00
L	6" Ductile Iron Pipe	LF	125	$ 150.00	$ 18,750.00
M	8" Ductile Iron Pipe	LF	135	$ 175.00	$ 23,625.00
N	6" Gate Valve	EA	2	$ 3,800.00	$ 7,600.00
O	8" Gate Valve	EA	2	$ 4,500.00	$ 9,000.00
P	Type K Copper Water Service Line	LF	25	$ 300.00	$ 7,500.00
Q	Cap and Abandon Existing Force Main	EA	1	$ 1,000.00	$ 1,000.00
R	Connect to Existing (water, sanitary sewer, sanitary force main)	LS	1	$ 15,000.00	$ 15,000.00
S	Erosion Control, Landscape and Surface Restoration	SY	1400	$ 34.00	$ 47,600.00
T	Vehicle Tracking Pad	EA	2	$ 2,800.00	$ 5,600.00
U	Site Utility Coordination (Xcel)	LS	1	$ 7,000.00	$ 7,000.00
				LIFT STATION & DEEP UTILITIES TOTAL:	**$846,125.00**

Addendum # 1 and #2 Acknowledged

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT D

CONSTRUCTION AGREEMENT

CONSTRUCTION AGREEMENT

THIS CONSTRUCTION AGREEMENT is made and entered into this 13th day of April, 2021, by and between the TOWN OF FRISCO, a Colorado home rule municipal corporation with an address of 1 Main Street, Frisco, CO 80443 (the "Town"), and BT Construction, Inc., a Colorado Corporation ("Contractor") (collectively the "Parties").

For the consideration described herein, the receipt and sufficiency of which is hereby acknowledged, the Parties hereby agree as follows:

Scope of Work. Contractor shall perform the following described work (the "Project"), in accordance with this Agreement and the Contract Documents, which Contract Documents are as defined in the General Conditions attached hereto and incorporated herein by this reference as Exhibit "A". The Project is generally described as follows:

Construction of a new sewage lift station and installation of deep utilities at the Frisco Bay Marina, as per the project manual and construction plans attached hereto.

The Project is described and/or depicted with particularity in the "Scope of Work" attached hereto as Exhibit B, which Exhibit is incorporated herein by this reference.

1. Bonds. Within ten (10) days of the date of this Agreement, Contractor shall provide the performance and payment bonds and certificate of insurance required by the Contract Documents.

2. Commencement and Completion of Work. Contractor shall commence the Project within ten (10) days of date of the Notice to Proceed. Substantial Completion of the Project shall be accomplished **120** days of the date of the Notice to Proceed, unless the period for completion is extended otherwise in accordance with the Contract Documents. Final Completion of the Project shall be accomplished within ten (10) days of the date of Substantial Completion.

3. Compensation/Contract Price. The Town agrees to pay Contractor, subject to all of the terms and conditions of the Contract Documents, for the Project, an amount not to exceed **Eight hundred forty-six thousand, one hundred twenty-five 00/100 DOLLARS ($846,125.00)** (the "Contract Price"). The Town shall pay Contractor in the manner and at such times as set forth in the General Conditions such amounts as required by the Contract Documents. The Town has appropriated funds equal to or in excess of the Contract Price.

4. Governing Law and Venue. This Agreement shall be governed by the laws of the State of Colorado, and any legal action concerning the provisions hereof shall be brought in Summit County, Colorado.

5. No Waiver. Delays in enforcement or the waiver of any one or more defaults or breaches of this Agreement by the Town shall not constitute a waiver of any of the other terms or obligation of this Agreement.

6. Integration. This Agreement and any attached exhibits constitute the entire Agreement between Contractor and the Town, superseding all prior oral or written communications.

7. Third Parties. There are no intended third-party beneficiaries to this Agreement.

8. Notice. Any notice under this Agreement shall be in writing, and shall be deemed sufficient when directly presented or sent pre-paid, first class United States Mail, or via electronic mail addressed to:

The Town: Jeff Goble, Public Works Director
~~Project Manager:~~
P.O. Box 4100
Frisco, CO 80443
jeffg@townoffrisco.com

Contractor: BT Construction, Inc.
ATTN: Josh Livermore
9885 Emporia Street
Henderson, CO 80640
josh.livermore@BTConstruction.com

9. Severability. If any provision of this Agreement is found by a court of competent jurisdiction to be unlawful or unenforceable for any reason, the remaining provisions hereof shall remain in full force and effect.

10. Modification. This Agreement may only be modified upon written agreement of the Parties.

11. Assignment. Neither this Agreement nor any of the rights or obligations of the Parties hereto, shall be assigned by either party without the written consent of the other.

12. Governmental Immunity. The Town, its officers, and its employees, are relying on, and do not waive or intend to waive by any provision of this Agreement, the monetary limitations (presently three hundred fifty thousand dollars ($350,000) per person and nine hundred ninety thousand dollars ($990,000) per occurrence) or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, *et seq.*, as amended, or otherwise available to the Town and its officers or employees.

13. Rights and Remedies. The rights and remedies of the Town under this Agreement are in addition to any other rights and remedies provided by law. The expiration of this Agreement shall in no way limit the Town's legal or equitable remedies, or the period in which such remedies may be asserted, for work negligently or defectively performed.

IN WITNESS WHEREOF, this Construction Agreement has been executed by the Parties as of the date first above written, whether or not the date of signing is some other date.

TOWN OF FRISCO, COLORADO

_____
Hunter Mortensen, Mayor

ATTEST:

_____
Deborah Wohlmuth,
Town Clerk

CONTRACTOR

By: _____
Its:_____

STATE OF COLORADO)
) ss.
COUNTY OF _____)

The foregoing instrument was subscribed, sworn to and acknowledged before me this ___ day of _____, 20__, by _____, as _____ of _____.

My commission expires:

(S E A L)

_____
Notary Public

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT E

GENERAL CONDITIONS

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

PART 1. DEFINITIONS

1.01 CONTRACT DOCUMENTS:

A. Invitation to Bid;
[B. Bid Form];
[C. Bid Schedule];
D. Construction Agreement;
E. General Conditions;
F. Special Conditions;
G. Technical Specifications;
H. Notice of Award;
I. Notice to Proceed;
J. Payment Bond;
K. Performance Bond;
L. Construction Drawings;
M. Documentation submitted by Contractor prior to Notice of Award; and
N. Addenda ___ through ____.

1.02 CHANGE ORDER:

A written order issued by the Town after execution of the Construction Agreement authorizing an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Time.

1.03 CONTRACT:

The entire written agreement covering the performance of the Work described in the Contract Documents including all supplemental agreements thereto and all general and special provisions pertaining to the Work and materials therefor.

1.04 CONTRACT PRICE:

The amount set forth in Paragraph 3 of the Construction Agreement.

1.05 CONTRACT TIME:

The time for completion of the Project as set forth in Paragraph 2 of the Construction Agreement.

1.06 DAY:

Calendar day, unless otherwise specified. When the last day for the occurrence of an event falls on a Saturday, Sunday or legal holiday as recognized by the Town, the time for performance shall be automatically extended to the next business day.

1.07 FINAL COMPLETION:

The date as certified by the Project Manager when all of the Work on the Project is completed and final payment may be made.

1.08 PROJECT:

The construction task or tasks more fully described in the "Scope of Work" provisions (Exhibit B) of the Construction Agreement.

1.09 PROJECT MANAGER:

The Town's duly authorized representative in connection with the Project.

1.10 SUBCONTRACTOR:

Any person, firm or corporation with a direct contract with Contractor who acts for or in behalf of Contractor in executing any part of the Contract, excluding one who merely furnishes material.

1.11 SUBSTANTIAL COMPLETION:

The date as certified by the Project Manager when the Town occupies or takes possession of all or substantially all of the Project, or when the Town may occupy or take possession of all or substantially all of the Project and put it to beneficial use for its intended purposes.

1.12 TOWN

The Town of Frisco, Colorado, a Colorado municipal corporation.

1.13 WORK:

All the work specified, indicated, shown or contemplated in the Contract Documents to construct the Project, including all alterations, amendments or extensions thereto made by supplemental agreements or written orders of the Project Manager.

PART 2. TIME

2.01 TIME OF THE ESSENCE:

All times stated in the Contract Documents are of the essence.

2.02 FINAL ACCEPTANCE:

Upon Final Completion, the Project Manager will issue final acceptance.

2.03 CHANGES IN THE WORK:

The Town reserves the right to order changes in the Work, in the nature of additions, deletions or modifications, without invalidating the Contract, and to make corresponding adjustments in the Contract Price and the Contract Time. All changes shall be authorized by a written Change Order signed by the Project Manager. The Change Order shall include appropriate changes in the Contract Documents and the Contract Time. The Work shall be changed and the Contract Price and Contract Time modified only as set forth in the written Change Order. Any adjustment in the Contract Price resulting in a credit or a charge to the Town shall be determined by mutual agreement of the parties before the work set forth in the Change Order is commenced. If a Change Order results in an increase in the Contract Price, approval of the Frisco Town Council may be required.

The Town shall provide Contractor with written assurance of additional appropriations should any change in the Work result in an increase in the Contract Price exceeding the amount originally appropriated for the Work.

2.07 DELAYS:

A. If Contractor is delayed in the progress of the Work by fire, unusual delay in transportation, adverse weather conditions not reasonably to be anticipated, or other unavoidable casualties beyond Contractor's control, the Contract Time shall be extended for a reasonable period of time.

B. Any request for extension of the Contract Time shall be made in writing to the Project Manager not more than seven (7) days after commencement of the delay; otherwise it shall be waived. Any such request shall contain an estimate of the probable effect of such delay on the progress of the Work.

C. Contractor shall not be entitled to any increase in the Contract Price, or to damages, or to additional compensation as a consequence of any such delays.

2.08 NO DAMAGES FOR DELAY:

The Town shall not amend the Contract Price nor shall Contractor be entitled to additional compensation of any sort for costs or damages incurred as a result of any delays in performance unless such delay is the direct result of the acts or omissions of the Town or persons acting on behalf of the Town, in accordance with C.R.S. § 24-91-103.5.

PART 3. CONTRACTOR'S RESPONSIBILITIES

3.01 COMPLETION/SUPERVISION OF WORK:

Contractor shall be responsible for completion of all Work in a timely and workmanlike manner in accordance with the terms and specifications of the Contract Documents, including the techniques, sequences, procedures and means. Contractor shall be responsible for the coordination of all Work. Contractor shall supervise and direct the Work and give it all attention necessary for proper supervision and direction. Contractor shall maintain a supervisor on site at all times when Contractor or any subcontractor is performing Work.

3.02 DUTY TO INSPECT AND CONTRACTOR'S REPRESENTATIONS:

Contractor shall inspect all Contract Documents, tests and reports, including soil tests and engineering tests, if applicable, and shall conduct a site or field review prior to executing the Contract. Contractor assumes the risk of all conditions which are disclosed, or which are reasonably suggested by any such tests or reports, or which would be disclosed by a field or site review. Contractor shall have the affirmative duty to advise the Town of any concerns which Contractor may have regarding construction conditions prior to executing the Contract.

In order to induce Town to enter into the Contract, Contractor makes the following representations:

a. Contractor has examined and carefully studied the Contract Documents and the other related data identified in or related to the Contract Documents;

b. Contractor has visited the site(s) and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance or furnishing 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, performance and furnishing of the Work; and

d. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the site(s), reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.

3.03 FURNISHING OF LABOR AND MATERIALS:

A. Contractor shall provide and pay for all labor, materials and equipment, including: tools; construction equipment and machinery; utilities, including water; transportation; and all other facilities and services necessary for the proper completion of the Work.

B. While engaged in the performance of the Work, Contractor shall maintain employment practices that do not violate the provisions of the Colorado Antidiscrimination Act of 1957, C.R.S. § 24-34-301, *et seq.*, as amended.

3.04 EMPLOYEES AND SAFETY:

A. Contractor shall maintain at all times strict discipline of its employees, and Contractor shall not employ on the Project any person unfit or without sufficient knowledge, skill, and experience to perform properly the job for which the employee was hired.

B. Contractor shall be fully responsible to the Town for the acts, negligence and omissions of all direct and indirect employees and subcontractors. The Contract Documents shall not be construed as creating any contractual relation between any subcontractor and the Town.

C. Contractor shall provide for and oversee all safety orders and precautions necessary for the safe performance of the Work. Contractor shall take reasonable precautions for the safety of all employees and others whom the Work might affect, all work and materials incorporated into the Work, and all property and improvements on the Project site(s) and adjacent property.

3.05 CLEANUP:

A. Contractor shall keep the Project site(s) and adjoining ways free of waste material and rubbish caused by its employees or subcontractors. Contractor shall remove all such waste material and rubbish daily during construction, together with all tools, equipment, machinery and surplus materials. Contractor shall, upon termination of its Work, conduct general cleanup operations on the Project site(s), including the cleaning of all surfaces, paved streets and walks, and steps. Contractor shall also conduct such general cleanup operations on adjacent properties which were disturbed by the Work.

B. If Contractor fails to perform the cleanup required by this Section, after written notice, the Town may cause the cleanup to be performed at Contractor's expense. Upon receipt of a statement for such cleanup, Contractor shall pay to the Town the costs incurred by the Town for such cleanup, or the Town shall have the right to withhold said amount from any final payment due to Contractor.

3.06 PAYMENT OF ROYALTIES AND LICENSE FEES:

Contractor agrees to pay all royalties and license fees necessary for the Project, and to defend against all actions for infringement of copyright or patent rights, and to save and hold the Town harmless from such actions.

3.07 TAXES, LICENSES AND PERMITS:

Contractor shall pay all taxes imposed by law in connection with the Project and shall procure all permits and licenses necessary for the prosecution of the Work.

3.08 SAMPLES AND SHOP DRAWINGS:

Contractor shall furnish, upon the request of the Project Manager, samples and shop drawings to the Project Manager, who shall review them for conformance with the Contract Documents. All Work shall comply with approved samples and drawings.

3.09 COMPLIANCE WITH LAWS AND REGULATIONS:

Contractor shall comply with all federal, state and local laws, ordinances, rules, regulations and orders in any manner relating to the Project. If any provision of the Contract Documents is at variance therewith, Contractor shall notify the Project Manager promptly.

3.10 SUBCONTRACTORS:

A. Contractor shall furnish to the Project Manager at the time the Construction Agreement is executed, a list of names of subcontractors to whom Contractor proposes to award the portions of the Work to be subcontracted by Contractor.

B. Contractor shall not employ a subcontractor to whose employment the Project Manager reasonably objects, nor shall Contractor be required to hire a subcontractor to whose employment Contractor reasonably objects.

C. All contracts between Contractor and subcontractor shall conform to the provisions of the Contract Documents, and shall incorporate the relevant provisions of the Contract Documents.

3.11 CORRECTIVE WORK:

When any Work does not conform to the Contract Documents, Contractor shall make the necessary corrections so that the Work will so conform. Such corrections shall be accomplished within the time period approved by the Project Manager. Failure to complete such required corrections within the time period required shall constitute a breach of the Contract.

3.12 OTHER CONTRACTS:

The Town reserves the right to let other contracts in connection with the Project. Contractor shall cooperate with all other contractors so that their work is not impeded by the Work, and Contractor shall give other contractors access to the Project site(s) necessary to perform their contracts.

3.13 COMMUNICATION:

Contractor shall direct all communications to the Town regarding the Project to the attention of the Project Manager.

PART 4. TERMINATION

4.01 LABOR DISPUTES:

Notwithstanding any other provision contained in this Contract, in the event of any picket or other form of labor dispute at the construction site(s), Contractor shall continue to perform the Work without interruption or delay. If Contractor ceases performance of the Work because of such picket or other form of labor dispute, the Town may terminate the services of Contractor after giving forty-eight (48) hours' written notice of its intent to do so.

4.02 DEFAULT:

The Town may terminate this Contract upon seven (7) days' written notice to Contractor if Contractor defaults in the timely performance of any provision of the Contract Documents, or otherwise fails to perform the Work, or any part thereof, in accordance with the Contract Documents. Termination of the Contract by the Town shall not be the Town's exclusive remedy, and the Town may pursue such other remedies and actions lawfully available to the Town including, but not limited to, an action at law for damages against Contractor or any bonding agency issuing a bond hereunder, or an action in equity for injunctive relief.

PART 5. WARRANTIES:

5.01 WARRANTY OR FITNESS OF EQUIPMENT AND MATERIALS:

Contractor represents and warrants to the Town that all equipment and materials used in the Project, and made a part of the Project, or placed permanently in the Project, shall be new unless otherwise specified in the Contract Documents. All equipment and materials used shall be of good quality, free of defects and in conformity with the Contract Documents. All equipment and materials not in conformity with the Contract Documents shall be considered defective.

5.02 GENERAL WARRANTY:

Contractor shall warrant and guarantee all material furnished and work performed by Contractor for a period of two (2) years from the date of final acceptance of the Project by the Project Manager. Under this warranty, Contractor agrees to repair or replace, at its own expense and under the direction of the Project Manager, any portion of the Project which fails or is defective, unsound, unsatisfactory because of materials or workmanship, or which is not in conformity with the provisions of the Contract. Should Contractor fail to perform any such work within the warranty period after a request by the Town, the Town may withdraw from the Performance and/or Payment Bonds any and all amounts necessary to complete the required work. The expiration of the warranty period shall in no way limit the Town's legal or equitable remedies, or the period in which such remedies may be asserted, for work negligently or defectively performed.

PART 6. BONDS, INSURANCE AND INDEMNIFICATION

6.01 INDEMNIFICATION:

Contractor agrees to indemnify and hold harmless the Town and its officers, insurers, volunteers, representative, agents, employees, heirs and assigns from and against all claims, liability, damages, losses, expenses and demands, including attorney fees, 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 Agreement or the Scope of Services if such injury, loss, or damage is caused in whole or in part by, the act, omission, error, professional error, mistake, negligence, or other fault of Contractor, any subcontractor of Contractor, or any officer, employee, representative, or agent of Contractor or of any subcontractor of Contractor, or which arise out of any worker's compensation claim of any employee of Contractor or of any employee of any subcontractor of Contractor.

6.02 NOTICE OF CLAIM:

If Contractor receives any claim arising from the performance of the Work, Contractor shall notify the Town in writing of the nature of the claim within twenty-four (24) hours of receipt of the claim by Contractor. In this notice, Contractor shall provide evidence that Contractor has notified Contractor's insurer of the claim. Contractor shall keep the Town apprised of the disposition of the claim, and Contractor shall take all necessary action to resolve the claim and make restitution, if required, as quickly as possible.

6.03 INSURANCE:

A. Contractor agrees to procure and maintain, at its own cost, a policy or policies of insurance sufficient to insure against all liability, claims, demands, and other obligations assumed by Contractor pursuant to this Agreement. Such insurance shall be in addition to any other insurance requirements imposed by law.

B. Without limiting the generality of the foregoing, Contractor shall procure and maintain, and shall cause any subcontractor of Contractor to procure and maintain, the minimum insurance coverages listed below. Such coverages shall be procured and maintained with forms and insurers acceptable to the Town. In the case of any claims-made policy, the necessary retroactive dates and extended reporting periods shall be procured to maintain such continuous coverage.

1. Worker's compensation insurance to cover obligations imposed by applicable law for any employee engaged in the performance of Work under the Contract, and Employer's Liability insurance with minimum limits of five hundred thousand dollars ($500,000) each accident, one million dollars ($1,000,000) disease – policy limit, and one million dollars ($1,000,000) disease – each employee. Evidence of qualified self-insured status may be substituted for the worker's compensation requirements of this paragraph.

2. Commercial general liability insurance with minimum combined single limits of at least one million dollars ($1,000,000) each occurrence and two million dollars ($2,000,000) general aggregate. The policy shall be applicable to all premises and operations. The policy shall include coverage for bodily injury, broad form property damage (including completed operations), personal injury (including coverage for contractual and employee acts), blanket contractual, products, and completed operations. The policy shall contain a severability of interests provision, and shall be endorsed to include the Town and the Town's officers, employees, and consultants as additional insureds. No additional insured endorsement shall contain any exclusion for bodily injury or property damage arising from completed operations.

3. "All Risk" Builder's Risk insurance in a form acceptable to the TOWN upon the entire Project for the full cost of replacement at the time of any loss. This insurance shall include, as named insureds, the Town, Contractor, and any Subcontractors. This

insurance shall include "all risk" insurance for physical loss or damage including without duplication of coverage, at least theft, vandalism, malicious mischief, transit, materials stored off site, collapse, falsework, temporary buildings, debris removal, flood, earthquake, testing, and damage resulting from defective design, workmanship or materials. The Contractor shall increase limits of coverage, if necessary, to reflect estimated replacement cost. The insurance shall be written without a co-insurance clause.

C. Any insurance carried by the Town, its officers, its employees, or its consultants shall be excess and not contributory insurance to that provided by Contractor. Contractor shall be solely responsible for any deductible losses under any policy of insurance required by this Section 6.03.

D. Contractor shall provide to the Town a certificate of insurance as evidence that policies providing the required coverages, conditions, and minimum limits are in full force and effect. The certificate shall identify this Contract and shall provide that the coverages afforded under the policies shall not be cancelled, terminated or materially changed until at least thirty (30) days prior written notice has been given to the Town. The Town reserves the right to request and receive a certified copy of any policy and any endorsement thereto.

6.04 PERFORMANCE AND PAYMENT BONDS:

Contractor shall furnish a Performance Bond and a Payment Bond, each in the full amount of the Contract Price, as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents, including the warranty. These bonds shall remain in effect at least until two (2) years after the date of Final Completion.

PART 7. PAYMENT

7.01 PROGRESS PAYMENTS:

A. The Town shall make periodic progress payments to Contractor within fifteen (15) days following the Project Manager's approval of the Work completed. A progress payment shall be made only after Contractor has submitted an application for a progress payment on a form approved by the Project Manager, and if requested by the Project Manager, Contractor shall submit copies of invoices from subcontractors or supplies and partial waivers executed by each.

B. Progress payments shall be in an amount equal to ninety percent (90%) of the Work actually completed until fifty percent (50%) of the total Work on the Project, as determined by the Project Manager, is completed. Such determination shall include materials and equipment not incorporated in the Work but delivered to the Project Site and suitably stored. After fifty percent (50%) of the total Work is completed, no additional retainage shall be held.

C. If Contractor fails to complete any required Work within the time period agreed between Contractor and the Project Manager, or within any time period set forth in the Contract Documents, as modified or extended, the Town is expressly authorized to withhold any progress payment for such Work until such Work is completed.

D. Whenever Contractor receives payment pursuant to this Contract, Contractor shall make payments to each of its Subcontractors of any amounts actually received that were included in Contractor's request for payment to Town for such subcontracts. Contractor shall make such payments within fifteen (15) days of receipt of payment from Town in the same manner as Town is required to pay Contractor pursuant to the Contract Documents if the Subcontractor is

satisfactorily performing under its contract with Contractor. Nothing in this paragraph shall be construed to affect the retention provisions of the Contract Documents.

7.02 FINAL PAYMENT:

Upon final acceptance of the Project, the Town shall pay the Contractor the remainder of the Contract Price theretofore unpaid. Notwithstanding any other part of this Section, the Contractor agrees that the Town shall, when required by C.R.S. § 38-26-107(1), publish a "notice of final payment" in a legal Summit County newspaper prior to making final payment to the Contractor. This notice of final payment advertises the date, time, and place when final payment will be made and is intended to alert subcontractors so they can present any claims for unpaid amounts to the Town. The final payment procedure typically delays the final payment made to the Contractor of the retainage amount.

Regardless of whether "notice of final payment" is required by state statute, final payment shall not be made to the Contractor until the Town has complied with all applicable requirements of C.R.S. § 38-26-107 and all claims, if any, have been resolved to the satisfaction of the Town.

7.03 LIQUIDATED DAMAGES:

A. Because time is of the essence and delayed performance constitutes a compensable inconvenience to the Town and its residents, the liquidated damages established in this Section shall be enforced. Such damages are not a penalty. For each day Final Completion is delayed after the Final Completion date stated in the Construction Agreement, as modified through approved change orders, Contractor shall be assessed the following amounts:

Contract Price	Amount per day
$0-$50,000	$350
$50,000-$100,000	$380
$100,000-$250,000	$440
$250,000-$500,000	$520
$500,000-$1,000,000	$640
$1,000,000-$2,000,000	$820
$2,000,000-$4,000,000	$1,080
$4,000,000-$8,000,000	$1,450
$8,000,000-$12,000,000	$1,820
$12,000,000 or greater	$2,250

B. Allowing Contractor to continue and finish the Work or any part thereof after the Final Completion date shall not operate as a waiver on the part of the Town of any of its rights under the Contract Documents. Any liquidated damages assessed shall not relieve Contractor from liability for any damages or costs of other contractors caused by a failure of Contractor to complete the Work in the Contract Time. Liquidated damages may be deducted from any payment due Contractor or the retainage. If the liquidated damages exceed the amount owed to Contractor, Contractor shall reimburse the Town.

7.04 ORAL AGREEMENTS PROHIBITED:

This Contract is expressly subject to the provisions of C.R.S. § 29-1-110(1), and Contractor acknowledges that neither the Town nor any employee or agent thereof is authorized to expend or contract for the expenditure of any monies in excess of those appropriated by the Frisco Town

Council. The Town acknowledges and agrees that sufficient funds have been appropriated to pay the Contract Price, but Contractor shall not rely upon the appropriation of any monies or other funds in addition to those already appropriated unless and until the same are lawfully appropriated by the Frisco Town Council.

7.05 ITEMS NOT INCLUDED IN BID:

No additional compensation shall be paid for any costs or services listed in the Contract Documents but not specifically listed in the Bid as a Bid item.

7.06 CHANGES IN QUANTITY:

A. Except as provided in Section 7.07, the unit Bid price shown in the Bid Schedule shall be used to determine the payment owed Contractor for any changes in quantity.

B. The actual quantity placed, as determined by the Project Manager, shall be used to calculate the payment due to Contractor.

C. Prior to any Work being performed in excess of any of the Bid Schedule quantities, Contractor shall notify the Town, in writing, of every quantity that will exceed one hundred five percent (105%) of the quantity listed on the Bid Schedule.

D. Except as provided in Section 7.08, Contractor shall not be entitled to compensation for any increased expense, loss of expected reimbursement or loss of anticipated profits, directly or indirectly caused by any changes in quantity.

7.07 BID PRICE ADJUSTMENTS:

A. When a major item is increased to more than one hundred twenty five percent (125%) or decreased below seventy five percent (75%) of the original quantity stated on the Bid Schedule, the unit Bid price shall be modified by written change order. Payment for major items shall be calculated by multiplying the actual quantity placed by the modified Bid price.

B. For purposes of this Section, a major item is any item having a Bid value, determined by multiplying the Bid quantity by the unit Bid price, that exceeds ten percent (10%) of the original Contract Price.

7.08 ELIMINATED ITEMS:

Should any items contained in the Bid Schedule be found unnecessary for completion of the Work, the items shall be eliminated. The Contract Price shall be modified through written change order, and the amount of the change order shall be the eliminated quantity multiplied by the unit Bid price stated in the Bid Schedule, minus any reasonable costs incurred by Contractor for the eliminated items. Reasonable costs shall be determined by the Project Manager based on information provided by Contractor, and may include mobilization of eliminated materials and equipment mobilization costs, if the sole purpose of the equipment was to place the eliminated material. In no case shall the costs exceed the amount of the eliminated items.

7.09 MATERIALS STORED BUT NOT INCORPORATED:

Payments may be made to Contractor for materials stored on the Project site(s) but not incorporated into the Work as evidenced by invoices or cost analyses of material produced, if the material has been fabricated or processed and is ready for installation into the Project and conforms with the Contract Documents. Payments shall not exceed eighty-five percent (85%) of

the price shown in the Bid Schedule or one hundred percent (100%) of the certified invoice cost of the stockpiled material, whichever is less. Payment for stockpiled materials shall not relieve Contractor of responsibility for loss or damage to the material. Payment for living plant materials or perishable materials shall not be made until the living or perishable material is made an integral part of the finished Work.

7.10 COST RECORDS:

Contractor shall make cost records available to the Town if the Town deems it necessary to determine the validity and amount of any item claimed.

PART 8. MISCELLANEOUS

8.01 PUBLICATIONS:

Any and all publications relating to the Project and authored by Contractor or any of its subcontractors shall be submitted to the Town for its prior written approval of the content of the publication. If the Town disapproves of the content of the publication, the author shall withdraw it from publication. The term "publication" as used herein shall include articles or letters to be published in any newspaper, magazine, trade journal or other periodical.

8.02 CONFIDENTIALITY:

Any and all reports, information, data, statistics, forms, designs, plans, procedures, systems, studies and any other communication form of knowledge given to or prepared or assembled by Contractor under this Contract shall, to the extent authorized and permitted by law, be kept as confidential and not be made available by Contractor to any individual, company or organization without the prior written consent of the Town. Notwithstanding the foregoing, Contractor shall not be restricted from releasing information in response to a subpoena, court order, or legal process, but Contractor shall notify the Town in writing before responding.

8.03 INDEPENDENT CONTRACTOR:

Contractor, for all purposes arising out of this Contract, is an independent contractor and not an employee of the Town. It is expressly understood and agreed that Contractor shall not be entitled to any benefits to which the Town's employees are entitled, such as overtime, retirement benefits, worker's compensation, injury leave or other leave benefits.

8.04 CONFLICTS:

Should any conflict arise in the Contract Documents, the order of precedence is as follows:

1. Construction Agreement.
2. Special Conditions.
3. General Conditions.
4. Supplemental Specifications.
5. Detailed Plans (Calculated dimensions will govern over scaled dimensions).
6. Standard Plans (Calculated dimensions will govern over scaled dimensions).

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT G

TECHNICAL SPECIFICATIONS

CONTRACT DOCUMENTS FOR CONSTRUCTION OF

FRISCO MARINA SITE UTILITIES AND LIFT STATION

FOR

TOWN OF FRISCO, COLORADO

March 12, 2021

MURRAYSMITH
1157 WEST CENTURY DRIVE, SUITE 220
LOUISVILLE, CO 80027

20-2802

ENGINEER may direct testing at a higher frequency upon failure to obtain specified densities or if the CONTRACTOR changes compaction equipment or methods of compaction. All test locations shall be determined by the ENGINEER.

1.18 LIMITS OF THE WORK AND STORAGE OF SPOILS

The limits of the site which may be used for construction, storage, materials handling, parking of vehicles and other operations related to the project include the project site as shown on the drawings and adjacent public rights-of-way subject to permission of the public owner of that right-of-way. The limits of work also include rights of access obtained by the CONTRACTOR, subject to all public laws and regulations and rights of access by utility companies and other holders of easement rights.

1.19 FIELD CHANGES, ALIGNMENT, AND GRADE

Changes of alignment and grade shall be made during the course of work in order to avoid interference with unforeseen obstructions. The CONTRACTOR shall locate existing utilities to be crossed, by potholing ahead of the pipe installation, of sufficient distance to avoid conflicts through pipe joint deflection if possible. All costs for minor field changes of alignment and grade shall be borne by the CONTRACTOR. The ENGINEER will endeavor to make prompt decisions on such matters. CONTRACTOR shall anticipate a minimum of 72 hours for any decision requiring significant piping change.

1.20 TESTING AND OPERATION OF FACILITIES

It is the intent of the OWNER to have a complete and operable facility. All the work under this contract will be fully tested and inspected in accordance with the specifications. Upon completion of the work, the CONTRACTOR shall operate the completed facilities as required to test the equipment under the direction of the ENGINEER. During this period of operation by the CONTRACTOR, the new facilities will be tested thoroughly to determine their acceptance.

1.21 PROTECTION OF EXISTING STRUCTURES AND WORK

The CONTRACTOR must take all precautions and measures necessary to protect all existing structures and work. Any damage to existing structures and work shall be repaired by removing the damaged structure or work, replacing the work and restoring to original condition satisfactory to the ENGINEER.

1.22 SALVAGE AND DEBRIS

Unless otherwise indicated on the drawings or in the specifications, all castings, pipe, equipment, demolition debris, spoil or any other discarded material or equipment shall become the property of the CONTRACTOR and shall be disposed of in a manner compliant with applicable Federal, State, and local laws and regulations governing disposal of such waste products. No burning of debris or any other discarded material will be permitted.

1.23 SAFETY STANDARDS AND ACCIDENT PREVENTION

The CONTRACTOR shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. The required and/or implied duty of the ENGINEER to conduct construction review of the CONTRACTOR's performance does not, and is not intended to, include review of the adequacy of the CONTRACTOR's safety measures in, on, or near the construction site.

The CONTRACTOR shall comply with the safety standards provisions of applicable laws and building and construction codes. The CONTRACTOR shall exercise every precaution at all times for the prevention of accidents and protection of persons, including employees, and property. During the execution of the work the CONTRACTOR shall provide and maintain all guards, railing, lights, warnings, and other protective devices which are required by law or which are reasonably necessary for the protection of persons and property from injury or damage.

1.24 PUBLIC SAFETY AND CONVENIENCE

General Rule: The CONTRACTOR shall ensure the safety of the public during its performance of the Work and shall minimize any public inconvenience in addition to any other requirement imposed by law. These duties include, but are not limited to, the matters listed below.

Access: The CONTRACTOR shall not unreasonably restrict access to public facilities, commercial property, fire hydrants, residential property, and other areas where the public can be expected to be present, such as sidewalks and streets without first obtaining approval of the OWNER. Driveways shall be closed only with the approval of the OWNER or after obtaining specific permission from the property owner or owners. In addition, the CONTRACTOR shall not obstruct or interfere with travel over any public street or sidewalk without approval of the OWNER.

Public Transit: The CONTRACTOR shall not interfere with the normal operation of any public transit vehicles unless otherwise authorized.

Work Site: The CONTRACTOR shall keep the Project site safe in compliance with applicable law. Safety includes, but is not limited to: 1) providing an approved type of secured and adequate barricades or fences that are easily visible from a reasonable distance around open excavations; 2) closing up or covering with steel plates all open excavations at the end of each Working Day in all street areas and in all other areas when it is reasonably required for public safety; 3) marking all open work and obstructions by lights at night; 4) installing and maintaining all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities; 5) observing any and all safety instructions received from the OWNER; and 6) following all laws and regulations concerning worker and public safety. In the event that the law requires greater safety obligations than that imposed by the OWNER, the CONTRACTOR

shall comply with the law.

Emergency: Emergency vehicles, including but not limited to police, fire, and disaster units shall be provided access to the work site at all times.

Cleanliness: The CONTRACTOR shall, on a continuing basis, keep the surfaces of all public and private roadways, sidewalks, and other pathways free of dirt, mud, cold plane grindings, and other matters that the CONTRACTOR may place upon the road. The cost of performing such work shall be included in the CONTRACTOR's Bid and no additional payment will be made for performing this task.

Parking: The CONTRACTOR shall make any necessary contacts with all applicable governmental bodies to arrange for the removal of parked automobiles, vehicles and other obstructions if they would interfere with the performance of the CONTRACTOR'S work.

Accidents: The CONTRACTOR'S Project Manager or superintendent shall be in charge of accident prevention. CONTRACTOR shall take all actions necessary to prevent damage, injury and loss to persons and property as a result of accidents.

Project Health and Safety Plan: CONTRACTOR shall develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. Contractor shall submit the written Safety Program to the OWNER within 30 days after the receipt of the written Notice to Proceed. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include the following items when they apply:

- Employee Orientation
- Safety Inspections
- Instruction and Training
- Accident Reporting
- Signs and Barricades
- Fire Prevention and Protection
- Welding, Cutting, and Burning
- Painting and Surface Treatment
- Electricity
- Machinery and Mechanized Equipment
- Excavations
- Sanitation
- Chlorine Safety
- Hazardous Materials
- Hazardous Communications Program
- Job Hazard Analysis
- First Aid/Medical Facilities
- Personal Protective Equipment
- Confined Space Entry Plan
- Shoring Plan
- Fall Protection Plan
- Emergency Action Plan
- Housekeeping
- Safety Training Requirements and Certification
- Pedestrian Access Around Work Site During Construction and After Hours

If the project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Plan. The Program shall subsequently be distributed to and implemented by the CONTRACTOR's personnel as well as its Subcontractors and Suppliers. CONTRACTOR shall fully implement and comply with the Safety Program and shall submit to the OWNER a letter signed by CONTRACTOR'S owner/president affirming such implementation and compliance within 15 days after on-site work has started. CONTRACTOR shall notify the OWNER when safety meeting will be held so that Owner's personnel may attend. A copy of the approved Health and Safety Plan must be maintained on-site at all times during the life of the Project.

The OWNER has no responsibility for Work site safety. Work site safety is the responsibility of the CONTRACTOR. The CONTRACTOR is required to have a competent person on site at all times during construction activities.

The CONTRACTOR shall provide signs on work zone fencing that provide information regarding access to businesses and stating that such businesses are open and in operation. The CONTRACTOR shall furnish and install the signs and provide sign attachments for the various business names.

1.25 WARRANTY PERIOD

The CONTRACTOR shall warrant all furnished materials and equipment for a period of one year from date of final acceptance of the Work by the OWNER. This warranty shall mean prompt attention to the correction and/or complete replacement of the faulty material or equipment. The expiration of the one-year warranty period shall not affect any other claims or remedy available to the OWNER. There may be other warranty provisions in these contract documents in addition to those noted above.

1.26 UTILITY PROPERTIES AND SERVICE

In areas where the CONTRACTOR's operations are adjacent to or near a utility and such operations may cause damage which might result in significant expense, loss and inconvenience, the operations shall be suspended until all arrangements necessary for the protection thereof have been made by the CONTRACTOR.

The CONTRACTOR shall notify all utility offices which may be affected by the construction operation at least 48 hours in advance. Before exposing any utility, the utility having jurisdiction shall grant permission and may oversee the operation. Should service of any utility be interrupted due to the CONTRACTOR's operation, the proper authority shall be notified immediately. It is of the utmost importance that the CONTRACTOR cooperates with the said authority in restoring the service as promptly as possible. Any costs shall be borne by the CONTRACTOR.

Utilities which may be impacted include the following:

Town of Frisco	Water
Xcel Energy	Gas
Xcel Energy	Power

1.27 SANITARY FACILITIES

The CONTRACTOR shall provide and maintain sanitary facilities for its employees and its subcontractors' employees that will comply with the regulations of the local and State Departments of Health and as directed by the ENGINEER.

1.28 STREET CLEANUP

The CONTRACTOR shall clean daily all dirt, gravel, construction debris, and other foreign material resulting from its operations from all streets and roads.

1.29 VEHICLE PARKING

The vehicles of the CONTRACTOR's and subcontractors' employees shall be parked in accordance with local parking ordinances.

1.30 NOT USED

1.31 RECORD DRAWINGS

CONTRACTOR shall maintain at the site one set of specifications, full size drawings, shop drawings, equipment drawings, and supplemental drawings which shall be corrected as the work progresses to show all changes made. Drawings shall be available for inspection by the ENGINEER. Upon completion of the contract and prior to final payment, specifications and drawings shall be turned over to the ENGINEER.

1.32 "OR EQUAL" CLAUSE

In order to establish a basis of quality, certain processes, types of machinery and equipment or kinds of material may be specified on the drawings or herein by designating a manufacturer's name and referring to its brand or product designation. It is not the intent of these specifications to exclude other processes, equipment or materials of a type and quality equal to those designated. When a manufacturer's name, brand, or item designation is given, it shall be understood that the words "or equal" follow such name or designation, whether in fact they do so or not. If the CONTRACTOR desires to furnish items of equipment by manufacturers other than those specified, he shall secure the approval of the ENGINEER prior to placing a purchase order.

No extras will be allowed the CONTRACTOR for any changes required to adopt the substitute equipment. Therefore, the CONTRACTOR's proposal for an alternate shall include all costs for any modifications to the drawings, such as structural and foundation changes, additional piping or changes in piping, electrical changes or any other modifications which may be

necessary or required for approval and adoption of the proposed alternate equipment. Approval of alternate equipment by the ENGINEER before or after bidding does not guarantee or imply that the alternate equipment will fit the design without modifications.

1.33 SURVEYS

Based upon the information provided by the Contract Documents, the CONTRACTOR shall develop and make all detail surveys necessary for layout and construction, including exact component location, working points, lines, and elevations. Prior to construction, the field layout shall be approved by the OWNER's representative. The CONTRACTOR shall have the responsibility to carefully preserve bench marks, reference points, and stakes, and in the case of destruction thereof by the CONTRACTOR or resulting from its negligence, the CONTRACTOR shall be charged with the expense and damage resulting therefore and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points, and stakes.

1.34 WORK HOUR LIMITATIONS

All work shall be conducted between the hours of 7:00 a.m. and 6:00 p.m. on non-holiday weekdays only. No weekend work will be allowed. Requests for variations in work hours shall be made in writing for consideration by the ENGINEER. No work shall be conducted outside of the above-described days and hours without prior approval of the ENGINEER.

1.35 DUST PREVENTION

All unpaved streets, roads, detours, haul roads, or other areas where dust may be generated shall receive an approved dust-preventive treatment or be routinely watered to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

Dust emissions from reservoir construction activities including sandblasting and painting shall be controlled to be within applicable environmental regulations. The CONTRACTOR shall be responsible for cleaning and repair of properties near the reservoir site which may become damaged by sandblasting or painting emissions.

1.36 EROSION AND SEDIMENTATION CONTROL

Erosion control measures shall be maintained throughout the project site until approved permanent cover such as a healthy stand of grass, other permanent vegetation, or other ground covering is established. When approved permanent ground cover is established, all temporary erosion control measures shall be removed from the construction site. Erosion control measures shall be installed as approved, per the erosion control drawing(s) in the above referenced document. Erosion control measures including stabilized construction entrances and sediment barriers must be established in conjunction with site clearing and grading.

During construction, and until permanent vegetation or other ground covering is

established, the erosion control facilities shall be upgraded as needed for unexpected storm events or site conditions and with the purpose of retaining sediment and sediment-laden water on the construction site.

1.37 INTERFERENCES, OBSTRUCTIONS, AND SEWER CROSSINGS

At certain places, power, light and telephone poles may interfere with excavation and the operation of the CONTRACTOR's equipment. Necessary arrangements shall be made with utility companies for moving or maintaining such poles. The utility company affected by any such interferences shall be notified thereof so that the necessary moving or proper care of poles and appurtenances may have appropriate attention.

All costs resulting from any other interferences and obstructions, or the replacement of such, whether or not herein specifically mentioned, shall be included and absorbed in the unit prices of the CONTRACTOR's bid.

1.38 NOISE LIMITATIONS

The project areas are located within a residential zoned area. All applicable City, County ordinances, and State and Federal regulations shall be complied with.

1.39 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. Materials and equipment stored overnight shall be placed neatly on the job site. Unusable materials (i.e. rejected or damaged liner material, old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.

   Provide appropriate barricades, signs, and traffic control devices in like-new condition where necessary to protect the public from any hazards associated with the storage of materials and equipment used for this project.

B. No equipment and/or materials shall be stored outside the immediate work area on public right-of-ways, in the following locations, or in the following manner:

   1. In any maintained landscaped or lawn area.

   2. In a manner that would totally eliminate an individual residents' street parking.

   3. In front of any business.

   The "immediate work area" is the area where work is taking place or will be taking place within one calendar day. The CONTRACTOR shall immediately move stored material or equipment which causes a nuisance or creates complaints.

1.40 COMPETENT PERSON DESIGNATION

CONTRACTOR shall designate a qualified and experienced "competent person" at the site whose duties and responsibilities shall include enforcement of applicable OSHA regulations regarding excavations, the prevention of accidents, and the maintenance and supervision of construction site safety precautions and programs.

1.41 EMERGENCY MAINTENANCE SUPERVISOR

The CONTRACTOR shall submit to the ENGINEER the names, addresses, and telephone numbers of at least two employees responsible for performing emergency maintenance and repairs when the CONTRACTOR is not working. These employees shall be designated, in writing by the CONTRACTOR, to act as its representatives and shall have full authority to act on its behalf. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

1.42 NOT USED

1.43 NOT USED

1.44 USE OF EXPLOSIVES

The use of explosives shall not be allowed on this project. Alternative methods of excavation shall be utilized.

1.45 NOT USED

1.46 NOT USED

END OF SECTION

SECTION 01 22 20 - UNIT PRICE MEASUREMENT AND PAYMENT

PART 1 GENERAL

Measurement and payment will be on a unit price basis in accordance with the prices set forth in the proposal for individual work items. Where work is required but does not appear as a separate item in the proposal, the cost for that work shall be included and absorbed in the unit prices named in the proposal. CONTRACTOR shall make a careful assessment when preparing the bid.

A. Mobilization, Bonds, Insurance and Demobilization: Payment for mobilization, bonds, insurance and demobilization will be on a lump sum basis. The amounts paid for mobilization in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:

1. When 5 percent is earned, either 100 percent of the amount for mobilization or 5 percent of the original contract amount, whichever is the least.

2. When all work is completed, amount of mobilization exceeding 5 percent of the original contract amount.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.

B. Existing Wet Well Modification: Payment for all modifications at the existing wet well, including but not limited to removal of the pumps, grouting to cap the existing effluent force main, including all associated coring, grouting, piping and appurtenances will be on a lump sum basis.

C. Lift Station Dewatering: Payment for this bid item, including all dewatering, un-watering, or other water control measures used in the removal, draining, or control of ground or surface water from the excavation area for the lift station, valve vault, and all lift station influent and effluent piping, will be on a per week basis. Contractor shall comply with all Federal, State, and Local permit requirements, including any applicable provisions of the Storm Water Management Plan and Dewatering Permit. All labor, materials, equipment, dewatering wells, etc. required to construct the project under wet conditions are incidental to the work and therefore no additional payment will be made under any circumstances.

D. Utility Trench Dewatering: Payment for this bid item, including all dewatering, un-watering, or other water control measures used in the removal, draining, or control of ground or surface water from the excavation area for utility trenching will be on a linear foot basis. Contractor shall comply with all Federal, State, and Local permit requirements, including any applicable provisions of the Storm Water Management

Plan and Dewatering Permit. All labor, materials, equipment, trash pumps, hoses, one foot of overexcavation, additional CDOT No. 57 stone per details, etc. required to construct the project under wet conditions are incidental to the work and therefore no additional payment will be made under any circumstances.

E. Soils Export: Payment for this bid item, including excavation, shoring, removal and disposal of material necessary in order to remove export material or to place the proposed utilities at a depth greater than is shown on the Drawings will be on a cubic yard basis rounded to the nearest 0.5 (1/2) CY.

F. Duplex Lift Station: Payment for the duplex lift station, including excavation, shoring, interior and exterior DI piping, couplings, controls, concrete wet well, anti-floatation base, hatch, valve vault, and all necessary appurtenances from the inlet of the lift station to the coupling downstream of the valve vault will be on a lump sum basis. These limits include all labor, materials, equipment, or other work required to construct the project per the Plans and Specifications.

G. Fire Hydrant Assembly: Payment for furnishing and installing fire hydrant assemblies will be on a per each basis. The unit price for hydrants shall include all costs for shackles, tie rods, pier blocks, gravel, painting and all other items for the complete installation of the hydrant including the pipe and gate valve connecting the hydrant to the main. Hydrant tees will be paid for at unit contract price each under the appropriate bid item.

H. 3" Schedule 40 PVC Pipe: Payment for furnishing and installing 3" Schedule 40 PVC pipe with Class D trench backfill, including all work and materials, excavation for up to 8.5 feet of cover, all required joint restraint systems for pipe, fittings, valves and appurtenances, clean outs, insulation, dewatering, Class D bedding, marking tape, tracer wire, Class D pipe zone and Class D trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings. Bedding, pipe zone and trench backfill material is understood to be imported granular material is understood to be imported granular material, compacted in place as shown on the plans. Class D fill material shall be as specified within Section 31 23 17, Trenching.

I. 4" SDR35 PVC Pipe: Payment for furnishing and installing 6" diameter SDR35 PVC pipe with Class D trench backfill, including all work and materials, excavation for up to 8.5 feet of cover, all required joint restraint systems for pipe, fittings, valves, 4" clean outs and appurtenances, dewatering, Class D bedding, blue board insulation, marking tape, tracer wire, Class D pipe zone and Class D trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings. Bedding, pipe zone and trench backfill material is understood to be imported granular material is understood to be imported granular material,

compacted in place as shown on the plans. Class D fill material shall be as specified within Section 31 23 17, Trenching.

J. 8" C900 PVC Pipe: Payment for furnishing and installing 8" diameter C900 pipe with Class D trench backfill, including all work and materials, excavation for up to 8.5 feet of cover, all required joint restraint systems for pipe, fittings, valves, 8" cleanouts, appurtenances, dewatering, Class D bedding, blue board insulation, marking tape, tracer wire, Class D pipe zone and Class D trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings. Bedding, pipe zone and trench backfill material is understood to be imported granular material is understood to be imported granular material, compacted in place as shown on the plans. Class D fill material shall be as specified within Section 31 23 17, Trenching.

K. 12" C900 PVC Pipe: Payment for furnishing and installing 12" diameter C900 PVC pipe with Class D trench backfill, including all work and materials, excavation for up to 8.5 feet of cover, all required joint restraint systems for pipe, bends, fittings, valves and appurtenances, dewatering, Class D bedding, marking tape, tracer wire, Class D pipe zone and Class D trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings. Bedding, pipe zone and trench backfill material is understood to be imported granular material is understood to be imported granular material, compacted in place as shown on the plans. Class D fill material shall be as specified within Section 31 23 17, Trenching.

L. 6" Ductile Iron pipe: Payment for furnishing and installing 6" Ductile Iron pipe with Class D trench backfill, including all work and materials, excavation for up to 8.5 feet of cover, all required joint restraint systems for pipe, bends, fittings, valves and appurtenances, dewatering, Class D bedding, marking tape, tracer wire, Class D pipe zone and Class D trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings. Bedding, pipe zone and trench backfill material is understood to be imported granular material is understood to be imported granular material, compacted in place as shown on the plans. Class D fill material shall be as specified within Section 31 23 17, Trenching.

M. 8" Ductile Iron pipe: Payment for furnishing and installing 8" Ductile Iron pipe with Class D trench backfill, including all work and materials, excavation for up to 8.5 feet of cover, all required joint restraint systems for pipe, bends, fittings, valves and appurtenances, dewatering, Class D bedding, marking tape, tracer wire, Class D pipe zone and Class D trench backfill will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed with restrained joints as indicated on the plans without deduction for fittings. Bedding, pipe

zone and trench backfill material is understood to be imported granular material is understood to be imported granular material, compacted in place as shown on the plans. Class D fill material shall be as specified within Section 31 23 17, Trenching.

N. 6" Gate Valve: Payment for furnishing and installing gate valves will be on a per each basis.

O. 8" Gate Valve: Payment for furnishing and installing gate valves will be on a per each basis.

P. Type K Copper Water Service Line: Payment for furnishing and installing water service connection per the size specified. Includes excavation, trenching, sheeting, shoring, bedding, air testing, backfill, service tap and saddle, corporation stop, service pipe, fittings, meter, meter box, and all appurtenances. Measured on a per lineal foot basis for the service size shown.

Q. Cap and Abandon Existing Force Main: Payment for providing cement group cap on existing sanitary sewer force main, including sampling and testing, cutting, installing cap, thrust restraint, and all other labor, materials and equipment required to cap the existing waterline in accordance with the Plans and Specification will be on a per each basis.

R. Connect to Existing (water, sanitary sewer, sanitary force main): Payment for this bid item, including coordination with the Town, verifying the location and configuration of the existing water main, sanitary sewer, or sanitary force main at the location of the connection, excavation and disposal of water material, shoring, and all other work, materials, testing or equipment required to permit connection in accordance with the Plans and Specifications will be on a lump sum basis.

S. Erosion Control, Landscape and Surface Restoration: Payment for this bid item, including all materials, labor, tools, and equipment necessary to install and maintain temporary erosion control and sediment maintenance measures throughout the life of the project, complete work in accordance with the approved permits, and to remove the temporary erosion control, general surface restoration other than streets, sidewalks and curbs including stripping and stockpiling topsoil, regrading to original contours, bark mulching planting areas, reseeding where necessary and cleanup following construction as required including resurfacing gravel surfaces as required, will be on a square yard basis.

T. Vehicle Tracking Pad: Measurement and payment for this item will be the actual number of vehicle tracking control pads installed. The unit bid price shall include, but is not limited to, all labor, materials, equipment, and transportation needed to install, complete-in-place, clean, and maintain a vehicle tracking control pad as shown on the Plans, and removal of pad upon project completion. Erosion control, including vehicle tracking control pads, should be complete-in-place prior to commencing any

installation, removal, and/or earthwork activities to the greatest extent possible. No payment for vehicle tracking control pads place outside of the dimensions shown on the Plans or field markings unless directed and approved by the Engineer will be included in the amount computed for payment.

U. Site Utility Coordination (Xcel): Payment for site utility coordination with Xcel shall be on a lump sum basis.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section contains administrative and procedural requirements for submittals for review, information, and for Project closeout.

B. Section includes:

1. Schedule of Submittals.
2. Submittal requirements.
3. Submittal procedures.
4. Engineer review.
5. Resubmittal procedures.
6. Product data.
7. Shop Drawings.
8. Samples.
9. Design data.
10. Test reports.
11. Certificates.
12. Manufacturer's instructions.
13. Manufacturer's field reports.
14. Erection Drawings.
15. Construction progress schedules.
16. Breakdown of contract price.
17. Construction photographs.
18. Operation and maintenance (O&M) instructions.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

B. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SCHEDULE OF SUBMITTALS

A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Engineer a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of manufacturer, supplier, trade name, subcontractor and model number of each

product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

C. The list and schedule shall be updated and resubmitted when requested by the Engineer.

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

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

A. Before submitting a Shop Drawing or Sample, Contractor shall have:

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

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

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

4. 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.

B. 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 of that submittal, and that Contractor approves the submittal.

C. 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 set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review of each such variation.

1.5 SUBMITTAL PROCEDURES

A. Contractor shall submit Shop Drawings and Samples to Engineer for review in accordance with the accepted Schedule of Submittals.

B. Transmit each submittal with Engineer-accepted transmittal form certifying compliance with requirements of Contract Documents.

C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.

D. Show each Submittal with the following numbering and tracking system:

1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 05 50 00 would be "05 50 00-1". Resubmittals of that submittal would be "05 50 00-1.1", followed by "05 50 00-1.2", and so on. The second product submittal for that Section would be "05 50 00-2".

2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.

3. Alternative method of numbering may be used if acceptable to Engineer.

E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.

F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.

G. Coordinate submission of related items.

1. All shop drawings for interrelated items shall be scheduled for submission at the same time.

2. The Engineer may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Engineer will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Engineer. Two copies of reviewed submittals will be kept by the Engineer, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.

I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Engineer and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.

J. For each submittal for review, allow not less than 14 days for Engineer review, excluding delivery time to and from Contractor.

K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

L. Allow space on submittals for Contractor and Engineer review stamps or comments.

M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.

N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.

O. Submittals not requested will not be recognized nor processed.

P. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.6 ENGINEER REVIEW

A. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.

B. The Engineer's review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.

C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

D. The Engineer will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".

E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

F. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review 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.

G. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

H. Engineer's review of a separate item as such will not indicate approval of the assembly in which the item functions.

I. Engineer's review of a Shop Drawing or Sample 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 1.4.C and Engineer has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.

J. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.

K. Engineer's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

L. Neither Engineer's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

A. 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. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULES

A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. In addition to a time-scaled bar chart schedule depicting the project critical path, the Contractor shall submit a detailed CPM logic diagram. The CPM diagram and time-scaled bar chart shall include the following:

- Construction activities
- Submittal and review of material samples and shop drawings
- Procurement and delivery of critical materials
- Fabrication, installation, and testing of special material and equipment
- Duration of work, including completion times of all stages and their sub-phases

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the Contractor upon the request of the Engineer.

Detailed subnetworks will include all necessary activities and logic connectors to describe the work and all restrictions to it. In the restraints, include those activities from the project schedule which initiated the subnetwork as well as those restrained by it.

Include a tabulation of each activity in the computer mathematical analysis of the network diagram. Furnish the following information as a minimum for each activity:

- Event (node) number(s) for each activity
- Activity description
- Original duration of activities (in normal workdays)
- Estimated remaining duration of activities (in normal workdays)
- Earliest start date or actual start date (by calendar date)
- Earliest finish date or actual finish date (by calendar date)
- Latest start date (by calendar date)
- Latest finish date (by calendar date)
- Slack or float time (in workdays)

Computer printouts shall consist of at least a node sort and an "early start/total-float" sort.

A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. A time-scaled bar chart schedule shall include the following:

- Construction activities
- Submittal and review of critical material samples and shop drawings
- Procurement and delivery of critical materials
- Duration of work, including completion times of all stages and their sub-phases

B. Attention is drawn to typical local climatic weather patterns and Work shall be coordinated accordingly.

C. Complete project schedule shall be revised and resubmitted to the Engineer at a minimum occurrence of every 4 weeks for review.

D. Three Week Lookahead Schedules: Provide each week at the weekly construction meeting. The previous week's completed work shall be shown on the schedule for a total of 4 weeks shown.

2.2 BREAKDOWN OF CONTRACT PRICE

A. Within 10 days after the Effective Date of the Contract, submit a complete breakdown of all lump sum bid items showing the value assigned to each part of the work, including an allowance for profit and overhead adding up to the total lump sum contract price.

B. Breakdown of lump sum bids shall be coordinated with the items in the schedule and shall be in sufficient detail to serve as the basis for progress payments during construction.

C. Engineer will review the contract price breakdown and may request items to be further broken down or for more items be added in order to facilitate tracking of work progress for payment.

D. Preparatory work, bonds, and insurance required in setting up the job will be allowed as a separate entry on the cost breakdown but shall not exceed 5 percent of the total base bid.

E. Upon acceptance of the breakdown of the contract price by the Engineer, it shall be used as the basis for all requests for payment.

2.3 PRODUCT DATA

A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

1. Note submittal will be returned to Contractor without review of submittal if products, models, options, and other data are not clearly marked or identified.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.4 SHOP DRAWINGS

A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer licensed in the state of Project responsible for designing components shown on Shop Drawings.

1. Include signed and sealed calculations to support design.

2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.

3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. All dimensioned shop drawings shall be scalable and provided as full-sized (22-inch x 34-inch) sheets. PDF electronic files shall print as scalable full-sized sheets.

E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.5 SAMPLES

A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Samples for Selection as Specified in Product Sections:

1. Submit to Engineer for aesthetic, color, and finish selection.

2. Submit Samples of finishes, textures, and patterns for Owner selection.

C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.

D. Include identification on each Sample, with full Project information.

E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.

F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.

G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

H. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.6 DESIGN DATA

A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.

B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

2.7 TEST REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.8 CERTIFICATES

A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

2.9 MANUFACTURER'S INSTRUCTIONS

A. Informational Submittal: Submit manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.

B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

2.10 MANUFACTURER'S FIELD REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit report within 48 hours of observation to Engineer for information.

C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.11 ERECTION DRAWINGS

A. Informational Submittal: Submit Drawings for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

2.12 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

A. Submit preliminary O&M materials for review by Engineer. The equipment manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Reviewed shop drawings and submittal data;

2. Model, type, size, and serial numbers of equipment furnished;

3. Equipment and driver nameplate data;

4. List of parts showing replacement numbers;

5. Recommended list of spare parts;

6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;

7. Maintenance and repair requirements including frequency and detailed instructions; and

8. Name, address and phone numbers of local representative and authorized repair service.

B. Following review of the preliminary O&M materials by the Engineer and before acceptance of the Work, submit four copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.

2.13 OTHER REQUIRED SUBMITTALS

A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.

1. Contractor Emergency Contact List.
2. Erosion and Sediment Control Plan.
3. Traffic Control and Protection Plan.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 45 00 - QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 PROVISIONS

A. Contractor's Responsibility for Testing

The OWNER shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.

B. OWNER's Right to Perform Additional Tests

The OWNER or ENGINEER reserves the right to complete additional testing. In such cases, the CONTRACTOR shall provide safe access for the OWNER or ENGINEER and their inspectors to adequately inspect the quality of work and the conformance with project specifications.

1.3 QUALITY ASSURANCE

A. Testing Requirements

An independently owned and operated laboratory approved by the ENGINEER shall perform all testing as specified herein.

B. Testing

1. General

a. All required testing of work and/or materials shall be conducted in the presence of the ENGINEER. The CONTRACTOR shall provide 48-hour notification to the OWNER and OWNER's REPRESENTATIVE prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the ENGINEER.

b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of material to be tested shall be selected by such laboratory or agency or by the ENGINEER. The CONTRACTOR shall furnish such samples of all materials without charge to OWNER.

c. The results from any and all tests are made for the information of the OWNER. Regardless of any test results, the CONTRACTOR is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

2. Costs of Testing

a. The OWNER shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.

b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the OWNER.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by OWNER-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.

2. Promptly notify OWNER and CONTRACTOR of irregularities and deficiencies observed in the Work during performance of their services.

3. Submit certified written report of each test, inspection and similar quality control service to OWNER, CONTRACTOR and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.

5. Re-test and re-inspect corrected work.

B. CONTRACTOR'S Responsibilities

1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify OWNER, ENGINEER, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.

3. Pay for any CONTRACTOR requested testing and inspecting not required by the Contract Documents.

4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. OWNER will deduct such costs from the Contract Price.

5. Submit copies of licenses, certifications, correspondence, records and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the OWNER, ENGINEER and Special Inspectors.

6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:

    a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

    b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.

7. Cooperate with Agencies performing required tests, special inspections, and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:

    a. Access to the Work.

    b. Incidental labor, equipment, and materials necessary to facilitate tests and special inspections.

    c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.

    d. Provide facilities for storage and field curing of test samples.

    e. Deliver samples to Testing Agencies.

8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.

9. Schedule times for tests, special inspections, obtaining samples, and similar activities. Distribute schedule to OWNER, ENGINEER, Special Inspectors, Testing Agencies, and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three copies of each report to the OWNER or OWNER's REPRESENTATIVE.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

A. The CONTRACTOR shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the CONTRACTOR. Testing locations to be determined by the ENGINEER.

Material to be Tested	Payment Responsibility for Initial Testing	Minimum Testing Frequency
Structural Backfill	OWNER	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot elevation increments, one test per 2,500 sf of material placed. See Article 3.5, Field Quality Control of Section 31 23 23, Fill for further details on testing requirements.
Trench Backfill	OWNER	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot elevation increments, one test per 200 lineal feet of pipeline trench as measured along pipe centerline. ENGINEER may reduce frequency to one test per lift for every 1,500 lineal feet of pipeline trench when satisfied with CONTRACTOR's method of compaction. See Article 3.16, Field Quality Control of Section 31 23 17, Trenching for further details.
Material to be Tested	**Payment Responsibility**	**Minimum Testing Frequency**
Concrete	OWNER	As required when placed. See detailed requirements in Article 3.12, Concrete Tests of Section 03 30 00, Cast-In-Place Concrete.
Grout	OWNER	Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the ENGINEER to insure continued compliance with Specifications. See detailed requirements in Article 3.2, Field Quality Control of Section 03 60 00, Grouting.

END OF SECTION

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes provisions for temporary protection of trees and other plant life in preparation for site or building excavation Work.

B. Related Sections:

1. Section 31 23 16 - Excavation
2. Section 31 23 17 - Trenching

C. This specification shall be applied concurrently and in conjunction with other plant material protection measures herein described and specified.

PART 2 MATERIALS - Not Used

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect all trees specified on the Drawings for protection prior to construction.

1. Document with written memorandum and photographs any unusual conditions.

2. Submit copies of documentation to ENGINEER prior to beginning work.

B. Verify all conditions on the Drawings with actual conditions at Site regarding tree protection prior to any site disturbance.

C. The ENGINEER must be present during demolition of existing conditions occurring within the drip line of trees designated to remain.

D. Notify ENGINEER 24 hours prior to inspections and/or tagging of protected trees.

3.2 PROTECTION

A. Install barricades specified in the Drawings at drip lines of trees designated to remain prior to the commencement of construction.

B. Clearly designate protected trees and clear of any material storage, personnel, or vehicular movement.

C. Provide temporary fencing, barricades, and guards as necessary or required to protect trees designated on the Drawings to remain, from damage above and below grade.

D. Protect root systems of trees and plant life to remain.

1. Protect from damage due to noxious materials in solution caused by runoff or spillage during mixing and placement of construction materials.

2. Protect from flooding, erosion, or excessive wetting resulting from dewatering operations and compaction.

3. Protect against unauthorized cutting, breaking, skinning roots and branches, or bruising bark.

4. Protect from smothering and compaction.

a. Do not store construction materials or permit vehicles to drive or park within the drip line area of any tree to remain.

5. Protect from dumping of refuse in close proximity.

E. Where cutting is necessary, review conditions with the ENGINEER before proceeding, and comply with directives of ENGINEER.

3.3 EXCAVATION AROUND TREES

A. Excavate within drip lines of trees only where indicated on the Drawings or as directed by ENGINEER.

B. Where trenching for utilities is required within drip lines, tunnel under or around roots by hand excavating.

1. Where possible trench toward trunk of tree and tunnel under central root mass to avoid severing all lateral roots on side of trench.

2. Do not cut main lateral roots or tap roots over 1-inch in diameter.

3. Temporarily support and protect trees from damage until permanently covered with approved backfill.

C. Do not allow exposed roots to dry out before backfill is placed.

1. Provide temporary earth or burlap cover.

2. Water roots daily when exposed and maintain in a moist condition.

D. Backfill roots only upon inspection approval from the ENGINEER.

1. Backfill around root excavations only with clean imported topsoil free from materials deleterious to root growth.

2. Backfill to eliminate voids and compact only by means of manual tamping at root areas.

3. Water sufficiently to settle topsoil and eliminate voids or air pockets around roots.

4. Allow for natural settlement of soil surface and furnish and apply topsoil sufficient to bring to original finish grade after backfill settlement.

E. If during excavation, any condition arises that threatens the survivability of the protected tree, or an unknown condition arises that affects the stability or integrity of the root system, notify the ENGINEER immediately.

3.4 REPAIR AND REPLACEMENT OF DAMAGED TREES

A. In the event of damage to existing trees:

1. Immediately prune limbs smaller than 3-inch caliper or roots smaller than 2-inch caliper to repair trees damaged by construction operations.

2. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees.

3. Any such pruning and/or repairs shall be approved in advance and at completion by ENGINEER.

4. The ENGINEER shall reserve the right, at cost to the CONTRACTOR, to obtain the services of a Certified Consulting Arborist with current membership in the American Society of Consulting Arborists to determine the severity of damage.

5. The CONTRACTOR is responsible for the cost of repairs caused by their actions or by the actions of subcontractors engaged by the CONTRACTOR.

B. Remove and replace dead or damaged trees which are determined by the ENGINEER to be incapable of restoration to normal growth patterns at no additional cost to OWNER.

1. Provide new trees of the same species as those removed or damaged, with size and/or quantity to be determined by ENGINEER.

2. Furnish replacement trees and plant life to the Site and plant, maintain, and warranty as directed by the ENGINEER.

3. If trees are not replaceable with the same species, and size, compensate the OWNER for the replacement cost of the trees based on the evaluation of a Certified Consulting Arborist.

4. The CONTRACTOR is responsible for additional costs of removing damaged trees and labor for planting new specimens.

3.5 DESIGNATED TREE REMOVAL PROCEDURES

A. If designated tree removal is specified by ENGINEER, furnish labor, material, and equipment necessary for removing and/or salvaging existing trees, if necessary, as designated on the Drawings for removal.

1. Verify location and species with ENGINEER prior to removal.

B. Salable logs or timber may be sold to CONTRACTOR's benefit upon notification and prior approval of OWNER. Upon approval, remove salable logs or timber promptly from site.

3.6 DESIGNATED TREE TRANSPLANTING PROCEDURES

A. If designated tree transplanting is specified by ENGINEER, verify and identify existing trees to be transplanted.

B. All work shall be in accordance with the standards and practices outlined in the following: Tree and Shrub Transplanting Manual, E.B. Himelick, 1981 Ed., International Society of Arboriculture.

C. Prior to commencement of Work, submit a coordination schedule, method of transplanting, traffic control, routing, etc., to ENGINEER, for review and approval.

D. Warranty for transplanted trees shall be determined and directed on a case by case basis by the ENGINEER, upon contracting of specified transplanting work.

E. Review and verify location of utilities in area of operation. Obtain location and jurisdictional approval from utilities prior to transplanting activities. Protect utilities and the public at all times.

F. Prior to transplanting, spray trees with an anti-desiccant emulsion-type film forming agent, "Dowax" by Dow Chemical Company, "Wilt-Pruf" by Nursery Specialty Products Inc., "D-Wax", by Plant Products Inc., or approved equal, prior to digging with two separate applications allowing 48 hours apart. Use a power sprayer to provide an adequate film over trunks, branches, stems, twigs, and foliage. Anti-desiccant must be dry prior to relocation.

G. Dig, ball and burlap, and move designated trees for relocation to the new planting location shown on the Drawings. In the event the new planting area is not prepared, place tree in a storage area approved by the ENGINEER solely designated for healing-in of plant materials until final planting may occur. Brace in a vertical position, provide shade, wind protection, and irrigation at plant storage area. Utilize all horticulturally proper methods for plant storage. Plants shall be maintained by CONTRACTOR while in storage.

3.7 GRADING AND FILLING AROUND TREES

A. Maintain existing grade within drip line of trees unless otherwise indicated on the Drawings or directed by the ENGINEER.

3.8 MAINTENANCE OF PROTECTIVE MEASURES

A. Maintain protective measures throughout the construction process. Immediately repair any alteration to protection measures throughout construction process. Repair or reinstall protective measures immediately upon alteration. Monitor protective measures daily.

B. Remove and clear area of debris and fencing, barricades, etc., upon final written approval of ENGINEER.

END OF SECTION

SECTION 01 75 16 - TESTING, TRAINING, AND SYSTEM START-UP

PART 1 GENERAL

1.1 SCOPE

This section specifies equipment and system testing and start-up, services of manufacturer's representatives, training of OWNER's personnel, and final testing requirements for the complete facility.

1.2 CONTRACT REQUIREMENTS

A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract.

B. Complete all testing, training, and start-up within the Contract Time(s).

C. Furnish all necessary labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.

D. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation, testing, and operator training.

1.3 START-UP PLAN

A. Submit start-up plan for each piece of equipment and each system not less than 2 weeks prior to planned initial equipment or system start-up.

B. Provide detailed Start-up Progress Schedule with the following activities identified:

1. Manufacturer's services
2. Installation certifications
3. Operator training
4. Submission of operation and maintenance manual
5. Functional testing
6. Performance testing
7. Operational testing

C. Provide testing plan with test logs for each item of equipment and/or system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.

D. Provide summary of shutdown requirements for existing systems if required, which are necessary to complete start-up of new equipment and systems.

E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.4 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.

2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

3. Flush fuel system and provide fuel for testing and start-up.

4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.

6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.

7. Perform cold alignment and hot alignment to manufacturer's tolerances.

8. Adjust V-belt tension and variable pitch sheaves.

9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

B. Electrical Systems

1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.

2. Perform continuity tests on grounding systems.

3. Test and set switchgear and circuit breaker relays for proper operation.

4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.

5. Check motors for actual full load amperage draw. Compare to nameplate value.

C. Instrumentation Systems

1. Bench or field calibrate instruments and make required adjustments and control point settings.

2. Leak test pneumatic controls and instrument air piping.

3. Energize transmitting and control signal systems, verify proper operation, ranges, and settings.

1.5 FUNCTIONAL TESTING

A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.

B. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.

C. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

D. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.6 CERTIFICATE OF PROPER INSTALLATION

A. At completion of functional testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:

1. Has been properly installed, aligned, adjusted, and lubricated.

2. Is free of any stresses imposed by connecting piping or anchor bolts.

3. Is suitable for satisfactory full-time operation under full load conditions.

4. Operates within the allowable limits for vibration.

5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.

6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.

B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:

1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.

2. Control logic for equipment start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.

C. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.7 TRAINING OF OWNER'S PERSONNEL

A. Provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.

B. Coordinate training schedule with City staff. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than two sessions per week.

C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 2 weeks prior to training session for that piece of equipment or system.

D. Satisfactorily complete functional testing before beginning operator training.

E. The OWNER may videotape the training for later use with the OWNER's personnel.

1.8 MINIMUM SERVICE SCHEDULE

Minimum services as specified shall be provided in accordance with the following schedule:

Specification Section	Equipment	Minimum On-Site Time Requirements		
		1) Equipment Installation	2) Equipment Testing	3) Operator Training
33 05 17	Precast Concrete Valve Vault	0.5 CWD	0.5 CWD	0.5 CWD
43 00 00	Packaged Lift Station	1 CWD	1 CWD	1 CWD

NOTE: CWD is defined as a consecutive working day consisting of 8 hours each from 8:00 a.m. to 5:00 p.m.

1.9 OPERATIONAL TESTING

A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.

B. Conduct operational test for continuous 7-day period.

C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.

D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.

E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

A. Maintain and submit to ENGINEER the following records generated during start-up and testing phase of project:

1. Daily logs of equipment testing identifying all tests conducted and outcome.

2. Logs of time spent by manufacturer's representatives performing services on the job site.

3. Equipment lubrication records.

4. Electrical phase, voltage, and amperage measurements.

5. Insulation resistance measurements.

6. Pump torsional and lateral vibration analysis report.

7. Data sheets of control loop testing including testing and calibration of instrumentation devices and set points.

END OF SECTION

SECTION 02 30 00 - SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.1 SUMMARY

A. Subsurface investigations and reporting have been performed for the purpose of obtaining data for the planning and design of this project. Copies of such reporting are attached to the Contract Documents as Supplementary Information.

1.2 LIMITATIONS

A. The subsurface investigations and reporting are being made available solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risk, duty to make examinations and investigations, or any other responsibility under the Contract Documents.

B. It is mutually agreed to by all parties:

1. Written reports are reference documents and are not part of the Contract Documents.

2. Subsurface investigations are for the purpose of obtaining data for planning and design of the project.

3. Data concerning borings and test pits is intended to represent with reasonable accuracy conditions and material found in specific borings and test pits at the time the borings and test pits were made.

C. It is expressly understood and agreed the Owner and Engineer assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigation thus made, the records thereof, or of the interpretations set forth therein, or made by the Owner in his use thereof; and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations, or records thereof, are representative of those existing throughout such areas, or any part, or that unforeseen developments may not occur.

D. The Owner's subsurface investigations and reporting are made available to Bidder or Contractor only on the basis of the understandings and agreement herein stated.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The extent of concrete work is shown on the Drawings.

B. This Section covers cast-in-place concrete including framework, shoring for concrete, and installation into formwork of items such as anchor bolts, setting plates, bearing plates, anchorages, inserts, reveals, frames, nosings, sleeves, and other items to be embedded in concrete.

C. Section includes:

1. Concrete
2. Portland cement
3. Aggregates
4. Water
5. Admixtures
6. Wall forms
7. Roof forms
8. Form oil
9. Epoxy adhesive
10. Curing compounds

1.2 RELATED SECTIONS:

A. Section 03 21 00 - Reinforcing Steel
B. Section 33 16 10 - Prestressed Concrete Water Utility Storage Reservoir

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals

B. Shop Drawings:

1. Reinforcement:

a. Comply with the ACI 315 "Details and Detailing of Concrete Reinforcement," showing bar schedules, stirrup spacing, diagrams of bent bars and arrangements of concrete reinforcement.

b. Show complete details and arrangement and bending of reinforcing and embedded items.

c. Include special reinforcement required and openings through concrete structures.

2. Formwork:

a. Submit shop drawings for fabrication and erection of specific finished concrete surfaces as shown or specified.

b. Show the general construction of forms including jointing, special formed joints or reveals, location and pattern of form tie placement, and other items which affect the exposed concrete visually.

C. Certifications: Certification of aggregate compliance with these Contract Documents, and source of supply and location of all materials and cement.

D. A sufficient quantity of the proposed aggregate, sand, air-entraining admixtures, cement and water for testing of materials, and concrete mix designs referred to herein.

1.4 PRE-CONCRETE PLACEMENT MEETING

A. Schedule and attend a Concrete Placement meeting at least 1-week prior to placing concrete.

B. The meeting shall be attended by the OWNER, ENGINEER, CONTRACTOR, Testing Laboratory Representative, and the Concrete Supplier.

C. The following shall be discussed at the meeting: Safety, Batching and Delivery, Adjustments to Mix; Site Dosing, Placement Rates and Anticipated Schedule of Placing and Finishing, Site Layout –Holding Area; Pump Truck Location; Truck Wash-out Area; Parking area, Equipment – Pumps and Appurtenances; Vibrators; Spare Equipment, Concrete Testing Procedures, and Curing.

1.5 QUALITY ASSURANCE

A. Codes and Standards - Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.

1. ASTM International (ASTM)

a. C31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field"

b. C33, "Standard Specification for Concrete Aggregate"

c. C39, "Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens"

d. C40, "Standard Test Method for Organic Impurities in Fine Aggregate for Concrete"

e. C1084, "Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete"

f. C88, "Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate"

g. C94, "Standard Specification for Ready-Mixed Concrete"

h. C131, "Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"

i. C136, "Standard Test Method for Sieve Analysis to Fine and Coarse Aggregate"

j. C143, "Standard Test Method for Slump of Hydraulic Cement Concrete"

k. C150, "Standard Specification for Portland Cement"

l. C156, "Standard Test Method for Water Loss Through Liquid Membrane Forming Curing Compounds for Concrete"

m. C173, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method"

n. C231, "Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method"

o. C233, "Standard Test Method for Air-Entraining Admixtures for Concrete"

p. C260, "Standard Specifications for Air-Entraining Admixtures for Concrete"

q. C289, "Standard Test Method for Potential Alkali Silica Reactivity of Aggregates (Chemical Method)"

r. C441, "Standard Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction"

s. C457, "Standard Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete"

t. C494, "Standard Specification for Chemical Admixtures for Concrete"

u. C670, "Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials"

v. C803, "Standard Test Method for Penetration Resistance of Hardened Concrete"

2. American Concrete Institute (ACI)

a. "Specifications for Structural Concrete," ACI 301 as supplemented and modified herein.

b. "Standard Practice for Selecting Proportions for Normal Heavyweight, and Mass Concrete," ACI 211.1.

B. Forming

1. Forming, shoring and bracing designs for footings, walls, and roofs shall be designed by the CONTRACTOR to meet all requirements specified here-in.

2. If requested by the ENGINEER, drawings and calculations shall be submitted verifying the selection of form ties, horizontal and vertical stiff-backs or braces for wall panels, forming and form openings, shoring of roof forms, or any other part of forming, shoring or bracing which may be considered critical by the ENGINEER.

3. All falsework and forming requirements for roof support systems must be designed by an ENGINEER registered in the same state as the reservoir will be built in. The drawings, with supporting calculations, must each be signed and sealed by the designer. No work shall be started until the roof support and form design has been reviewed by the ENGINEER. The falsework design ENGINEER must visit the site and approve the erection of all shoring prior to the placement of any concrete.

4. The CONTRACTOR shall be solely responsible for the adequacy of the forming, shoring and bracing design.

5. The turn-around time of the ENGINEER's review will be 2 weeks from date of receipt of each written submittal.

6. Any formwork installed by CONTRACTOR shall be solely at CONTRACTOR's risk. The ENGINEER's review will not lessen or diminish the CONTRACTOR's liability.

1.6 CONCRETE MIX DESIGNS

A. All concrete materials shall be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

B. If the concrete mix designs specified herein have not been used previously by the ready-mix supplier or if directed by the ENGINEER, mix proportions and concrete strength curves for regular cylinder tests, based on the relationship of 7-, 14- and 28-day strengths versus slump values of 2, 4, and 6 inches, all conforming to these

Specifications, shall be established by an approved ready-mix supplier or an independent testing laboratory. A laboratory, independent of the ready-mix supplier, shall be required to prepare and test all concrete cylinders.

The costs for preparation of mix designs (if required by the OWNER to be performed by an independent testing laboratory) and testing of concrete and materials shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

C. The exact proportions by weight of all materials entering into the concrete delivered to the jobsite shall conform to the approved mix design unless specifically so directed by the ENGINEER or Laboratory for improved specified strength or desired density, uniformity and workability.

D. The proportions of such mix design shall be based on a full cubic yard of hardened concrete.

E. Ready-mix companies or jobsite batch plants shall furnish delivery tickets, signed by a Certified Weighmaster, on which each shall state the weight of aggregates, sand, cement, admixtures and water and the number of cubic yards of concrete furnished, which will be compared against the approved mix design.

F. There shall be no variation in the weights and proportions of materials from the approved mix design.

G. There shall be no variation in the quality and source of materials once they have been approved for the specific mix design.

1.7 READY-MIXED CONCRETE

Ready-mixed concrete shall conform to the requirements of ACI 301 and ASTM C94. In case of conflict, ACI 301 shall govern.

PART 2 PRODUCTS

2.1 WALL FORMS

A. Full Height Pours: The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

B. Wall Form Ties

1. Form ties which remain in the wall of a subgrade water-retaining structure shall have waterstops and a 1-inch minimum break back or cone depth.

2. Snap ties, if used, shall not be broken until the concrete has reached the design concrete strength. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. The use of tie wires as form ties will not be permitted. Fully threaded stub bolts may be used in lieu of smooth ties with waterstops.

3. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Plugs shall be A-58 SURE PLUG as manufactured by DAYTON SUPERIOR, Santa Fe Springs, CA; phone: (714) 522-3442.

4. Ties shall positively secure the wall to the required dimension and hold the wall to that dimension prior to and during concrete placement.

C. Wall Form Stiffeners

1. Horizontal walers shall consist of structural steel channels, angles or tubing of adequate size to retain the concrete without deflecting.

2. The walers shall be rolled or welded to the proper radii or offset brackets shall be used for shaping the wall to the dimensions shown on the Drawings and shall be used both for inside and outside wall forms in direct contact with the wall panels and at vertical spacings of no more than 96 inches on center.

3. There shall be at least one such waler within 24 inches of the top and bottom of the wall.

4. The largest dimension of the steel waler shall be in the radial direction.

5. Vertical structural steel or wood members shall be used at a minimum horizontal spacing of 74 inches and shall have sufficient rigidity and strength to insure the proper vertical alignments with the aid of braces under all predictable stress conditions.

6. In lieu of the above, a different system and spacings may be used if it is satisfactorily demonstrated to the ENGINEER that it will be equally effective.

2.2 FORMS FOR EXPOSED FINISH CONCRETE

Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Finish in largest practicable sizes

to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Use overlaid plywood complying with U.S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form", Class I. Use flexible spring steel forms or laminated boards free of distortion and defects to form radius bends as required.

2.3 FORMS FOR UNEXPOSED FINISH CONCRETE

A. Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

2.4 FORM MATERIALS

A. Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound. Petroleum based coatings shall not be used for structures in creeks and waterways. Biodegradable coatings shall be used which will not contaminate the creeks/waterways or an alternate method for stripping the form shall be proposed.

B. Chamfers, Reveals, Drips

Provide preformed PVC or shaped wood or metal of size and profile as shown on drawings.

C. Cylindrical Columns and Supports

Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide units having "seamless" interior to minimize spiral gaps or seams.

D. Pan Forms

Provide forms for concrete pan-type construction complete with covers and end enclosures to form a true, clean, smooth concrete surface. Design units for easy removal without damaging placed concrete. Block adjoining pan units if required to avoid lateral deflection of formwork during concrete placement and compaction. Provide standard or tapered end forms, as shown.

If required, factory-fabricate pan form units to required sizes and shapes of the

following:

1. Steel – 16-gauge minimum, free of dents, irregularities, sag and rust, or

2. Glass-Fiber Reinforced Plastic - Molded under pressure with matched dies, 0.11 inches minimum wall thickness.

E. Inserts

Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work. Provide "Parabolt" by the Molly Company, "Phillips Red-Head", or "Burke" products. The CONTRACTOR is responsible for insuring that all required anchorage not specified in the project documents is installed per current building code and applicable ICC report requirements.

2.5 REINFORCING MATERIALS

A. Reinforcing Bar (rebar): ASTM A615 and as follows below>

Stirrups and Ties	Grade 60 (Grade 40 may be used for #3 and smaller)
All other Uses	Grade 60

B. Steel Wire: ASTM A82, plain, cold-drawn, steel.

C. Welded Wire Fabric (WWF): ASTM A185, welded steel wire fabric.

D. Supports for Reinforcement

Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars, and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise specified. Wood, brick, concrete blocks, and other devices will not be acceptable. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are hot-dip galvanized, after fabrication, or plastic protected or stainless steel protected.

E. Fiber Reinforcement – Collated polypropylene fiber, 3/4-inch, manufactured from 100 percent virgin homopolymer polypropylene, hydrophobic, in compliance with ASTM C116.

2.6 CONCRETE COMPOSITION

Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, and specified additives so proportioned and mixed as to produce a plastic workable mixture in accordance with requirements of this section of the specification and suitable to the specific conditions of placement.

2.7 PORTLAND CEMENT

A. Portland cement shall be from an approved source and shall conform to the requirements of the current ASTM Specification C150, for Type II cement. Only one brand of cement from one manufacturing plant may be used. The use of ground granulated blast furnace slag is not allowed.

B. Cement may be delivered in paper sacks or in bulk.

C. If cement is delivered in sacks, each sack shall contain not less than 94 pounds of cement, and if delivered in bulk, one barrel of cement shall be considered to weigh 376 pounds.

D. In order that the cement may not become unduly aged after delivery, the CONTRACTOR shall use cement that has been stored on the jobsite before using cement direct from freighting, hauling or transporting operations.

E. Storage bins for bulk cement shall be watertight and constructed so that there will be no dead storage.

F. If there is reason to believe that dead storage exists, the bins shall be emptied completely at least once every four months.

G. Cement bins at the mixing plant, and cement storage silos shall be provided with effective dust collectors at the vent to prevent loss of cement.

H. The CONTRACTOR shall designate the source and quantity of cement required for his needs at least 30 days prior to its use, so that appropriate tests, inspection, and certification can be made.

I. Certified mill certificates shall be furnished by the cement company with every shipment, giving proof that the above requirements have been met.

J. In addition, the OWNER may conduct, at its own expense, any tests it considers necessary, to insure that the cement furnished meets the specified requirements.

K. Any cement not meeting the Specifications will be rejected.

L. The OWNER may direct the use of Portland cement of a type other than that above specified, in which case it will pay the additional cost, if any, for the cement required over the cost of that specified, or shall receive appropriate credit for any cement required of a lesser cost than specified.

2.8 FINE AND COARSE AGGREGATES

A. Aggregates shall conform to ASTM C33 and as herein specified. Provide aggregates from a single source for all exposed concrete.

B. Fine aggregates shall be clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances and consisting of hard, strong, durable, and uncoated particles.

C. Material removable by decantation from fine aggregate shall not exceed 5 percent by weight.

D. The moisture content of fine aggregate shall not exceed 8 percent by weight at the time the aggregate is used for the concrete.

E. Fine aggregate shall be subjected to careful, thorough analysis to determine conformity with all requirements of these specifications.

F. Mortar specimens made with the fine aggregate shall have a compressive strength after 7 days of at least 90 percent of the strength of similar specimens made with Ottowa sand having a fineness modulus of 2.40 ± 0.10.

G. Coarse aggregate shall be washed gravel or crushed stone consisting of hard, tough, durable particles free from adherent coating. Use of pit or bankrun gravel is not permitted.

H. It shall contain no vegetable matter of soft, friable, thin, flat or elongated particles in quantities considered deleterious.

I. A thin, flat or elongated particle is defined as a particle having a maximum dimension in excess of five times its minimum dimension.

J. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered in the work under consideration shall not be used.

K. When crushed stone is used, the crusher shall be equipped with a screening system which will entirely separate the dust from the stone and convey it to a separate bin.

L. The substances designated shall not be present in excess of the following amounts:

1. Soft fragments 5 percent

2. Clay lumps 1.4 percent
3. Material removed by decantation 1 percent

M. When the material removed by decantation consists essentially of crushed dirt, the maximum amount permitted may be raised to 1-1/2 percent.

N. Coarse aggregate shall be subjected to a careful, thorough analysis to determine conformity with all requirements of these Specifications.

O. The maximum size aggregate shall be 1-1/2-inch and the aggregate shall be uniformly well graded from coarse through fine in accordance with the following schedule.

Sieve Size	Percent Passing
1	90 - 100
3/4	70 - 90
3/8	45 - 65
NO. 4	31 - 47
No. 8	23 - 40
No. 16	17 - 35
No. 30	10 - 23
No. 50	2 - 10
No 100	0 - 3
No. 200	0 - 2

P. Corrective measures to remedy deficiencies in aggregate grading may be used only with the written approval of the ENGINEER.

Q. The CONTRACTOR shall furnish satisfactory evidence to the ENGINEER that all aggregate used in the work meets the requirements specified herein. Tests shall be performed by a reputable independent testing laboratory and the cost of testing be borne by the CONTRACTOR.

R. If the ENGINEER deems that additional testing of aggregate is necessary, he may select samples from any of the aggregate delivered to the ready-mix plant or jobsite and have them tested by a laboratory of his choice. Such material shall not be used in the work until test reports are available. If in such tests the material fails to meet the specified requirements, the aggregate will be rejected and the expense of testing shall be borne by the CONTRACTOR. If such tests show the aggregate to be satisfactory, the cost of additional testing will be paid by the OWNER but the CONTRACTOR shall have no claim for costs due to delays caused by testing.

S. When tested in accordance with "Standard Test Method for Organic Impurities in Fine Aggregate for Concrete," (ASTM C40), the fine aggregate shall provide a color in the supernatant liquid no darker than the reference standard color solution.

T. When tested in accordance with "Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate," (ASTM C88), the loss resulting after five cycles shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate when using sodium sulfate.

U. When tested in accordance with ""Standard Test Method for Resistance to Abrasion of Small Size Coarse Aggregate by use of the Los Angeles Machine," (ASTM C131), the coarse aggregate shall show a loss not exceeding 50 percent after 500 revolutions or 10 percent after 100 revolutions.

V. When tested in accordance with "Standard Test Method for Potential Alkali Silica Reactivity of Aggregates (Chemical Method)," (ASTM C289), the aggregates should be represented by points lying to the left side of the solid line of Figure 2 therein.

2.9 WATER

Water for mixing shall be clean, fresh, and free from injurious amounts of oil, acid, chlorides, sulfates, alkali, or organic matter. Water shall conform to ACI 301.

2.10 ADMIXTURES - GENERAL

All admixtures used in any mix design shall be manufactured and supplied by the same admixtures company to insure compatibility.

2.11 RETARDING DENSIFIERS

A. All Class "A" concrete (as defined in Section 03 30 00-2.9) used for wall construction shall also contain DARATARD-17, as manufactured by Grace Construction Products or approved equal in the amounts recommended by the additive manufacturer whenever the air temperature during the pour exceeds 85degrees Fahrenheit (F).

B. To be considered as equal, any alternate product offered for consideration shall contain no calcium chloride, and shall be compatible with air-entrained cements and air-entraining admixtures conforming to the applicable ASTM, AASHTO, ANSI and Federal specifications.

C. CONTRACTOR shall certify that admixtures do not contain calcium chlorides or other corrosive materials.

2.12 AIR-ENTRAINING AGENTS

A. Unless specifically required by OWNER, Class "A" concrete shall not be air-entrained. Unless otherwise specified, all other concrete may be air-entrained at the option of the CONTRACTOR.

B. Air-entraining agents shall meet ASTM C260, ASTM C233 and ASTM C457.

C. The maximum total volumetric air content of the concrete before placement shall be 6 percent plus or minus 1 percent as determined by ASTM C173 or ASTM 231.

D. Subject to these Specifications, consideration will be given to the following products: PROTEX "AES," GRACE "DAREX AEA," MASTER BUILDERS "MB-AE90," or SIKA CHEMICAL "AER."

2.13 WATER REDUCING ADMIXTURES

A. In addition to air-entrainment, approved water reducing additives, which do not affect the ultimate performance of any steel in any way, may be added to maintain the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C494, Type A or D.

B. The use of water reducing additives shall not permit a reduction in the minimum specified cement content or in the specified amount of air-entrainment.

C. Admixtures shall contain no calcium chloride, tri-ethanolamine or fly ash. All admixtures shall be from the same manufacturer.

D. Superplasticizers, if allowed by the ENGINEER, shall conform to ASTM C494, Type F or G, batch plant added using second or third generation only.

E. Set control admixtures if allowed by the ENGINEER, shall conform to ASTM C494, Type B (retarding) or Type C (accelerating).

2.14 PROPORTIONING NORMAL CONCRETE

Unless indicated otherwise on the Drawings, concrete shall be of the following classes, each meeting the mix and compressive strength requirements as specified hereafter, and shall be used as follows:

1. Class "A" Prestressed concrete reservoir walls.
2. Class "B" Roof slabs and drop panels, floor slabs, wall footings. Pump station floor slabs and footings
3. Class "C" Pipe blocks and appurtenances, columns and column footings

At the CONTRACTOR's option, Class "A" concrete may be substituted for Class "B" and "C" concrete. Likewise, Class "B" concrete may be used in lieu of Class "C" concrete. If Class "A" concrete is substituted for Class "B" or Class "C" concrete, such concrete shall be air-entrained if the Class "B" or "C" concrete is required to be air-entrained.

2.15 MEASUREMENT

A. All measurements shall be by weight. However, CONTRACTOR, at his own expense, may increase the cement content at a corresponding reduction in weight of aggregate and sand, whenever he is concerned that the minimum strength and mix ratio requirements under these specifications cannot be met. The amount of water to be used shall be the amount necessary to produce a plastic mixture of the specified slump.

B. The slump shall be between 2 inches and 4 inches when tested in accordance with ASTM Specifications C143. Variations in the slump range may be allowed by the ENGINEER if admixtures, such as water reducers or superplasticizers, are utilized in the concrete mix. Regardless of the measured slump, the maximum allowable water-cement ratios as specified here-in, shall be strictly adhered to.

2.16 COMPRESSIVE STRENGTH, WATER AND CEMENT CONTENT

A. Notwithstanding what has been stated here-before, and unless shown otherwise on the Drawings, the concrete shall meet the following requirements:

	Class A	Class B	Class C
1. Min. Compressive Strength	5,000 psi	4,000 psi	3,500 psi
2. Max. Water Content (gallon per 94 lb. sack of cement)	4.5 gal.	4.5 gal.	4.5 gal.
3. Min. Cement Content (94 lb. sack of cement per cubic yard of solid concrete)	7.0 sacks	5.5 sacks	6.0 sacks
4. The cement content is required irrespective of strength. Up to a maximum of 15% of cementatious material may be fly ash in accordance with ASTM C618. The use ground granulated blast furnace slag is not allowed.			
5. The total chloride ion content of hardened concrete shall be less than 0.06 percent by weight of cement.			

2.17 WALL FORMS

A. Full Height Pours: The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete. A plastic shotcrete reglet shall be incorporated into the top of the reservoir corewall as shown on the Drawings.

B. Ties

1. Form ties which remain in the corewall of water-retaining structures shall have waterstops and a 1-inch minimum breakback or cone depth.

2. Snap ties, if used, shall not be broken until the concrete has reached the design concrete strength. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. The use of tie wires as form ties will not be permitted. Fully threaded stub bolts may be used in lieu of smooth ties with waterstops.

3. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Plugs shall be A-58 SURE PLUG as manufactured by DAYTON SUPERIOR.

4. Ties shall positively secure the wall to the required dimension and hold the wall to that dimension prior to and during concrete placement.

C. Form Size

1. BURKE, ECONOMY, SYMONS, ALUMA, and overlaid plywood complying with U.S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form," Class 1, forms may be used for forming of circular walls, as long as there are no straight sections longer than 36 inches at any place around the outside circumference of such walls.

2. The height of such wall panels shall not exceed 8 feet unless built-in pouring openings are incorporated in such walls.

D. Form Stiffeners

1. Horizontal walers shall consist of structural steel channels, angles, or tubing of adequate size to retain the concrete without deflecting.

2. The walers shall be rolled or welded to the proper radii or offset brackets shall be used for shaping the wall to the dimensions shown on the Drawings and shall be used both for inside and outside wall forms in direct contact with the wall panels and at vertical spacings of no more than 96 inches on center.

3. There shall be at least one such waler within 24 inches of the top and bottom of the wall.

4. The largest dimension of the steel waler shall be in the radial direction.

5. Vertical structural steel or wood members shall be used at a minimum horizontal spacing of 74 inches and shall have sufficient rigidity and strength to insure the proper vertical alignments with the aid of braces under all predictable stress conditions.

6. In lieu of the above, a different system and spacings may be used if it is satisfactorily demonstrated to the ENGINEER that it will be equally effective.

2.18 ROOF FORMS

A. Forms and falsework supports for the roof shall be sufficiently rigid and strong to support the wet concrete and the men and equipment necessary for its placement without appreciable deflections. A minimum of 40 pounds per square foot (psf) for live-load shall be allowed in the design.

B. Allowable deflections and required form camber in roof forms shall be regulated per ACI 347.

C. Forms shall be sloped equal to the prescribed roof slope to avoid exceeding the design roof slab thickness.

2.19 FORM OIL

Form oil compounds shall be NSF-61 approved for use in potable water and shall be provided which will not adversely affect finished concrete surfaces by bonding or staining. Selected form coating shall not adversely affect application of curing compounds or future application of bonding or adhesive products.

2.20 EPOXY ADHESIVE

An approved non-sag epoxy adhesive shall be applied over all dry-packed holes on the inside surface of the corewall. An acceptable material is SELECT BOND GP-3000, as manufactured by SELECT PRODUCTS CO. or LV EPOXY as manufactured by SIKA CORPORATION. Approved equal materials may be used.

2.21 CURING COMPOUND

A. All horizontal, screeded and floated surfaces, exposed to drying winds and sunlight, shall be sprayed with ATLAS QUANTUM-CURE as manufactured by Atlas Construction Supply, Inc. (application rate: 200 square foot per gallon (sf/gallon)). Application of the curing compound shall conform to the requirements of 03 30 00 - 3.11.

B. Alternate curing compounds will be accepted if they are pigmented or colored, such as white, at the time of application and are non-toxic to potable water. Regardless of the type of curing compound used, CONTRACTOR shall assume complete responsibility for its adequacy.

PART 3 EXECUTION

3.1 CONCRETE QUALITY

A. Concrete shall conform to the requirements specified herein. The required proportions shall be assembled, well mixed, transported, placed, consolidated, finished, and cured as here-in-after specified. Concrete shall be uniformly dense and sound, free from faults, cracks, voids, honeycomb and other imperfections.

B. If not called for specifically, and unless specified otherwise hereunder, concrete requirements shall follow ACI 301 where applicable.

3.2 MIXING

A. Concrete shall be batched in fully automatic or semi-automatic stationary plants or approved portable batch type plants, and mixed in stationary or truck mixers. Mixing equipment and mixing procedures shall be subject to the approval of the ENGINEER.

B. Site-Mixed Concrete

1. Conform to ACI 304 except as modified by these Specifications.

2. Use a batch type mixer capable of combining the aggregates, cement, and water within the specified time into a thoroughly mixed and uniform mass and discharging the mixture without segregation.

3. Use supporting equipment that can accurately proportion the cement, the coarse and fine aggregates, the admixtures, and the water which enters the mixing drum. Proportion the cement and aggregate by weight.

4. Discharge each entire batch before recharging. Do not allow the volume of the mixed materials per batch to exceed the manufacturer's rate capacity of the mixer.

5. Mixing time shall be as follows:

   a. For mixer of capacity of 1-cubic yard or less, 1-1/2 minutes after batching is completed.

   b. For mixers of capacities larger than 1-cubic yard, 1-1/2 minutes plus 1/2-minute for each additional 1/2-cubic yard capacity or fraction thereof in excess of 1-cubic yard.

   c. The mixer shall revolve at a uniform rate as specified by the manufacturer for the mixing equipment.

C. Ready-mixed Concrete

1. Provide central-mixed concrete conforming to ASTM C94 except as modified by these Specifications.

2. Limit the haul time of central-mixed concrete so that the specified slump is attained without the onsite addition of water which will cause the mix design water-cement ratio to be exceeded. In no event shall the time exceed 90 minutes from the batch plant to the completion of the pour, unless specifically approved by the ENGINEER.

3. Use truck-transported, dry-batched concrete or mix on the jobsite when haul time is excessive. Do not re-temper partially hardened concrete.

3.3 PROTECTION FROM ABRASION OR FIRE

A. Every reasonable precaution shall be taken to protect finished surfaces from abrasion or other damage. Concrete surfaces or edges likely to be injured during the construction period shall be protected by leaving the forms in place or by erecting satisfactory covers. No fire shall be permitted in direct contact with concrete at any time.

3.4 PLACEMENT OF CONCRETE

A. Placement shall conform to ACI 304 except as modified by these Specifications.

B. Notify the ENGINEER of readiness, not just intention, to place concrete in any portion of the work. This notification shall be made a minimum of 48 normal working day hours prior to proposed concrete placing. All forms, steel, anchors, ties, inserts, and other embedded items shall be in place before the CONTRACTOR's notification of readiness is given to the ENGINEER.

C. Schedule sufficient equipment for continuous concrete placing, program backup equipment, and the actions to be taken in case of an interruption in placing. Provide extra concrete vibrators. Test the concrete vibrators the day before placing concrete.

D. Concrete in walls shall not be placed in layers thicker than 24 inches (vertical dimension) at any one time except that the bottom layer shall be no thicker than 12 inches.

E. Concrete in circular spirally-tied columns, having no horizontal reinforcement crossing into the region bounded by the vertical reinforcement, may be deposited from the top of the column form at CONTRACTOR's option such that no separation of the coarse aggregate from the mortar takes place. All concrete shall be vibrated as required herein. The final quality of the poured concrete column shall be the responsibility of the CONTRACTOR. If the quality of the column is found to be unacceptable, the ENGINEER, at the CONTRACTOR's expense, may require the complete removal of the column and may require that an alternate placement method by used.

F. Each layer of concrete in walls and columns shall be vibrated thoroughly before the next layer may be placed thereon. Vibrators shall be taken through the top layer down through the full layer thickness below to insure proper integration of the concrete and to avoid the development of cold joints and honeycomb between the layers. In other words, each layer of concrete shall be vibrated at least twice.

G. Each wall footing, wall section, column footing (if any) and column pour (if any) shall immediately be preceded with a cement/sand slurry mix consisting of equal parts cement and sand in combination with 4-1/2 gallons of water per sack of cement. The thickness of the slurry shall be 1-inch average for the wall and columns and 1/2-inch average for the wall and column footings.

H. Unforeseen cold joints in walls shall be roughened and then covered with a pure mixture of cement and water of approximately 1-inch thickness, before the pour may be continued.

I. Horizontal waterstops in floor and roof decks, if shown on the Drawings, shall be lifted up, then the concrete shall be placed under the waterstop, the waterstop shall then be laid down on that concrete, additional concrete shall be placed on top of that waterstop to the approximate finish level of the concrete, where upon the concrete shall be thoroughly vibrated in one continuous motion from one end of the waterstop to the other end without skipping any areas. Visual observation shall be performed by the CONTRACTOR to certify that voids under waterstops do not exist.

J. Cold joints in floor, roof slabs, and in wall-footings shall be avoided at all costs. Joints shall be continuously covered with new concrete, and shall be thoroughly integrated through vibration, even if it means that horizontal passes of only 6 inches in width be made until additional concrete and equipment becomes available to permit wider passes in concrete placement.

K. The following minimum equipment, which must be in excellent working condition, shall be available on the site for every concrete placement operation on floor, wall and roof:

1. Conveying: Two pumps, or two cranes, or one pump and one crane (for floor and roof decks only).

2. Vibrating: Three vibrators of 14,000 vibrations per minute (minimum).

3. Trowelling: Two power-operated trowelling machines (for floor and roof decks only).

The ENGINEER shall be the sole judge as to the acceptability of the equipment and as to its condition and capacity. The CONTRACTOR shall assume complete responsibility for having adequate equipment.

L. Use mechanical vibration in placing concrete to eliminate rock pockets and voids, to consolidate each layer with that previously placed, to completely embed reinforcing bars and fixtures, and to bring just enough fine material to exposed surfaces to produce a smooth, dense, and even texture. Vibrators shall be of the high-frequency internal type, and the number in use shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least three operable vibrators shall be available at the site. Use external vibrators for consolidating concrete when the concrete is otherwise inaccessible for adequate consolidating, provided the forms are constructed rigidly enough to resist displacement or damage from external vibration.

M. Not used.

N. If avoidable, do not place concrete during rainstorms. Protect concrete placed immediately before rain to prevent rainwater from coming in contact with it. Keep sufficient protective covering on hand at all times for this purpose.

O. Concrete placed for encasement shall not be backfilled until the concrete has reached at least 50 percent of its 28-day compressive strength confirmed by concrete cylinder tests. The CONTRACTOR may mold and cure additional concrete cylinders as specified here-in to verify that the 50 percent strength has been achieved, prior to the required 7-day test. The CONTRACTOR shall keep the trench dewatered until that time. The CONTRACTOR may use type III cement (High Early Strength) in lieu of type II cement in the same batch quantities as specified, but there will be no additional reimbursement to the CONTRACTOR for costs incurred using such concrete.

3.5 PUMPING CONCRETE

A. Base pump size on the rate of concrete placement, length of delivery pipe or hose, aggregate size, mix proportions, vertical lifts, and slump of concrete. The minimum inside diameter of pipe or hose shall be based on the maximum aggregate size as follows:

- 1-1/2-inch maximum aggregate: 4 inches minimum I.D.
- 1-inch maximum aggregate: 3 inches minimum I.D.

B. Do not use aluminum pipes for delivery of concrete to forms.

C. Before pumping is started, prime the delivery pipe or hose by pumping mortar through the line using 5 gallons of mortar for each 50 feet of delivery line. Do not deposit mortar in the forms.

3.6 GENERAL FORMING

A. Purpose

1. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. Construct forms complying with ACI 347.

2. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines.

B. Design

1. The surfaces of all forms in contact with the concrete shall be clean, rigid, tight, and smooth.

2. Openings sufficient in size and number to permit convenient access to properly clean, inspect and place concrete within the forms shall be provided.

3. Exposed sharp edges shall be eliminated from finished concrete work by means of 3/4-inch triangular fillets or chamfer strips placed in the forms.

C. Removal

1. All forms shall be removed before backfilling is placed.

2. Forms shall be so constructed that they can be removed without hammering on, or prying against, the concrete and shall be removed in such a manner as to prevent damage to the concrete and to ensure the complete safety of all parts of the structure.

D. Form-Ties and Seepage

1. Form-ties may be loosened temporarily to permit the removal of bulkheads.

2. All forms, whether prefabricated or custom made, shall be assembled and connected in such a manner that only minor mortar seepage through the joints will occur during vibration of the concrete, which shall be small enough that no honeycomb areas will develop.

E. Clean and Oil

1. All dirt, chips, sawdust, mud, water, and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein.

2. Forms previously used shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being reused.

3. Before concrete is deposited within the forms, all inside surfaces of steel and plywood form surfaces shall be thoroughly, but not excessively, coated with an approved non-staining bond releasing form oil.

3.7 WALL, WALL FOOTING, AND COLUMN FOOTING FORMS

A. All vertical wall and column footing sides shall be formed by methods acceptable to the ENGINEER and to the correct elevations and location shown on the Drawings.

B. Pouring Openings

1. Pouring of walls may be done only through pouring openings on one of the wall sides, and may not be pumped or poured from the top through the use of "elephant trunks" or tremies.

2. CONTRACTOR shall either erect the complete form on one side of the wall and then erect the form panels on the other side of the wall while the concrete pour is in progress or remove form panels from either the inside or outside form assembly before concrete pouring starts.

3. The horizontal centerline distance between such openings shall not exceed 96 inches nor shall the distance between the nearest opening and the bulkhead for the vertical joint exceed 36 inches.

4. The vertical centerline distance between horizontal rows of openings shall not exceed 96 inches.

5. The minimum pouring opening size shall be 18-inch by 18-inch.

6. The bottom of the lower openings shall be no more than 48 inches from the top of the wall-footing.

7. Under no circumstances shall forming be such that the drop of concrete in the forms will exceed 8 feet in any one place.

C. Blockouts

There shall be no blockouts or other types of wall-openings other than those shown on the Drawings.

D. Remove Wood Splinters

1. CONTRACTOR shall remove all wood splinters on concrete surfaces after stripping of wood forms.

2. Such work shall be completed before sandblasting of exterior wall surfaces may be started.

E. Bulkheads

1. Bulkheads to form vertical wall joints shall be strong enough to withstand concrete pressures during pouring and vibrating, and shall be properly placed between the forms and against the waterstop to avoid mortar seepage.

2. Holes shall be provided in the bulkheads to permit passage of horizontal mild steel reinforcing where required by the Drawings.

3. Unless these are specifically called for on the Drawings, no chamfer strips shall be placed in the corners of vertical construction joints of reservoir walls.

F. Form Removal

1. Forms may be removed as soon as the concrete has developed sufficient strength to prevent sagging, excess deflection, misalignment, spalling, cracking, breaking of edges and surfaces, and any other damage to the concrete.

2. Removal of wall and column forms shall not be started any sooner than 12 hours of accumulated time with the ambient air temperature above 50 degrees F after completion of the wall or column pour, respectively.

Hammering or prying against concrete surfaces to remove forms is prohibited.

G. Alignment and Tolerances

1. Every precaution shall be taken to see that all forms are in the proper alignment, plumb, placed to correct radius, and that all form supports are secure and tight.

2. Form sills shall be used to contain or hold down neoprene pads and facilitate proper alignment of forms. The maximum permissible variation in the horizontal and vertical location of the waterstops, neoprene pads and seismic cables (if required) is plus or minus 1/4-inch.

3. The maximum permissible variation in reservoir radius, as measured from the center of the reservoir to the inside wall surface at the bottom, is plus or minus 3/8-inch.

4. The out-of-round tolerance is: 3/4-inch in 50 feet, 3/8-inch in 10 feet, and 3/16-inch in 24 inches from the true curvature specified at any point on the wall.

5. The maximum permissible variation in the vertical alignment, from the bottom to the top of the wall, is plus or minus 3/8-inch.

6. The allowable tolerance in the average wall thickness for poured walls shall not vary more than 1/8-inch either way. All transitions from plus to minus shall be gradual, even and smooth, and without abrupt changes in the surfaces.

7. Adequate time and cooperation shall be provided to the Inspector to verify the compliance of these requirements prior to closing up the forms or pouring concrete.

H. Slipform

The use of slipform construction on liquid-retaining walls will not be permitted on any part of the reservoir.

I. Gaps between Wall and Wrapped Wire

Irrespective of what has been stated elsewhere in this section, the forming and bracing method shall be such that no gaps between the wrapped wire and the corewall will develop which exceed 3/8-inch at any place on the wall.

3.8 ROOF FORMS

A. Form Finish and Alignment

The finished form surface shall be smooth, true to elevation and alignment and all joints between boards, plywood sheets or form panels shall be mortar-tight, or be made mortar-tight by taping or other means as the situation calls for, before any concrete pour may be started.

B. Form Removal

1. Removal of the forms will be permitted only when the concrete has attained 90 percent of its design strength (verified by cylinder tests) and no sooner than 7 days (168 hours) of cumulative time above 50 degrees F after concrete installation.

2. As soon as the forms have been removed, the CONTRACTOR will carefully examine the top and bottom surface of the concrete for any defects in the concrete or irregularities in the surface which shall be repaired as required.

3. Hammering or prying against concrete surfaces to remove forms is prohibited.

C. Form Adjust and Release

The CONTRACTOR shall provide either wedges under timber posts, screw jacks under shoring, or provide other means to adjust the forms and relieve the load.

D. Tolerance

1. Unless stated otherwise on the Drawings, the permissible tolerance at any point for flat or dome-roof form-surfaces shall not exceed plus or minus 1/4-inch from the specified elevation or thickness. The finished roof surface shall be capable of completely draining. CONTRACTOR shall camber or provide necessary forming supports to prevent low spots and to ensure drainage. If low spots should occur, CONTRACTOR shall submit a corrective procedure to the ENGINEER for approval.

2. Any transition between high and low points shall be gradual, smooth and even, and shall be to the satisfaction of the ENGINEER.

3.9 BULKHEADS AND SCREEDS FOR FLOORS AND ROOFS

A. Unless free-spanning vibrating and finishing screeds are used, sufficient floor and roof screeds shall be installed to ensure that the finished concrete surface will conform to the slopes, elevations, and tolerances specified in these documents.

B. Screeds and bulkheads shall be set to specified alignment and elevations permitting a maximum tolerance of 1/4-inch plus or minus.

C. All transitions between high and low points shall be gradual, smooth and even, and shall be to the satisfaction of the ENGINEER.

3.10 SURFACE FINISHES

A. Smooth Form Finish

1. Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view, or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, dampproofing, painting or other similar system.

2. Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

3. Curb finishes: Curbs shall be screeded off accurately to true lines and planes or warped surfaces as indicated or directed. Finish smooth. Arises shall be true and straight or properly eased where curved and neatly rounded with approved tool. Smooth trowel finish with corners rounded to 3/4-inch radius.

B. Wood-Float Finish

1. This requires an integral finish by wood-float after screeding, to compact the surface evenly.

2. Any excess surface water shall be removed before floating and no mortar shall be used for leveling.

3. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing or sand bed terrazzo, and as otherwise shown on drawings or in schedules.

4. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float, or both. Consolidate the surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding 1/4-inch in 10 feet when tested with a 10-foot straightedge placed on surface at not less than two different angles. Cut down high spots and fill at low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

C. Steel Trowel Finish

1. This shall be an integral finish obtained by trowelling with a steel trowel after the surface has been floated and allowed to stand until all water-sheen has disappeared.

2. Final trowelling shall be done after the concrete has hardened sufficiently to prevent drawing moisture and fine materials to the surface and when the concrete is sufficiently hard that no mortar accumulates on the trowel.

3. Cement, or mixture of cement and sand, shall not be spread on surfaces to absorb excess water or to stiffen the concrete.

4. Trowelling shall produce a dense, smooth, impervious surface free from defects and blemishes.

5. All finished top surfaces of wall and wall-corbel (if required), column-footings (if required), and floors shall receive a smooth, even, level, and hard (so called "burnt") steel trowel finish. The entire wall footing surface, particularly along each side of the circumferential waterstop in the area to receive neoprene pads, shall also receive a hard steel trowel finish.

D. Non-Slip Broom Finish:

1. Apply non-slip broom finish to exterior and interior concrete platforms, steps and ramps and elsewhere as shown on the drawings or in schedules.

2. Immediately after trowel finish, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the ENGINEER before application.

E. Unformed Surfaces

1. Unformed surfaces which will not be exposed in the completed work shall be brought to required finished elevations and left true and regular.

F. Screeds

1. Sufficient screeds, unaffected by form deflections under concrete loads, shall be installed to ensure an even concrete surface, true to grade and elevation, without unacceptable local depressions of any sort.

2. Screeds shall be set to the required levels and be approved by the ENGINEER before any concrete may be placed.

G. Form Tie Holes

1. Tie holes shall be thoroughly sandblasted or roughened. After the taper tie holes have been cleaned, plugs, as specified in Section 03 30 00 - 2.12 B.3, shall be installed in the middle third of the corewall. The tie holes shall then be coated with a water insensitive epoxy or an acceptable bonding agent and properly filled through damp-packing with a mortar of dry consistency and a mix of one part of cement to one part sand. The amount of water to be added to the cement-sand mix shall be such that the mortar can be driven into the voids and will compact properly. The outside of the tie hole shall be drypacked no sooner than 7 days after the inside has been drypacked.

2. Embeco or other fast-setting cements/additives shall not be used for damp-packing such cavities.

3. Interior reservoir wall surfaces which have been damp-packed shall be covered with an approved 10-mil thick water insensitive non-sag epoxy coating, which shall conform to the requirements specified herein. Finished surfaces shall be free from sand streaks or other voids.

H. Abrasive Blasting

1. The exterior surface of poured concrete wall areas, which will receive wire-wrapped prestressing/shotcrete or paint, if any, shall be abrasive blasted, regardless of the forming method used, by a mechanical etching or shot blast system combined with a vacuum recovery system, or a self-contained waterblasting system.

2. The surface shall be blasted sufficiently to remove all laitance, form oil or other type coatings.

3. The surface shall be cut sufficiently to provide a good mechanical bond between the shotcrete covercoat and the concrete wall. The surface shall be cut to a minimum CSP5 profile, was established by the International Concrete Repair Institute (ICRI), over a minimum 90 percent of the area as measured over any one foot square area.

4. Systems that have not been used in the past to prepare circular tank wall surfaces for shotcreting and strandwrapping or systems which rely on sandblasting or steel shot without a vacuum system will not be allowed.

5. All abrasive blasting shall be done to the satisfaction of the ENGINEER, and this work shall not be started before the completion date of the curing period or before all the tie-holes have been drypacked.

I. Honeycombed areas

1. Unless the removal of one or more defective panels is required by the ENGINEER, defective surfaces, such as honeycomb, shall be cut out entirely until homogeneous concrete is met, even if it means going through the entire wall, floor or roof slab. Removal of defective areas must be performed in a way as to avoid damage to all embedded items such as reinforcing steel, vertical threadbars, waterstops, or any other items.

2. Such areas shall be coated with an approved epoxy or adhesive bonding material, which shall be applied in accordance with the manufacturer's instructions, before damp-packing the area with a mix consisting of one part of Portland cement and two parts of sand and fine gravel, epoxy and sand mix, or any combination of materials and mixes as the situation dictates in the opinion of the ENGINEER.

3. The water content of the damp-pack material shall be such that a ball of the mix may be squeezed in the hand without bringing free water to the surface.

4. Damp-pack material shall be tamped into place and finished to match adjacent concrete surfaces.

5. Particular care shall be taken that no sagging of the material will occur.

6. The bond between any two layers of damp-pack shall be improved through the use of an approved epoxy bonding agent.

7. Surfaces which have been damp-packed shall be kept continuously damp during, and for a period of not less than 7 days after completing the damp-pack operation, by the curing procedure described below in Section 03 30 00 - 3.11.

8. Under no circumstances shall CONTRACTOR apply a plaster coat over the honeycomb areas to conceal the existence of the honeycomb in the concrete.

9. Neither Embeco, calcium chloride, nor fast-setting cements/additives shall be used for filling honeycomb areas, nor shall they be mixed with damppack material. CONTRACTOR shall provide certification that any material placed on or in the corewall shall be free of chlorides and other materials corrosive to prestressing steel.

10. Determination of defective areas is at the discretion of the ENGINEER.

J. Miscellaneous Surfaces

1. Miscellaneous surfaces that are not covered herein and not specifically designated on the Drawings shall be finished as directed by the ENGINEER.

K. Schedule of Finishes

Surface Description	Finish Required
Vault:	
Interior Floor	Steel Trowel Finish
Interior of Wall	Smooth Form Finish
Exterior of Wall	Smooth Form Finish
Underside of Roof	Smooth Form Finish
Surface of Roof	Steel Trowel Finish

3.11 CURING

A. The Contractor shall begin curing immediately after initial concrete set has occurred. Exposed concrete surfaces shall be kept moist during finishing operations prior to initiating specified curing procedures.

B. Curing of the roof and floor slabs shall be made by covering the slab with curing blankets, which incorporate a water containing felt or burlap element and a white plastic cover, and kept continuously wet for a period of no less than 7 days (168 hours). After removal of curing blankets the slab shall be sprayed with a curing compound as specified in Section 03 30 00 - 2.16.

C. All other horizontal, screeded and floated surfaces, exposed to drying winds and sunlight, shall be sprayed with a curing compound as specified in Section 03 30 00 - 2.16 at an application rate of 200 sf/gallon or more as recommended by the manufacturer.

D. Water for curing shall be generally clean and free from any elements which might cause staining or discoloration of the concrete.

E. All formed concrete surfaces shall be sprayed with a concrete curing compound as specified in Section 03 30 00 - 2.16 at an application rate of 200 sf/gallon, or as recommended by the product manufacturer, whichever provides the most coverage. This requirement will be waived if the forms have been left in place for at least 7 days.

3.12 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas

1. Repair and patch defective areas with cement mortar immediately after removal of forms but only when directed by the ENGINEER.

2. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter and holes left by tie rods and bolts down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the ENGINEER.

3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

B. Repair of Formed Surfaces

1. Repair exposed-to-view formed concrete surfaces that contain defects, which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the ENGINEER. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolt; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.

2. Repair concealed formed concrete surfaces that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects, as such, include cracks in excess of 0.01-inch wide, cracks or any width and other surface

deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.

C. Repair of Unformed Surfaces

1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.

3. Repair finished unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.

4. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so those repairs can be made without damage to adjacent areas.

5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the ENGINEER.

6. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with a neat cement grout coating, or use concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same material to provide concrete of the same type or class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over 1-inch in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of 1-part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as

required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

8. Repair methods not specified above may be used subject to the acceptance of the ENGINEER. Alternate repair methods must be submitted and approved by the Engineer prior to installation.

3.13 CONCRETE TESTS

A. Compression tests shall conform to ASTM C39, ASTM C670 and ASTM C803.

B. Proportioning (or chemical analysis) tests shall conform to ASTM C1084.

C. Air content: ASTM C231, pressure method; one for each set of compressive strength test specimens. If air content is found to be out of conformance during site concrete testing, air content will be checked for every 9-cubic yard truck delivered to the site until three consecutive trucks are found to have air content meeting the specification. Testing will then return to rate outlined in 03 30 00 - 3.13.E

D. Slump Test: ASTM 143; one test for each concrete load at point of discharge; and one for each set of compressive test specimens.

E. At least one slump test and five test cylinders shall be made, under the supervision of the ENGINEER, by an approved testing lab for every 40 cubic yards of ready-mixed concrete delivered to the jobsite. Each cylinder shall be coded to identify the date of delivery, the truck number, the location where the concrete has been used and the slump measured upon discharge. For each reservoir wall section, two sets of five cylinders shall be made. When the frequency of testing will provide less than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

F. The specimens shall be standard test cylinders, 6 inches in diameter, 12 inches in length, and they shall be prepared in accordance with ASTM Standard C31.

G. Molds for the standard test cylinders shall be furnished by the independent testing laboratory contracted by the OWNER at the expense of the OWNER.

H. All costs for making and testing of concrete and materials, by an approved recognized reputable testing laboratory, will be borne by the OWNER.

I. Making and testing of cylinders shall be performed by an approved testing laboratory that normally engages in the preparation of concrete mix designs and testing of concrete materials.

J. A compression test may be made on one cylinder from each group of five after 7 and/or 14 days, at the ENGINEER's option. A strength test shall be made using two cylinders from each group of five at 28 days for use in evaluating the concrete strength in accordance with the current editions of the IBC and ACI 318.

K. As requested by the ENGINEER, proportioning tests for each class of concrete delivered to the jobsite, shall be made from test cylinders designated by the ENGINEER.

L. In addition to the test cylinders referred to in Section 03 30 00 - 3.13.E, an additional three test cylinders shall be made for each day's pour, or for every 4,000 square feet of wall and roof surface, whichever provides the largest number of cylinders.

They shall be cured in the same manner, and in the same location of the concrete area to be investigated. Before walls may be prestressed, or before roof-forms may be stripped, at least one cylinder, of each batch of three cylinders, must be tested to verify whether the in-place concrete strength meets the minimum specified design strength.

M. The method of determining the standard deviation of compressive concrete strengths from previously utilized mix designs having previously recorded test results and the minimum allowable average compressive strengths of mix designs not having any previously recorded test results shall comply with the requirements of the code and commentary sections in the current edition of ACI 318.

N. The compressive test results of the cylinders referred to in Section 03 30 00 - 3.13.J above will be compared against the strength-versus-slump relationship curves referred to in Section 03 30 00 - 1.4 B. Proportioning tests may then be made, at the discretion of the ENGINEER, on those groups of cylinders which have shown low readings.

O. Any concrete not meeting the minimum specified design strength and any concrete showing a cement content less than the ratio by weight established in the original mix design will be subjected to further testing of concrete cores complying with ASTM C42 taken from the concrete in question. Should these tests confirm that the specified requirements have not been met, the extra costs involved in such testing shall be borne by CONTRACTOR; and the concrete, at the ENGINEER's option, and at CONTRACTOR's sole expense, may be rejected and must then be removed from the site or may be strengthened with additional shotcrete or concrete as the situation warrants it. Should the core tests indicate that the strength requirement has been met or if the low strength concrete is deemed acceptable to the ENGINEER, the extra costs involved in such testing shall still be borne by the CONTRACTOR.

END OF SECTION

SECTION 03 60 00 - GROUTING

1.1 SUMMARY

A. This Section includes all work necessary to form, mix, place, cure, repair, finish, and do all other work as required to produce finished grout, in accordance with the requirements of the Contract Documents.

B. Work covered in this Section includes:

1. Grouting
2. Removal of loose and spalling grout and concrete
3. Anchoring, patching, grouting, and sealing

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-In-Place Concrete

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications, codes, and standards shall be as specified in Section 03 30 00, Cast-In-Place Concrete and as referred to herein.

B. Commercial Standards:

1. CRD-C 621, Corps of Engineers Specification for Non-Shrink Grout

2. ASTM C109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)"

3. ASTM C531, "Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes"

4. ASTM C579, "Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes"

5. ASTM C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"

1.4 SUBMITTALS

A. Certified Test Results: Verifying the compressive strength, shrinkage, and expansion requirements specified herein.

B. Manufacturer's Literature: Containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout used in the work.

1.5 QUALITY ASSURANCE

Field Tests

A. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the ENGINEER to ensure continued compliance with these specifications. The specimens will be made by the ENGINEER or its representative.

B. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the ENGINEER. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

C. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at the cost of the CONTRACTOR.

D. The cost of all laboratory tests on grout shall be borne by the CONTRACTOR and the CONTRACTOR shall obtain the specimens for testing. The CONTRACTOR shall also be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.

PART 2 PRODUCTS

2.1 PREPACKAGED GROUTS

A. Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents, unless another type is specifically referenced.

B. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, non-corrosive, non-chloride, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

C. Class A non-shrink grouts shall have minimum 28-day compressive strength of 5,000 pounds per square inch (psi); shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and

shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRDC 621.

D. Class B non-shrink grouts shall have minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD C621.

E. Application

1. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

2. Class B non-shrink grout shall be used or the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

2.2 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.3 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers approved by the ENGINEER. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of Class A non-shrink grout shall provide on-site technical assistance upon request.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 GROUTING PROCEDURES

Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

END OF SECTION

SECTION 07 92 00 - SEALANTS AND CAULKING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal.

B. Section includes:

1. Sealants
2. Filler gaskets
3. Primers and bond breakers

1.2 DEFINITIONS

A. Sealants: Where the words "sealants" or "caulking" are used in this text, they shall be considered to be synonymous and shall mean sealant or caulking compounds as specified under Part 2 of this specification.

1.3 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Product data and materials list of items proposed to be provided under this Section.

C. Sufficient technical data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Type A Sealant

1. Application: General building sealant.

2. Material: One component polyurethane sealant.

   a. Vulkem 116, as manufactured by Tremco.
   b. Sonolastic NP1, as manufactured by BASF.

B. Type B Sealant

1. Application - General building sealant for wide joints.

2. Materials - Self leveling one component polyurethane.

   a. Vulkem 45, as manufactured by Tremco

C. Filler Gasket (Backer Rod) Cord Strip

1. Ethafoam, as manufactured by Dow Chemical
2. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn
3. Equal, as approved by ENGINEER

PART 3 EXECUTION

3.1 PREPARATION

A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.

B. Brush out all foreign matter and loose particles.

C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

A. Primers and Bond Breakers

1. Apply to surfaces as required; verify with manufacturer.

2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.

3. Prime wood surfaces where specifically required.

4. Use proper type primers and bond breakers, apply per sealant manufacturer's printed instructions.

B. Sealants

1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.

2. If caulking systems for such joints are not shown, provide as specifically approved.

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).

2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.

3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per manufacturer's printed instructions.

4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.

5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

A. Remove all damaged, defective or improperly installed sealant and/or caulking and replace.

B. Clean and remove all sealant and caulking from adjacent surfaces.

C. Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

SECTION 09 80 01

PROTECTIVE COATING FOR SEWER STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.

B. This specification is applicable to the lift station wet well, when specified on the plans.

C. This section covers work, materials and equipment required for protecting and/or rehabilitating concrete, metal and masonry structures and other underground vaults by spray-application of a coating system to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity as required.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM D638 - Tensile Properties of Plastics.

B. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.

C. ASTM D695 - Compressive Properties of Rigid Plastics.

D. ASTM D 7234 (Concrete) - Pull-off Strength of Coatings Using a Portable Adhesion Tester

E. ASTM D 4541 (Steel) - Pull-off Strength of Coatings on Steel

F. ASTM D2584 - Volatile Matter Content.

G. ASTM D2240 - Durometer Hardness, Type D.

H. ASTM D543 - Resistance of Plastics to Chemical Reagents.

I. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.

J. ACI 506.2-77 - Specifications for Materials, Proportioning, and Application of Shotcrete.

K. ASTM C579 - Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.

L. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.

M. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.

N. Los Angeles County Sanitation District – Evaluation of Protective Coatings for Concrete.

O. ASTM F1216 (Including Appendix XI-X7): Design Parameters for Buried Structures (structural rehabilitation) utilizing the External Buckling Equation for thickness determination.

P. ASTM D2990: Test Methods for Tensile, Compressive and Flexural Creep and Creep Rupture in Plastics

Q. SSPWC 210-2.3.3 - Chemical resistance testing published in the Standard Specifications for Public Works Construction, 1997 edition (otherwise known as "The Greenbook").

R. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.

S. ICRI - International Concrete Repair Institute

1.3 SUBMITTALS

All materials and procedures required to establish compliance with the specifications shall be submitted. Submittals shall include at least the following:

A. Technical Data Sheet on each product used.

B. Materials Safety Data Sheet (MSDS) for each product used.

C. ASTM References.

D. Independent Third-Party Test Reports from Certified and Accredited Laboratories

E. Descriptive literature, bulletins, and/or catalogs of materials.

F. Work procedures including flow diversion plan, method of repair, etc.

G. Material and method for repair of voids and concrete spalling in structures.

H. Material and method of repair of leaks or cracks in structures.

I. CONTRACTOR and Manufacturer Qualifications

1. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used. Certification letter shall be dated within six months of bid date.

2. The Manufacturer shall provide four (4) references which demonstrate previous successful projects completed for the specified structural protective coating system or comparable, during the last two (2) years.

3. Certification that the equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment. Certification letter shall be dated within six months of bid date.

4. Proof of any necessary federal, state or local permits or licenses necessary for the project.

J. Final installation report on completed structures.

K. Sample warranty signifying the applicator provide warranty repairs.

L. Manufacturer's Material Warranty

M. Traffic control plan.

1.4 WARRANTY

Protection coating system shall provide a minimum of a 3-year manufacturer's product and applicator's application warrantee against coating failure. "Failure" will be deemed to have occurred if the protective lining fails to (a) prevent the internal deterioration or corrosion of the structure (b) protect the substrate and environment from contamination by effluent or (c) prevent groundwater infiltration. If any such failure occurs within 3 years of initial completion of work on a structure, the damage will be repaired to restore the lining at no cost to the OWNER within 60 days after written notification of the failure.

1.5 QUALITY ASSURANCE

A. Furnish materials of quality required by the American Society for Testing and Materials (ASTM) or other approved standards and specifications. CONTRACTOR shall initiate and enforce quality control procedures consistent with the coating product(s) manufacturer recommendations and applicable NACE or SSPC standards as referenced herein.

B. The manufacturer and applicator of the total liner system of wastewater structures shall be a company that specializes in the design, manufacturer, or installation of corrosion protection systems for wastewater structures. Applicator shall be completely trained in leak repair, surface preparation, and corrosion materials

application on wastewater structures. Corrosion materials/products shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner.

C. The applicator shall be trained and certified by the manufacturer for the handling, mixing, application and inspection of the liner system as described herein. CONTRACTOR shall submit certificates and qualifications to indicate that they are certified by and trained by the coating product manufacturer to apply the liner products as identified in this section.

D. To ensure total unit responsibility, all materials and installation thereof shall be furnished and coordinated with one applicator who turnkeys the work and assumes full responsibility for the entire operation.

PART 2 PRODUCTS

2.1 NEW STRUCTURES

A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Generally, 28 days is adequate cure time for standard Portland. If earlier application is desired, compressive or tensile strength of the concrete can be tested to determine if acceptable cure has occurred. (Note: Bond strength of the coating to the concrete surface is generally limited to the tensile strength of the concrete itself. Engineer may require pull tests to determine suitability of concrete or metal for coating)

B. Cementitious patching and repair materials should not be used unless they or the coating manufacturer provides information as to its suitability and procedures for topcoating with the approved coating. Project specific submittals should be provided including application, cure time and surface preparation procedures which permit optimum bond strength with the approved coating.

C. Remove existing coatings prior to application of the new protective coating. Applicator is to maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

2.2 STRUCTURE REPAIR MATERIALS

A. Repair materials shall be used to; fill voids, bugholes, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the engineer and protective coating applicator. Repair materials must be compatible with the specified coating and shall be applied in accordance with the manufacturer's recommendations.

B. The following products may be accepted and approved as compatible repair basecoat materials for approved topcoating for use within the specifications:

1. 100% solids, solvent-free grout specifically formulated for approved topcoating compatibility. The grout manufacturer shall provide instructions for trowel or spray application and for approved topcoating procedures.

2. Factory blended, rapid setting, high early strength, non-shrink cementitious or epoxy repair mortar that can be trowelled or pneumatically spray applied may be approved if specifically formulated to be suitable for approved topcoating. Such repair mortars should not be used unless their manufacturer provides information as to its suitability for topcoating with the approved topcoating. Project specific submittals should be provided including application, cure time and surface preparation procedures which permit optimum bond strength with the approved coating.

3. In the case of excessive infiltration, a hydraulic cement or plug may be used to stop the flow of the infiltration. Approved manufacturers include Strong, or approved equal. The hydraulic cement shall be compatible with the spray applied coating.

2.3 PROTECTIVE COATING SYSTEM

A. The coating system shall provide a corrosion resistant coating system that restores vertical or conical wall profiles to their original surface shape and dimensions and eliminates moisture travel through the concrete, brick, steel and grout substrates. The coating system shall remain integral to and joint free at transition points such as manhole floors, concrete flow troths and frames and covers. The materials to be utilized in the lining of structures shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Lining shall be resistant to wastewater of at least 110 degree temperature.

B. Manufactures

1. Spraywall, by Sprayroq.

2. Or approved equal

C. PROTECTIVE COATING MATERIAL

1. The resin based material shall be used to form the sprayed structurally enhanced monolithic liner covering all interior surfaces of the structure, including benches and inverts of manholes. The finished liner shall be 100% Solids polyurethane and conform to the minimum physical requirements listed below. The physical requirements must be verified by an independent, certified, third party testing laboratory within the last five years and must be submitted for the prior to application.

Compressive strength	ASTM D 695	> 18,000 psi

Tensile strength	ASTM D 638	> 7,450 psi
Bond (Concrete)	ASTM D7234	> 200 psi

Or Substrate Failure

Bond (Steel)	ASTM D4541	> 1,600 psi
Flexural Modulus (Initial)	ASTM D 790	> 735,000 psi
Flexural Modulus (Long Term)	ASTM D 2990	529,200 psi
Flexural Strength (Initial)	ASTM D 790	>14,000 psi
Flexural Strength (Long Term)	ASTM D2990	10,080 psi
Density		87 ± pcf
Chemical Resistance:	ASTM D543	

Severe Municipal Sewer: All types of service

Successful Pass: Sanitation District of L.A. County Coating Evaluation Study or SSPWC 211-2

2. When the wall of the resin based liner is to be structurally designed to withstand the hydraulic load generated by the groundwater table the long term (50yr) value of the flexural modulus of elasticity will be utilized to calculate the thickness of the structural liner. The initial flexural modulus of elasticity (short term) of the submitted resin material will be utilized with the long term deformation percentage as determined by ASTM D2990 (see below) in the design equations outlined in ASTM 1216-09, Appendix X1-X7 (Circular Geometries) or Flat Wall Beam Analysis for walled structures. The value of the long term flexural modulus of the proposed product will be certified by an independent, certified, third party testing lab, independent of the Manufacturer and submitted prior to application.

3. When groundwater loading is not an issue and only a corrosion barrier is required, the rehabilitation lining shall be installed to the thickness necessary to qualify as a monolithic (void free) liner. The roughness of the substrate will dictate the thickness needed to create the monolithic liner and eliminate any opportunity for voids in the lining. The minimum value for coating thickness for corrosion protection for non-structural rehabilitation shall be 125 mils and structural shall be a minimum 250 mils.

4. PROTECTIVE COATING APPLICATION EQUIPMENT

a. Manufacturer approved spray equipment shall be used in the application of the specified protective coating.

PART 3 EXECUTION

3.1 NOT USED

3.2 EXAMINATION

A. Prior to commencing surface preparation, the Coating System CONTRACTOR shall inspect all surfaces specified to receive the coating and notify OWNER, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein. The use of acid for cleaning purposes, no matter how diluted, will not be allowed.

B. Prior to entering structures, an evaluation of the atmosphere will be conducted to determine the presence of toxic, flammable vapors or possible lack of oxygen. The evaluation shall be in accordance with local, state or federal safety regulations. A positive flow ventilation system shall be installed to ventilate the manhole during construction.

3.3 SURFACE PREPARATION

A. Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed.

B. Surface preparation methods shall produce a cleaned, abraded and sound surface with no evidence of laitance, loose concrete, brick or mortar contaminants or debris, and shall display a surface profile suitable for application of the coating system, a minimum ICRI Concrete Surface Profile (CSP) 4 or a 60-grit sandpaper profile is recommended.

C. Concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that sound substrate remains.

D. Choice of surface preparation method(s) should be based upon the condition of the structure and concrete or masonry surface, potential contaminants present, access to perform work, and required cleanliness and profile of the prepared surface to receive the coating product(s).

E. Surface preparation method, or combination of methods, that may be used include high pressure water cleaning of a minimum 3,500 psi at 4.5 gpm, water jetting, abrasive blasting, shot blasting, grinding, scarifying, detergent water cleaning, hot water blasting and others as referenced in NACE No. 6/SSPC SP-13. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean

neutralized surface suitable for the specified coating product(s). CONTRACTOR shall prevent and remove, where necessary, large debris from the structure so as to prevent sewer clogging.

F. After completion of the surface preparation, review the following check list, which is the inspection for the following:

- Leaks
- Cracks
- Holes
- Exposed Rebar
- Ring and Cover Condition
- Invert Condition
- Inlet and Outlet Pipe Condition

G. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for top coating with the specified protective coating.

3.4 APPLICATION

A. Temperature of the surface to be coated shall be maintained between 60°- and 120°- degrees F or as recommended by the manufacturer.

B. Surfaces to receive protective coating shall be dry to the touch and or with no visible dampness. This is to insure maximum adhesion to the substrate.

C. Specified surfaces should be shielded to avoid exposure of direct sunlight or other intense heat source. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.

D. Appropriate personal protection equipment shall be utilized but in every case when applying the liner, the sprayer and personnel in direct contact with the spray atmosphere, will always be protected by supplied air.

E. Coat all interior surfaces with the approved coating system in strict accordance with the manufacture's recommendations. Coating shall be field applied. Coating system shall be continuous from the manhole invert and extend upward to bottom of the manhole frame . Exterior surfaces are not to be coated. For large diameter pipes the coating will be continuous and extend into the structure and have a minimum coverage of 6" circumference around the pipe penetration. If any attachments are scheduled for installation or are existing in a structure, the fasteners shall be installed/embedded into the concrete structure prior to the coating system application to ensure a uniform seal around the protruding fasteners. A permanent identification and date of work

performed shall be affixed to the structure in a readily visible location within the structure.

F. Coating finish shall be as smooth as the surface being coated.

G. The structure should be allowed to cure for 24 hours, or as recommended by the manufacturer and return to ambient temperature prior to any physical testing, including vacuum testing.

H. The applicator shall provide a final written report to ENGINEER detailing the structure location, structure number or unique identifier (provided to the CONTRACTOR by the ENGINEER), date or report, date of installation, and description of installation.

3.5 TESTING

A. CONTRACTOR shall notify the ENGINEER upon completion of surface preparation work. ENGINEER may conduct visual inspections of surface preparation work and request additional preparation work be provided to properly allow adhesion of repair and coating products if necessary.

1. High Voltage Spark Test. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. This test is critical when applied to corrosion protection applications (i.e. mil coatings less than 250 mils). Sufficient drying or curing of the coating shall be allowed prior to conducting a test. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations. Unless otherwise specified, re-testing of only the repaired areas shall be in accordance with the above outlined procedures.

2. Adhesion Testing. The adhesion tests shall be performed on a minimum of one or 10% of all rehabilitated structures, whichever is greater, or as shown on the Plan and/or specified in the Special Provisions. Adhesion testing shall be conducted after the lining or coating system has cured per manufacturer instruction and in accordance with ASTM D4541(Steel) or ASTM D7234(Concrete). Adhesion is critical for proper performance of a corrosion barrier (i.e. < 250 mils). A minimum of one 20 mm dolly shall be affixed to the lined surface of the structure at the upper section or cone area, mid section and at the bottom, unless otherwise specified in the Special Provisions. Each testing location shall be identified by the Engineer. The adhesive used to attach the dollies to the liner shall be rapid setting with tensile strength in excess of the liner material and permitted to cure in accordance with

manufacturer recommendations. The lining material and dollies shall be adequately prepared to receive the adhesive. Prior to the pull test, the Contractor shall utilize a scoring device to cut through the coating until the substrate is reached. Extreme care shall be required while scoring to prevent micro cracking in the coating, since cracks may cause failures at diminished strengths. Failure due to improper dolly adhesive or scoring shall require retesting. The pull tests in each area shall meet or exceed 200 psi. and shall include subbase adhered to the back of the dolly or no visual signs of coating material in the test hole. Pull tests with results between a minimum 150 psi and 200 psi shall be acceptable if more than 50% of the subsurface is adhered to the back of the dolly. A test result can be discarded, as determined by the Engineer, if there is a valid nonstatistical reason for discarding the test results as directed by Sections 8.4 and 8.5 of ASTM D4541 and ASTM D7234. If any test fails, a minimum of three additional locations in the section of the failure shall be tested, as directed by the Engineer. If any of the retests fail, all loosely adhered or unadhered liner in the failed area, as determined by the Engineer, shall be removed and replaced at the Contractor's expense. If a structure fails the adhesion test, one additional structure or 10% of the initial number of structures selected for testing shall be tested at the discretion of the Engineer.

B. A final visual inspection shall be made by the Inspector and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired

END OF SECTION

SECTION 11 05 00 - COMMON WORK RESULTS FOR EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing and operation of equipment and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents.

B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise specified or shown.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. All equipment, products and their installation shall be in accordance with the following standards, as applicable and as specified in each section of these specifications:

1. ASTM International (ASTM)
2. American Public Health Association (APHA)
3. American National Standards Institute (ANSI)
4. American Society of Mechanical Engineers (ASME)
5. American Water Works Association (AWWA)
6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
7. American Welding Society (AWS)
8. National Fire Protection Association (NFPA)
9. Federal Specifications (FS)
10. National Electrical Manufacturers Association (NEMA)
11. Manufacturer's published recommendations and specifications
12. Colorado Occupational Safety and Health Division (CO-OSHA)

B. The following standards have been referred to in this Section of the specifications.

1. ASTM International:

a. ASTM A48 - Specification for Gray Iron Castings.

b. ASTM A108 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.

2. American National Standards Institute (ANSI):

a. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.

b. ANSI B16.5 - Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys.

c. ANSI B46.1 - Surface Texture.

d. ANSI S12.6 - Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors.

3. American Society Mechanical Engineers (ASME):

a. ANSI/ASME B1.20.1 - General Purpose Pipe Threads (Inch).
b. ANSI/ASME B31.1 - Power Piping.

4. American Water Works Association (AWWA):

a. AWWA C206 - Field Welding of Steel Water Pipe.

1.3 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Furnish complete shop drawings for all equipment specified in the various sections, together with all piping, valves, and controls for review by the ENGINEER.

2. Include calculations showing equipment anchorage forces and the capacities of the anchorage elements where required.

C. Special Tools:

1. Supply one complete set of special tools where necessary for the assembly, adjustment, and dismantling of the equipment.

2. Tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal.

D. Spare Parts:

1. Obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment.

2. Furnish the name, address and telephone number of the nearest distributor for each piece of equipment.

3. Spare parts shall be supplied when indicated in the appropriate equipment specification sections.

E. Torsional and Lateral Vibration Analysis:

1. Where required by the individual equipment sections, provide a torsional and lateral vibration analysis of the equipment, in accordance with Section 01 13 00, Submittals.

2. Equipment shall be designed and constructed such that the natural frequency of the drive train is avoided by a minimum of 25 percent throughout the entire operating range.

3. Analysis shall be performed by a specialist experienced in this type of work and approved by the Engineer.

   a. The specialist, or their assigned representative who shall similarly be experienced in this type of work and who shall be approved by the Engineer, shall visit the Site during startup and testing of the equipment to analyze and measure the amount of equipment vibration, certify that the operating frequency avoids the natural frequency by 25 percent, and make a written recommendation for keeping the vibration at a safe limit.

1.4 QUALITY ASSURANCE

A. Demonstrate all equipment meets the specified performance requirements. Provide the services of an experienced, competent, and authorized service representative of the manufacturer of each item of major equipment, who shall visit the Site to perform the following tasks:

1. Assist the Contractor in the installation of the equipment.

2. Inspect, check, adjust if necessary, and approve the equipment installation.

3. Start-up and field-test the equipment for proper operation, efficiency, and capacity.

4. Perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the ENGINEER.

5. Instruct the OWNER's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.

B. The costs of all inspection, startup, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the Contractor. When available, the Owner's operating personnel will provide assistance in the field testing.

C. Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts.

D. The type of finish shall be the most suitable for the application and shall be in accordance with ANSI B46.1.

E. Unless otherwise noted, all equipment furnished shall have a record from the same manufacturer of at least 3 years successful, trouble-free operation in similar applications.

1.5 DELIVERY, HANDLING, AND STORAGE

A. All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage.

B. Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.

C. All equipment shall be protected from exposure to corrosion and shall be kept thoroughly dry at all times.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Hearing Protection:

1. At each high noise level location, where equipment produces noise exceeding 85 dBA at 3 feet or exceeding OSHA noise level requirements for operator safety, supply two pairs of high attenuation hearing protectors.

2. Ear protectors shall meet the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz.

3. Hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband.

4. Protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the CONTRACTOR and mounted in an approved location near the noise producing equipment.

B. Welding:

1. Unless otherwise specified or shown, all welding shall be by the metal arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS.

2. Qualification of welders shall be in accordance with the AWS Standards governing same.

C. Protective Coatings:

1. All equipment shall be painted or coated in accordance with Section 09 90 00, Painting and Coating, unless otherwise indicated.

2. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil.

3. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

D. All equipment subject to vibration shall be provided with restrained spring type vibration isolators or pads per manufacturer's written recommendations.

E. Shop fabrication shall be performed in accordance with the Specifications and the Engineer-approved shop drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Design Loads:

1. All equipment supports, anchors, and restraint shall be adequately designed for static, dynamic, wind, and seismic loads.

2. The design horizontal seismic force shall be the greater of that noted in the general structural notes or as required by the governing building code (10 percent of gravity minimum).

B. Equipment foundations shall be as per manufacturer's written recommendations.

C. All equipment shall be mounted as shown on the manufacturer's standard details, unless otherwise shown or specified.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

2.4 FLANGES AND PIPE THREADS

A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125 or B16.5, Class 150, unless otherwise shown.

B. All pipe threads shall be in accordance with ANSI/ASME B1.20.1 and with requirements of Section 40 05 13, Common Work Results for Process Piping.

2.5 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts, three-piece spacer couplings or universal type couplings for extended shafts shall be installed.

B. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Taper-lock bushings may be used to provide for easy installation and removal on shafts of various diameters.

D. Where universal type couplings are shown, they shall be equipped with grease fittings.

2.6 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association (AFBMA).

B. All field-lubricated type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

C. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

D. Except where otherwise specified or shown, all bearings shall have a minimum B-10 life expectancy of 5 years or 20,000 hours, whichever occurs first.

E. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the manufacturer. Split type housings may be used to facilitate installation, inspection, and disassembly.

F. Sleeve type bearings shall have a Babbitt or bronze liner.

2.7 V-BELT DRIVES

A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA and RMA standards.

B. Unless otherwise specified, sheaves shall be machined from the finest quality gray cast iron.

C. All sheaves shall be statically balanced. In applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 feet per minute (fpm) may be required to be of special materials and construction.

D. To facilitate installation and disassembly, sheaves shall be furnished complete with taper-lock or QD bushings as required.

E. Finish bored sheaves shall be furnished complete with keyseat and set screws.

F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.8 DRIVE GUARDS

A. All power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910) requirements.

B. Guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened.

C. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.9 FLEXIBLE CONNECTORS

A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment.

2.10 GASKETS AND PACKINGS

A. Gaskets shall be in accordance with the requirements of Section 40 05 13, Common Work Results for Process Piping.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron type "V" packing shall be Garlock No. 432, John Crane "Everseal" or equal.

C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER.

2.11 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location.

B. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

PART 3 EXECUTION

3.1 WELDING

A. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions.

B. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed.

C. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions.

D. All sharp corners of material to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.2 COUPLINGS

A. The Contractor shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

B. Installation shall be per equipment manufacturer's printed recommendations.

3.3 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with his subcontractors.

B. If the packaged system has any additional features other than specified, the Contractor shall coordinate such features and furnish all material and labor necessary for a complete installation, as required by the manufacturer, at no additional cost to the Owner.

END OF SECTION

SECTION 26 05 00

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. Power Panels

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:

1) Over 100V: More than five feet from foundation wall: Use thick wall nonmetallic conduit.

2) Within five feet from foundation wall: Use rigid steel conduit

3) Under 100V: Use rigid steel conduit

4) Minimum size: 1 inch.

c. Outdoor Locations, Above Grade: Use rigid steel conduit.

d. In Slab Above Grade:

1) Use rigid steel conduit for circuits that are 24V or less.

2) Use rigid thick wall non-metallic conduit for 120V to 480V circuits.

3) Maximum Size Conduit in Slab: 2 inch, 1 inch for conduits that cross over each other, or with structural engineer's approval.

4) Conduits shall not be spaced closer than 3 conduit widths on center.

5) Aluminum conduit shall not be embedded in concrete.

6) Conduits shall not pass through a structural concrete beam without the structural engineer's approval.

e. In or under slab on grade:

1) Use rigid steel conduit for circuits that are 24V or less.
2) Use rigid thick wall non-metallic conduit.

f. Wet and damp locations: Use rigid steel conduit or aluminum conduit.

g. Dry locations:

1) Concealed: In walls or above ceilings, use rigid steel or aluminum conduit.
2) Exposed: Use rigid steel conduit or aluminum conduit.

h. Rigid Steel Conduit.

1) 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).

1) PVC conduit shall be heavy wall, schedule 40, shall be UL labeled for aboveground and underground uses.

j. PVC-Coated Rigid Steel Conduit.

1) 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.

2) Manufacturers: Ocal, PermaCote, or Robroy Industries.

k. Rigid Aluminum Conduit.

1) 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

1) Conduit: Moisture proof vinyl jacketed, liquid-tight, hot-dipped galvanized flexible steel and shall be UL labeled.

2) 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.

1) Luminaries and equipment supporting boxes: rated for weight of equipment supported.

2) Concealed installations.

b. Nonmetallic outlet boxes: ANSI/NEMA OS 2.

c. Cast Boxes: NEMA FB 1, Type FD, Cast Ferroalloy.

1) Provide gasketed cover by box manufacturer.
2) Provide threaded hubs.
3) Models VXF, GRFX as manufactured by Crouse-Hinds.
4) 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.

1) Material: Galvanized cast iron Cast aluminum in corrosive areas.

2) Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

3) 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.

1) Material: Galvanized cast iron.

2) Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.

3) Cover Legend: ELECTRIC.

4) Model: WPD as manufactured by Crouse-Hinds.

4. Large Junction Boxes and Wiring Gutters

a. Indoor Locations:

1) Steel, NEMA 12.

b. Outdoors:

1) Stainless steel.
2) Weather-tight NEMA 4.

c. Construction.

1) Provide rigid handles for box covers larger than 9 sq. ft. or heavier than 25 lbs.

2) Provide split covers for covers larger than 12 sq. ft.

3) 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:

1) Underground conduit runs.
2) Runs between concrete sections subject to relative movement.

b. Material:

1) Ferroalloy hubs.
2) Neoprene outer jacket.
3) Stainless steel jacket clamps.
4) Molded plastic inner sleeve.
5) Tinned copper braid grounding strap.

c. Model XD as Manufactured by Crouse-Hinds.

7. Expansion Fittings

a. Locations:

1) In long conduit runs, to permit linear movement caused by thermal expansion and contraction.

2) In long conduit runs to prevent conduit from buckling.

3) Indoors and outdoors, where conduit expansion occurs or where there is a wide temperature range.

4) At structural expansion joints.

b. Material:

1) End fittings: Ferroalloy.
2) 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

1) 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.

f) Service entrance and 4 AWG and above:

g) Conductors: Single, stranded, copper.

h) Insulation: 600V cross-linked polyethylene, UL Type XHHW/USE or THHN.

i) Suitability: Wet or dry locations at 75°C and 90° C copper temperature.

2) 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

1) 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.

2) 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

1) General Use:

a) Conductors: Single, tinned copper, 14 AWG

b) All conductors shall be stranded

c) Insulation: 600V thermoplastic, UL Type THWN/THHN.

d) Millivolt or Milliampere Instrumentation and Control.

e) Conductors: 18 AWG stranded copper, 2 or 3 as required.

f) Insulation: 15 mils, minimum, 90°C PVC.

g) Shield: Mylar aluminum tape with 20 AWG copper drain wire, fully covering conductors.

h) Jacket: 20 mils, minimum, 80°C PVC.

i) Suitability: Wet or dry steel conduit.

2) Manufacturers: Belden "UL Instrumentation Cable – 1032A", Samuel Moore "Dekoron ICMX" No. 1852-686 and 1862-686, or equal.

d. Telephone and Networking

1) 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.

2) Arc-Proofing Tape: Irvington "77 Arc-Proofing Tape", Slipknot No. 50 or Slipknot No. 3, or approved equal.

11. Wiring Devices

a. General:

1) Industrial Specification grade.
2) White.

b. Receptacles:

1) 120 V duplex outlets: NEMA 5-20R, 3 wire, grounding, 20A, 125 V, Leviton 5362, or approved equal.

2) 120 V duplex GFCI outlets: NEMA 5-20R, 3 wire, grounding, 20A, 125 V, Leviton 7899, or approved equal.

3) 240 V duplex outlets: NEMA 6-20R, 3 wire, grounding, 20A, 250 V, Leviton 5462, or approved equal.

4) Welding outlets: 50A, 125/250V, 3 pole, 4 wire, grounding, NEMA 14-50R, Leviton 55050, or approved equal.

c. Light Switches:

1) 277 V lighting circuits: 20 amp, 120/277 V, Leviton 1221-2W to 1224-2W, or approved equal.

12. Device Plates

a. General:

1) Mounting hardware countersunk and finished to match plate.
2) Provide over-sized plates where standard plates do not cover wall opening.
3) Provide engraving as indicated on drawings.

b. Indoors:

1) Surface mounted devices: Galvanized or cadmium-plated steel.
2) Flush mounted devices in other finished areas: Phenolic plastic, white.
3) All other flush mounted devices: Type 302 stainless steel.

c. Outdoors and Indoors when identified on Drawings as Weatherproof:

1) Weatherproof with spring doors for receptacles and with provisions for padlocking switches on and off.

2) 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. Power Panels

a. General:

1) Circuit breaker panel board.
2) With neutral.
3) Dead front.

b. Enclosure:

1) NEMA 12, surface in unfinished areas, NEMA 1 flush in finished areas or as indicated on the drawings.

2) Door with latch and lock.

3) Typewritten circuit directory.

4) 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:

1) Molded case thermal magnetic.

2) Multiple pole breakers shall be common trip.

3) Bolt-in.

4) Individually front replaceable.

5) Indicating "On", "Off", and "Tripped".

6) RMS symmetrical interrupting capacity shall be as indicated on the drawings.

7) Breakers, trip ratings, and number of poles as indicated on the drawings.

d. Buses:

1) Three phase and neutral bus insulated from cabinet.

2) Ground bus.

   a) Connected to cabinet.
   b) Clamp type lug for supply circuit and each load circuit.
   c) Removable bond to neutral bus.

3) Copper bussing.

4) Ampere and voltage ratings as indicated on the drawings.

5) Bracing coordinated with circuit breakers interrupting capacity.

15. Lighting Panels

a. General:

   1) Circuit breaker panel board.
   2) With neutral.
   3) Dead front.

b. Enclosure:

   1) NEMA 1 or as indicated on the drawings.

   2) Door with latch and lock.

   3) Typewritten circuit directory.

   4) 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:

   1) Molded case thermal magnetic.

   2) Multiple pole breakers shall be common trip.

   3) Bolt-in or plug-in.

   4) Individually front replaceable.

   5) Indicating "On", "Off", and "Tripped".

   6) 10,000 amp RMS symmetrical interrupting capacity at 240 V.

7) Handle clips to prevent casual operation for circuit breakers indicated on drawings.

8) Ground fault interrupting breakers with a sensitivity of 5mA for receptacle branch circuit and where indicated on drawings.

9) Breakers, trip ratings, and number of poles as indicated on the drawings.

d. Buses:

1) Two phase and neutral bus insulated from cabinet.

2) Ground bus.

a) Connected to cabinet.
b) Clamp type lug for supply circuit and each load circuit.
c) Removable bond to neutral bus.

3) Copper.

4) Ampere and voltage ratings as indicated on the drawings.

5) Bracing coordinated with circuit breakers interrupting capacity.

16. Equipment Disconnects

a. General:

1) Heavy-duty safety switches.
2) Square D or Cutler-Hammer.

b. Enclosure:

1) Indoor dry areas: NEMA 12.
2) Outdoor: NEMA 4X.
3) Corrosive Areas: NEMA 4X.
4) Use above guidelines unless otherwise noted on drawings.
5) Padlocked external operating handle.

c. Switch:

1) 25,000 amp symmetrical withstand.

2) Poles to match equipment served.

3) 600 VAC.

4) Continuous current rating not less than the serving branch circuit over current protection.

5) Non-fusible except where fusing is required by the served equipment or as noted on the drawings.

17. Separately Enclosed Motor Starters.

a. General:

1) Starters shall have a disconnecting means.

2) 3 phase: NEMA size 1 minimum size or as indicated on the drawings.

3) 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.

4) Two spare NO and NC auxiliary contacts.

5) Pilot devices.

6) Nameplates to identify the starter and all the items in the starter.

7) Square D or Cutler-Hammer.

b. Enclosure:

1) Indoor dry areas: NEMA 12.

2) Outdoors & corrosive areas: NEMA 4X.

3) External operating handle to be interlocked with the door to prevent opening door when handle is in the closed position.

4) Padlocked external operating handle.

c. Contactor:

1) 3 phase: NEMA size 1 minimum size or as indicated on the drawings.
2) 1 phase: NEMA size 0 minimum size or as indicated on the drawings.
3) Rated for the voltage being provided.
4) 120 VAC coils.
5) Non-reversing NEMA rated magnetic starters.

d. Overloads:

1) One solid state overload relay in each phase.
2) External manually reset push button for reset of the overload relay.
3) Overloads shall provide phase loss tripping capability.

e. Disconnecting Device:

1) 3 phase: MCP type disconnect rated at 25KAIC minimum.
2) 1 phase: MCP or fused type disconnect rated at 10KAIC minimum.

18. Reduced Voltage Solid State Starters

a. Starter shall be provided with:

1) Phase loss, phase unbalance and phase reversal protection.

2) Shorted SCR protection.

3) 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.

4) 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

5) Independently adjustable acceleration and deceleration current limit adjustable from 150 to 400 percent of motor full load current.

6) 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.

19. Surge Protective Device (SPD).

a. General:

1) SPD units shall be installed as shown on the drawings.

2) SPD units shall be appropriate for the voltages indicated on the drawings.

3) Approved manufacturers: Cutler Hammer, Square D, LEA, or equal.

4) SPD units shall comply with UL 1449 and 1283.

5) SPD units shall comply with IEEE C62.41 and IEEE C62.45.

6) SPD units shall have a 30 amp disconnect directly before the TVSS unit.

7) SPD units shall have indication for trouble alarms and surge count.

8) For assembled equipment the SPD unit shall be of the same manufacturer as the assembled equipment.

b. Ratings:

1) Maximum let through voltage shall be:

Mode	120/208	277/480
L-N or L-G	400V	800V
L-L	800V	1800V

2) Minimum total surge current capability:

Location	Per Phase	Per Mode
Switchgear	250 KA	125KA
MCC	160KA	80KA
Panelboards	120KA	60KA

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.

      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.

   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.

   1) At handholes, manholes, and vaults.
   2) Building entrance junction boxes.
   3) One inch or larger connections to equipment.

k. Provide flexible conduit where flexible connections are necessary, including each motor without flexible cord.

   1) Keep length to a minimum, not to exceed 6' maximum.
   2) 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.

      1) Two inches between conduits.

      2) Three inches over conduit where not reinforced.

      3) Three inches over reinforcing.

      4) Reinforced at and 5' past portion on disturbed earth or subject to traffic.

      5) Reinforced within 5' of a structure, manhole or vault.

      6) Reinforced for entire length and 2' beyond each adapter to steel conduit if non-metallic is used in duct bank.

      7) 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.

      8) 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:

1) Phase A: Brown
2) Phase B: Orange
3) Phase C: Yellow
4) Neutral: White
5) Ground: Bare or Green

b. Color code all feeder, and branch circuit conductors, 120/208 VAC as follows:

1) Phase A: Red.
2) Phase B: Black.
3) Phase C: Blue.
4) Neutral: White.
5) 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:

        1) Drill and tap the flange.
        2) Provide a bolted connection.
        3) 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.

11. Clean finishes and touch-up damage.

I. 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.

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 26 09 00

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 26 05 90 – Electrical Work, General
2. Section 26 29 23 – 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.

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:

      1) Level: 1.0% percent of measured span.

      2) 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 AEGISPowerline 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.

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. 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. Pressure and Level Instrumentation

a. Hydrostatic Level Transducers

1) 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.

B. Level Instrumentation

a. Radar Level Transmitters

1) 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 or CPVC, and shall be suitable for operation over a temperature range of -40 to +392^{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.

2) The supplier shall furnish drawings complete with dimensions and elevations for the sensor mounting.

3) 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 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.

4) 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.

5) 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 VEGA "VEGAPULS 64" or approved equal.

b. Weighted Float Level Switches

1) 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.

C. Miscellaneous Instrumentation.

a. Limit Switch

1) 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.

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.

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.

c. Field Wiring. Field wiring materials and installation shall conform to the requirements of the electrical section.

d. 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.

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 2-hour session, and the schedule shall be arranged and coordinated with the Engineer.

3.3 INSTRUMENT LIST

Tag #	Description	Service	Scale	Provided Under Specification
LSHH-200	High High Level Float	Weighted Float		By Station Supplier
LSH-200	High Level Float	Weighted Float		By Station Supplier
LSL-200	Low Level (Stop) Float	Weighted Float		By Station Supplier
FE/FIT-300	Station Discharge	Magnetic Flow Meter		By 16900
LSh-300	Wetwell High Level Alarm Flaot	Weighted Float		By 16900

END OF SECTION

SECTION 26 36 23

208 VOLT AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SUMMARY

A. This section covers the furnishing and installation of a 208 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 208 volt, 3 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 01 33 00.

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 10,000 Amps 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.

      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.

3) 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 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes range of soil and subsoil materials intended to be referenced by other sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other sections and on Drawing notes.

B. Section includes:

1. Subsoil materials
2. Topsoil materials

1.2 RELATED SECTIONS

A. Section 31 05 16 - Aggregates for Earthwork
B. Section 31 10 00 – Site Clearing
C. Section 31 22 13 - Rough Grading
D. Section 31 23 16 – Excavation
E. Section 31 23 17 - Trenching
F. Section 31 23 23 - Fill

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. ASTM International (ASTM):

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials source.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish materials of each type from same source throughout the Work.

B. Soil Testing:

1. Soil sampling and testing to be completed by an independent laboratory approved by the Engineer.

2. Frequency of testing shall be determined by the Engineer.

3. All soil testing shall be paid for by the Contractor.

C. Compaction Tests:

1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180) .

2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.

D. Soil Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

A. Subsoil Type S1, Select Native Material:

1. Select earth obtained from on-site excavations approved for use by Engineer.

2. Graded.

3. Free of peat, humus, vegetative matter, organic matter and rocks larger than 6 inches in diameter.

4. Processed as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.

B. Subsoil Type S2, Imported Fill Material:

1. Imported earth approved for use by Engineer.
2. Meeting the requirements of Subsoil Type S1.

2.2 TOPSOIL MATERIALS

A. Topsoil Type TS1, Select Native Topsoil Material:

1. Top 6 - 12 inches of existing soil containing organic matter.

2. Engineer decision shall be final as to determination of what material is topsoil quality.

3. Graded.

4. Free of roots, rocks larger than 1/2-inch subsoil, debris, large weeds, and foreign matter.

a. Screening: Single screened.

B. Topsoil Type TS2, Imported Topsoil Material:

1. Imported borrow.

2. Friable loam.

3. Reasonably free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds, and foreign matter.

a. Screening: Single screened.

4. Acidity range (pH) of 5-1/2 to 7-1/2.

5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 SPOILS

A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of at a location provided by the Contractor and approved by the Engineer.

B. Make arrangements for disposal of the material at no additional cost to the Owner.

C. Landfill permit to be obtained by the Contractor and provided to Engineer prior to commencement of disposal.

2.4 SOURCE QUALITY CONTROL

A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D1557 (AASHTO T180).

B. When tests indicate materials do not meet specified requirements, change material or vary compaction methods and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of facilities.

B. Site within clearing limits shall be stripped of topsoil as required to obtain additional topsoil necessary to complete Work indicated in the Drawings or as specified.

C. When practical, do not excavate wet topsoil.

D. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.

E. Remove excess excavated subsoil and topsoil not intended for reuse from Site.

F. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from Site.

3.2 STOCKPILING

A. Stockpile soils at locations shown in the Drawings or at locations as approved by Engineer for redistribution as specified.

1. Site may not have sufficient area to stockpile excavated material that will be required for fill later in the project. If additional stockpile area is required to complete the Project on schedule, arrange off-site stockpile areas.

2. No additional payments will be made for stockpiling excavated materials off-site.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Prevent intermixing of soil types or contamination.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

1. Grade surface of stockpiles to prevent ponding of water.
2. Cover stockpiles to minimize the infiltration of water.

F. Stockpile unsuitable and/or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes a range of coarse and fine aggregate materials intended to be referenced by other Sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other Sections and in Drawing notes.

B. Section Includes:

1. Coarse aggregate materials
2. Fine aggregate materials

1.2 RELATED SECTIONS

A. Section 31 05 13 - Soils for Earthwork
B. Section 31 22 13 - Rough Grading
C. Section 31 23 17 - Trenching
D. Section 31 23 19 - Dewatering
E. Section 31 23 23 - Fill
F. Section 32 11 23 - Aggregate Base Courses

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses

2. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates

3. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

3. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

4. AASHTO TP61 - Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate

B. ASTM International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Aggregate Testing:

1. Aggregate sampling and testing to be completed by an independent laboratory approved by the Engineer.

2. The frequency of testing shall be determined by the Engineer.

3. All aggregate testing shall be paid for by the Contractor.

C. Compaction Tests:

1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180).

2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.

D. Aggregate Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate Type A1, Dense-Graded Aggregate: Crushed rock with ¾-inch-0, 1-inch-0, 1-1/2-inch-0, 2-inch-0 and 2-1/2-inch-0 gradation as shown in the Drawings and meeting the requirements provided below.

1. Grading - Dense-graded base aggregate shall be crushed rock, including sand. Uniformly grade the aggregates from coarse to fine.

2. Sieve analysis shall be determined according to AASHTO T27.

3. The aggregates shall conform to one of the grading requirements Table 31 05 16-A below.

Table 31 05 16-A
Grading Requirements for Dense-Graded Aggregate
Separated Sizes
Percent Passing (by weight)

Sieve Size	2-1/2" - 0	2" - 0	1-1/2" - 0	1" - 0	3/4" - 0
3"	100				
2-1/2"	95 - 100	100			
2"	-	95 - 100	100		
1-1/2"	-	-	95 - 100	100	
1-1/4"	55 - 75	-	-	-	
1"	-	55 - 75	-	90 - 100	100
3/4"	-	-	55 - 75	-	90 - 100
1/2"	-	-	-	55 - 75	-
3/8"	-	-	-	-	55 - 75
1/4"	30 - 45	30 - 45	35 - 50	40 - 55	40 - 60
No. 4*	-	-	-	-	-
No. 10	1	1	1	1	1

[1] Of the fraction passing the 1/4-inch sieve, 40 percent to 60 percent shall pass the No. 10 sieve.
* Report percent passing sieve when no grading requirements are listed.

4. Fracture of Rounded Rock:

a. Determined according to AASHTO TP61.

b. Provide at least one fractured face based on the following percentage of particles retained on the 1/4-inch sieve for the designated size:

Minimum Percent of Fractured Particles
by Weight of Material

Designated Size	Retained on 1/4-Inch Sieve
1-1/2-inch – 0 and larger	50
Smaller than 1-1/2-inch – 0	70

5. Durability:

   a. Crushed rock aggregate shall meet the following durability requirements:

Test	Test Method	Requirements
Abrasion	AASHTO T 96	35.0 percent maximum
Degradation (Coarse Aggregate)	ODOT TM 208	30.0 percent maximum
Passing No. 20 Sieve, Sediment Height	ODOT TM 208	3.0-inch maximum

6. Sand Equivalent -- Crushed rock aggregate will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 50.

B. Coarse Aggregate Type A2, Granular Drain Backfill Material: Crushed or uncrushed rock or gravel as shown in the Drawings.

1. Material shall be clean and free draining.
2. Sieve analysis shall be according to AASHTO T27.
3. Grading: Meeting the gradation requirements provided in Table 31 05 16-B below.

Table 31 05 16-B
Grading Requirements for Granular Drain Backfill Material
Separated Sizes
Percent Passing (by weight)

Sieve Size	Separated Sizes 1-1/2-inch – 3/4-inch	Separated Sizes 3/4-inch – 1/2-inch
2-inch	100	
1-1/2-inch	90 - 100	
1-inch	20 - 55	100
3/4-inch	0 - 15	85 - 100
1/2-inch	-	0 - 15
3/8-inch	0 - 5	-

2.2 SAND

A. Sand: Sand material shall consist of granular material, naturally produced or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash, and other deleterious material, meeting the gradations of Table 31 05 16-C below.

Table 31 05 16-C
Grading Requirements for Sand
Separated Sizes
Percent Passing (by weight)

Sieve Size	Coarse Sand	Medium Sand	Fine Sand
1-inch	100	100	100
3/8-inch	95 - 100	95 - 100	-
#4	80 - 100	70 - 95	90 - 100
#30	10 - 30	10 - 45	-
#100	-	2 - 10	2 - 10
#200	0 - 8	0 - 7	0 - 4
Sand Equivalent	50 min.	50 min.	50 in.

2.3 SOURCE QUALITY CONTROL

A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).

B. Sand - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).

C. When tests indicate materials do not meet specified requirements, change material and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

PART 3 EXECUTION

3.1 STOCKPILING

A. Stockpile materials imported to site as shown in the Drawings or at locations as approved by Engineer for redistribution as specified.

B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

C. Prevent intermixing of aggregate types or contamination.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

1. Grade surface of stockpiles to prevent ponding of water.
2. Cover stockpiles to minimize the infiltration of water.

3.2 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in preparation for site or building excavation work.

1.2 RELATED SECTIONS:

A. Section 01 56 39 – Temporary Tree and Plant Protection
B. Section 02 41 00 - Demolition
C. Section 31 22 13 - Rough Grading

1.3 DEFINITIONS

A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.

C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

D. Limits of Disturbance: Work area boundary as shown on the Plans.

E. Root Wad: Tree stump and root mass including all roots greater than 1-inch diameter.

F. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Clearing, Grubbing, and Stripping Plan: Drawings clearly showing proposed limits to clearing, grubbing, and stripping activities at Site.

C. Certification or disposal permit for landfill and/or waste disposal site.

D. A copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.5 QUALITY ASSURANCE

A. Existing Conditions: Determine the extent of Work required and limitations before proceeding with Work.

B. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits prior to commencing clearing, grubbing, and stripping.

C. Conform to applicable local, state, and federal codes for environmental requirements and disposal of debris,

1. Burning on project site will not be permitted.
2. Use of herbicides will not be permitted.

D. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.

E. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of laborers, other persons, and property in the vicinity of the work and requirements of the General Provisions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or specifications.

B. Wound Paint: Emulsified asphalt formulated for use on damaged plant tissues.

PART 3 EXECUTION

3.1 GENERAL

A. Clear, grub, and strip areas needed for waste disposal, borrow, or Site improvements within limits shown in approved Clearing, Grubbing, and Stripping Plan.

B. Remain within the property lines at all times.

C. Do not injure or deface vegetation or structures that are not designated for removal.

3.2 EXAMINATION

A. Verify existing plant life designated to remain is tagged or identified.
B. Identify waste and salvage areas for placing removed materials.

3.3 PREPARATION

A. Carefully coordinate the work of this Section with all other work and construction.

B. Call Local Utility Line Information service at 1-800-922-1987, not less than three working days before performing Work.

C. Request underground utilities to be located and marked within and surrounding construction areas.

1. Disconnect or arrange for disconnection of utilities (if any) affected by required work.

2. Keep all active utilities intact and in continuous operations.

D. Prepare Site only after:

1. Erosion and sediment controls are in place.

a. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls and in compliance with COP Erosion and Sediment Control Manual and ESC Permits.

2. Tree and vegetation protection is installed.

a. Protect existing site improvements, trees, and shrubs to remain to preclude damage during construction.

b. Follow the provisions set forth in 01 56 39, Temporary Tree and Plant Protection for all temporary tree and plant protection measures.

3. Temporary fencing is installed along the Limits of Disturbance.

4. Notification of utility agencies; disconnect or arrange for disconnection of utilities (if any) affected by required work. Keep all active utilities intact and in continuous operation.

3.4 PROTECTION

A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.

B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.

C. Preservation and Trimming of Trees, Shrubs, and Other Vegetation:

1. Avoid injury to trees, shrubs, vines, plants, grasses, and other vegetation growing outside of the areas to be cleared and grubbed and those trees and shrubs designated to be preserved.

2. Protect existing trees and shrubs against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of roots by stockpiling construction materials, excavated materials, excess foot or vehicular traffic, and parking of vehicles within drip line.

3. Provide temporary guards, as necessary, to protect trees and vegetation to be left standing.

4. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.

5. Provide protection for roots and limbs over 1-1/2-inch diameter cut during construction operations. Coat cut faces with emulsified asphalt.

6. Repairable damage to trees and shrubs designated to remain shall be made by a professional tree surgeon approved by the Engineer. Cost shall be borne by the Contractor.

D. Landscaped Areas:

1. When any portion of the Work crosses private property or landscaped areas, excavate topsoil separately and pile it on the opposite side of the trench from the subsoil.

2. Conduct Work in a manner that will restore original conditions as nearly as practicable.

3. Remove and replace any trees, shrubs, plants, sod, or other vegetative material as needed to complete Work.

4. All shrubs or plants shall be balled by experienced workers, carefully handled and watered, and replaced in their original positions without damage. Sod shall be handled in a similar manner.

5. Wherever sod cannot be saved and restored, the ground must be reseeded and cared for until a stand of grass is reestablished.

6. Plants or shrubs killed or destroyed shall be replaced and paid for by the Contractor.

7. It is the intent of this paragraph that the Contractor shall leave the surface and plantings in substantially the same conditions as before the Work is undertaken.

E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, and curbs.

F. Repair and Replacement:

1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.5 LIMITS

A. As follows, but not to extend beyond Limits of Disturbance and within the approved disturbance limits in the Environmental Zones:

1. Excavation: 5 feet beyond top of cut slopes.

2. Trench Excavation: 6 feet from trench centerline, regardless of actual trench width.

3. Fill:

a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
b. Stripping: 2 feet beyond toe of permanent fill.

4. Structures: 15 feet outside of new structures.

5. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.

6. Other Areas: As shown.

B. Remove rubbish, trash, and junk from entire area within the Limits of Disturbance as material is generated. Stockpiling shall not be permitted without written approval of Owner.

3.6 CLEARING AND GRUBBING

A. Clear and grub areas within limits shown in approved Clearing, Grubbing, and Stripping Plan.

B. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with the applicable sections of these Specifications.

C. Clearing:

1. Remove trees, saplings, snags, stumps, shrubs, brush, vines, grasses, weeds, and other vegetative growth within the clearing limits shown in the Drawings, except those trees and shrubs noted to remain in the Drawings or as directed by the Engineer.

2. Clearing shall be performed in such a manner as to remove all evidence of the presence of vegetative growth from the surface of the project site and shall be inclusive of sticks and branches of thickness or diameter greater than 3/8-inch and of grasses, weeds, exceeding 12 inches in height except as otherwise indicated.

3. Clear undergrowth and deadwood, without disturbing subsoil.

D. Grubbing: Clear areas required for access to site and execution of Work and remove all stumps, root wads, and roots over 1-inch diameter to the following depths:

1. Future Structures and Building Areas	24 Inches
2. Roads and Parking Areas	18 Inches
3. All other Areas	12 Inches

3.7 TREE REMOVAL

A. Exercise care in cutting, felling, trimming, and handling of those trees shown for removal to prevent damage to neighboring trees and structures to remain.

B. Tree Salvage: As shown on the Plans.

C. No trees may be removed unless approved and permitted by the Engineer.

D. Do not top trees unless otherwise specified or approved by Owner in writing.

E. Refer to Section 01 56 39, Temporary Tree and Plant Protection for tree protection requirements.

3.8 REMOVAL AND DISPOSAL

A. Native vegetation may be mulched and used on Site.

B. Asphalt and Gravel Surfaces:

1. Asphalt, concrete, and gravel surfaces designated for removal shall be done to full depth.

2. Asphalt, concrete, and gravel removed at Site may be reused at Site where shown in the Drawings or following approval of the Engineer.

3. Haul removed asphalt, concrete, and gravel which is unsuitable for reuse or that exceeds quantity required.

C. Remove debris, rock, abandoned piping, and extracted plant life from Site.

D. Remove from the Site all debris, materials, equipment, and items found thereon and materials and debris resulting from the Work, except as otherwise indicated.

1. All existing improvements designated on the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the Work.

2. Unless otherwise specified, any resulting voids shall be thoroughly cracked out for drainage and backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

F. Do not burn or bury materials on site. Leave site in clean condition.

G. Removal: All material resulting from demolition, clearing and grubbing, and trimming operations shall be removed from the Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

H. Cleanup: During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, and debris.

I. Adjacent areas shall be returned to their existing condition prior to the start of Work.

3.9 CLEANUP

A. During the time Work is in progress, make every effort to maintain the Site in a neat and orderly condition.

B. All refuse, broken pipe, excess fill material, cribbing, and debris shall be removed as soon as practicable.

C. Should the Work not be maintained in a satisfactory condition, the Owner may cause the work to stop until the cleanup of the Work has been done to the satisfaction of the Engineer.

D. The Work will not be considered complete or the final payment certificate issued until all rubbish, unused material, or equipment shall have been removed and the premises left in a condition satisfactory to the Owner and the Engineer.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes excavation required for site structures. Excavating for utilities outside building is included in Section 31 23 17, Trenching.

B. Section Includes:

1. Excavating for site structures

1.2 RELATED SECTIONS

1. Section 01 45 00 - Quality Control
2. Section 02 41 00 - Demolition
3. Section 31 05 13 - Soils for Earthwork
4. Section 31 05 16 - Aggregates for Earthwork
5. Section 31 10 00 - Site Clearing
6. Section 31 22 13 - Rough Grading
7. Section 31 23 17 - Trenching
8. Section 31 23 19 - Dewatering
9. Section 31 23 23 - Fill
10. Supplemental Information: Geotechnical report; bore hole locations, and findings of subsurface materials.

1.3 DEFINITIONS

A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. Common Excavation shall further include all debris, junk, broken concrete, and all other material. All excavation shall be classified as Common Excavation, unless provided as Rock for under Section 31 23 18, Rock Removal below.

B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.

C. Concrete Excavation: The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling, splitting and breaking methods, or a necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete excavation includes materials composed of Portland cement that are not identified other than manholes, structures, sewer pipe, or other appurtenances.

D. Exploratory Excavation: The removal and replacement of material from locations shown on the Drawings, or as directed for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed utilities.

E. Overbreak: Material beyond and outside of the slope limits established by the Owner's Representative, which becomes displaced or loosened during excavation and is excavated.

F. Pothole Excavation: Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as exploratory excavation, for the purposes of locating an underground utility and to investigate underground conditions.

G. Rock Removal: As defined in Section 31 23 18, Rock Removal.

H. Spoils: Excavated materials from Site unsuitable for use as fill or not required for backfill and grading.

I. Unsuitable Materials: See Spoils.

1.4 REFERENCES

A. Local utility standards when working within 24 inches of utility lines.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: At a minimum, to include the following:

1. Methods and sequencing of mass excavation.

2. Proposed onsite and off-site spoil disposal locations.

3. Anticipated difficulties and proposed resolutions.

4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.

5. Proposed haul routes.

B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.

1.6 QUALITY ASSURANCE

A. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

B. Provide adequate survey control to avoid unauthorized over-excavation.

C. Weather Limitations:

1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (F) shall not be used as fill or backfill until material completely thaws.

2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to commencing work in this Section, become familiar with site conditions. In the event discrepancies are found, notify the Engineer as to the nature and extent of the differing conditions.

B. Call Local Utility Line Information service at 1-800-922-1987 not less than 3 working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.

C. Identify required lines, levels, contours, and datum.

D. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

3.2 SITE CONDITIONS

A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.

B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.

C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 EXISTING UNDERGROUND UTILITIES

A. Protect active utilities encountered, located or otherwise, and notify persons or agencies owning same.

B. Remove inactive or abandoned utilities from within the project grading limits in accordance with Section 33 11 50, Existing Pipe Abandonment.

C. For sewer and other miscellaneous drainage facilities, fill and plug pipes as follows:

1. General:

a. Remove all structures to a minimum of 3 feet below subgrade, unless otherwise noted.

b. Cover top surface of all abandoned structures with two sheets of nonwoven geotextile, extended at least 1-foot beyond the outside walls of the abandoned manhole, sump, or basin.

c. Plug all abandoned pipes with permanent plugs as specified in Section 33 11 50, Existing Pipe Abandonment.

2. Sumps:

a. Remove existing sediment, soil, and water. Properly dispose of these materials in accordance with the requirements of these specifications.

b. Remove top cone and first solid concrete section to a depth of approximately 8 to 10 feet below ground.

c. Fill sump with CLSM.

d. Backfill remaining voids for facilities within existing or proposed roadways with approved materials meeting the requirements of Section 32 11 23, Aggregate Base Courses.

3. Salvaging Manhole Frames, Covers, and Grates:

a. Remove manhole frames, covers, and grates scheduled for salvage and store in approved location.

b. Frames, grates, and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the Work if of suitable size and condition.

c. Replace, at no additional cost to the Owner, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.

d. Clean salvaged components to be reused of foreign material by methods that will not harm the components.

4. Existing Manhole Frames and Covers: Manhole frames and covers removed by the Contractor are the property of the Owner. Notify the Engineer a minimum of 48 hours before removal to arrange for pickup of the removed frames and covers, if not reused.

3.4 PRESERVATION OF EXISTING IMPROVEMENTS

A. Protect adjacent existing structures which may be damaged by excavation work.

1. Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place, will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.

2. Open slopes shall not be cut within 5 feet of any existing spread footings unless approved by the Engineer.

3. Do not interfere with 45 degree bearing splay of foundations unless approved by the Engineer

4. Excavated material shall not be placed adjacent to existing or proposed structures.

3.5 EXCAVATION

A. General:

1. Method of excavation shall be the Contractor's option, but care shall be exercised as final grade is approached to leave it in undisturbed condition.

2. If the final grade for supporting structures is disturbed, it shall be restored to requirements of these Specifications and satisfaction of the Engineer at no additional cost to Owner.

3. The Contractor is advised that footings should be poured as soon as possible to minimize unfavorable final grade conditions from developing.

4. Provide all measures to ensure public safety.

B. Control of Water:

1. Provide and maintain equipment to remove and dispose of water during the course of the work of this Section and keep excavations dry and free of frost or ice.

2. Bearing surfaces that become softened by water or frost must be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.

3. Grade top perimeter of excavation to prevent surface water from draining into excavation.

4. See additional requirements in Section 31 23 19, Dewatering.

C. Frozen Ground: Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.

D. Excavate material of every nature and description to the lines and grades as indicated in the Drawings and/or as required for construction of the facility.

1. Allow for forms, shoring, working space, granular base, topsoil, and similar items, wherever applicable.

2. Trim excavations to neat lines. Remove loose matter and lumped subsoil.

E. Excavated Materials: Soils excavated at Site will be treated and used as one of two general categories of material as provided below.

1. Fill:

a. Subsoil Type S1, Select Native Fill, as approved for use by Engineer.

2. Spoils:

a. Ensure there is sufficient suitable material available to complete embankments and other required fillings prior to disposing of any excavated materials.

b. Make arrangements for disposal of spoils and include as part of contract work in preparing of project bids.

c. Landfill permit or written permission from private property owner to be obtained by the Contractor and provided to the Engineer.

F. Shoring:

1. As specified in Section 31 50 00, Excavation Support and Protection.

1. The Contractor shall be solely responsible for excavation protection and worker safety and shall provide sheeting and shoring wherever required, all in accordance with current local, state, and federal laws, codes, and ordinances.

2. Where shoring, sheet piling, sheeting, bracing, lagging, or other supports are necessary to prevent cave-ins or damage to existing structures, it shall be the responsibility of the Contractor to design, furnish, place, maintain, and remove such supports in accordance with applicable ordinances and safety requirements.

3. The design, planning, installation, and removal of all sheeting accomplished in such a manner as to maintain the undisturbed state of the soil below and adjacent to the excavation.

G. Slope existing banks with machine to angle of repose or less until shored.

1. Shape, trim, and finish cut slopes to conform to lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

2. Protection of excavation side slopes:

a. Use excavation methods that will not shatter or loosen excavation slopes.

b. Where practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line.

c. Avoid overbreaks. Overbreak is incidental to the Work, except in cases where the Owner's Representative determines that such overbreak was unavoidable.

d. Excavation in rock or rocky cuts:

1) Once completed, thoroughly test the slopes with bars or other approved means to remove all loose, detached, broken, or otherwise unstable material.

2) Remove jutting points. Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat, and stable condition.

3) Dispose of the materials removed under this subparagraph in the same manner as other excavated material.

e. Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.

3. Construct slopes free of all exposed roots.

4. Construct slopes free of unstable rock and loose stones exceeding 3 inches in diameter.

5. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend off-site, outside of easements, outside of rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

6. Trim all surfaces neatly and smoothly.

H. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 17, Trenching and Section 31 23 23, Fill.

I. Notify Engineer of unexpected subsurface conditions.

J. Over-excavation for Unsuitable Foundation Conditions:

1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.

2. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

3. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.

K. Rock Removal:

1. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section.

2. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.

3. Concrete removal, as defined herein, shall be treated as Rock Removal.

L. Stockpile excavated material in area(s) designated on or off site in accordance with Section 31 05 13, Soils for Earthwork.

3.6 FIELD QUALITY CONTROL

A. Perform excavation and controlled fill operations in accordance with the requirements of this Section.

B. Coordinate the visual inspection and approval of all bearing surfaces by Engineer before installing subsequent work.

3.7 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability and store excavated materials at a distance from top of excavation.

B. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the requirements for excavation and backfill of all utilities, including installation of pipe bedding, pipe zone backfill, trench backfill, and related Work as shown on the Drawings and as specified.

B. Section includes:

1. Excavating trenches for pipe, utility vaults, and other utilities.
2. Compacted fill from top of utility bedding to final grades.
3. Trench and utility vault backfilling and compaction.

C. Related Sections

1. Section 01 45 00 - Quality Control
2. Section 31 05 13 - Soils for Earthwork
3. Section 31 05 16 - Aggregates for Earthwork
4. Section 31 10 00 - Site Clearing
5. Section 31 22 13 - Rough Grading
6. Section 31 23 16 - Excavation
7. Section 31 23 23 - Fill
8. Section 33 31 10 - Sanitary Utility Sewerage Piping: Sanitary sewer piping and bedding
9. Supplemental Information: Geotechnical report; bore hole locations and findings of subsurface materials.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. ASTM International (ASTM):

1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

5. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.3 DEFINITIONS

A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill. Lean cement concrete fill. A self-compacting, cementitious material.

B. Flexible Pipe: For the purposes of these Specifications, tubing between 1/2-inch and 4-inch diameter constructed of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) are considered flexible pipes. HDPE piping 4 inches in diameter and larger is also considered flexible pipe.

C. Geosynthetics: Geotextiles, geogrids, geomembranes, and drainage composite materials.

D. Imported Material: Materials obtained from sources offsite, suitable for specified use.

E. Lift: Loose (uncompacted) layer of material.

F. Obstructions: Items which may be encountered during utility and vault trenching which do not require replacement.

G. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.

2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

H. Pipe Bedding: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches below the bottom outside surface of pipe, conduit, cable, or duct bank to the trench foundation so as to uniformly support the barrel of the pipe.

I. Pipe Zone: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 12 inches above the top outside surface of pipe, conduit, cable, or duct bank.

J. Pipe Bedding, Pipe Zone, and Trench Backfill Classifications:

1. Class A: Backfill with suitable native or imported material that is approved to meet the characteristics required for the specific surface loading or other criteria of the backfill zone.

2. Class B: Backfill with imported granular material consisting of gravel or crushed rock meeting the requirements of this Section and Coarse Aggregate Type A1 as specified in Section 31 05 16, Aggregates for Earthwork; typical designated size shall be 1-inch-0 or 3/4-inch-0.

3. Class C: Backfill with Fine Sand, as specified in Section 31 05 16, Aggregates for Earthwork.

4. Class D: Backfill with approved pit run or bar run material, well-graded from coarse to fine; maximum dimension shall be 3 inches.

5. Class E: Backfill with CLSM. See Section 31 23 24, Flowable Fill.

K. Pothole Excavations: Removal and replacement of all materials via coring, vacuum extraction, or similar method for the purposes of locating an underground utility and to investigate underground conditions.

L. Prepared Trench Bottom: The bottom of the trench on which the pipe bedding is to lie and which provides support for the pipe.

M. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM Standards.

N. Rigid Pipe: For the purposes of these Specifications, pipe constructed of PVC, ductile iron, steel, concrete, and clay pipes are considered rigid pipes.

O. Sewer, Pipes, and Mains: Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.

P. Trench Backfill: Trench backfill zone for full trench width extending from the top of the pipe zone to pavement base rock, ground surface, or other surface material.

Q. Trench Stabilization: Removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.

R. Utility: Any buried pipe, duct, conduit, or cable.

S. Well-Graded: A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.4 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Excavation Protection Plan: At a minimum, to include the following:

1. Methods and sequencing of mass excavation.

2. Proposed on-site and off-site spoil disposal locations.

3. Anticipated difficulties and proposed resolutions.

4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.

5. Proposed haul routes.

B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.

C. Product Data:

1. Geotextile fabric, indicating fabric and construction
2. Marking tapes
3. Tracer wire
4. Connectors for tracer wire and/or marking tapes
5. Tracer wire locate boxes
6. Marker balls
7. Locator stations
8. Ground wires
9. Plastic or copper markers for service laterals.

D. Imported Materials:

1. Materials Source: Submit name and location of imported fill materials suppliers.

2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

3. Submit results of aggregate sieve analysis and standard proctor test for granular material.

E. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

F. Concrete: Mix designs in accordance with Submittal requirements of Section 03 30 00, Cast-in-Place Concrete.

1.5 QUALITY ASSURANCE

A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.

B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.

C. CLSM:

1. In-place testing: In accordance with ASTM C403.
2. Compressive testing: In accordance with ASTM D4832.

D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

1.6 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

B. Coordinate trenching and utility installation work with other work at utility construction location occurring near or adjacent to specified herein.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Subsoil Fill: Type S1, Select Native Material as specified in Section 31 05 13, Soils for Earthwork.

B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

C. Concrete:

1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).

2. Structural concrete as specified in Section 03 30 00, Cast-in-Place Concrete with compressive strength of 3,000 psi.

D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

E. Sand: As specified in Section 31 05 16, Aggregates for Earthwork.

F. Trench Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 MARKING TAPE

A. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.

2. Foil Thickness: Minimum 0.35 mils.

3. Laminate Thickness: Minimum 5 mils.

4. Width: 6 inches.

5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.

7. Manufacturers and Products:

a. Reef Industries; Terra Tape, Sentry Line Detectable
b. Mutual Industries; Detectable Tape
c. Presco; Detectable Tape

B. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities and as specified in NEMA Z535.1, Safety Color Code.

Color	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines

2.3 ELECTRONIC LOCATING MATERIALS

A. Marker Balls:

1. Exterior Material: High-density polyethylene.

2. Size: Maximum 4-1/2 inches in diameter.

3. Range: Locatable with standard electronic marker locating devices at depths up to 5 feet.

4. Field Type: Spherical RF field regardless of orientation.

5. Contain no floating or movable parts, and no batteries or active components.

6. Color: Provide colored marker balls per Article 2.03 B above.

7. Manufacturer and Product: Omni Marker Model 162 (green), Omni Marker Model 161 (blue), or approved equal.

B. Tracer Wire:

1. Direct burial No. 12 AWG solid, annealed copper-clad steel (CCS) high strength tracer wire.

2. Tensile Breaking Load: 380-pound average.

3. Jacket:

   a. High molecular weight high-density polyethylene complying with ASTM D1248, 30-volt rating.

   b. Color: Provide in colors per Article 2.03 B above.

4. Manufacturer and Product: Copperhead Industries; LLC, 12 CCS high strength reinforced tracer wire, or approved equal.

C. Tracer Wire Connectors:

1. Waterproof, corrosion proof and suitable for No. 12 AWG solid core wire.

2. Prefilled with silicone and suitable for use with low-voltage tracer lines of less than 50 volts.

3. Lug Connectors:

   a. Waterproof plastic housing that encases the silicone prefilled lug terminals.

   b. Manufacturer and Product: King Innovations; DryConnTM Direct Bury Lug or approved equal.

4. Twist Connectors:

   a. Waterproof epoxy-filled packaging that encases the silicone prefilled twist connectors.

   b. Manufacturer and Product: 3M Division; DBY Direct Bury Splice Kit 09053 connectors or approved equal.

D. Ground Wire: No. 12 AWG bare solid copper wire.

E. Locator Station:

1. Test Station:

   a. Lexan® polycarbonate.
   b. Color: Provide in colors per Article 2.03 B above.

2. Terminals suitable for No. 12 AWG leads.

3. Use single (two lead) locator stations with two terminals, one for ground wire and one for tracer wire, when only one tracer wire is terminated in manhole.

4. Use multi-lead locator stations with the appropriate number of terminals when 2 or more tracer wire leads are terminated in manhole.

5. Manufacturer and Product: Cott Manufacturing Company; FlangeFink® Cathodic Protection Test Station.

2.4 VISUAL IDENTIFICATION MATERIALS

A. Tracer Wire Locate Boxes:

1. Material: Polyolefin.

2. Cover:

   a. Color: Provide in colors per Article 2.03 B above.

b. Provide box cover identification marking for facility type such as "Sewer Locate Wire", as approved by Owner.

c. Locking type with a nominal 6-inch opening.

3. Manufacturer and Product: Carson Industries LLC; L Series Model 708 or approved equal.

B. Service Lateral Plastic or Copper Markers:

1. Service Lateral Plastic or Copper Markers: Use markers of the type that requires installation to be recessed below grade.

a. Material: Plastic or copper. In new concrete, use "new construction" markers; in existing concrete use "retrofit" markers and use adhesive recommended by the manufacturer.

b. Plastic Pavement Markers:

1) UV stabilized and fade resistant.

2) Material: Meet or exceed a tensile strength of 3,500 psi, and meet test requirements as outlined in ASTM G53, Standard Practice for Light and Water Exposure of Nonmetallic Material.

3) Color: Provide in color per Article 2.03 B above with the words, "WARNING, BURIED SANITARY SEWER Call Before You Dig," molded to the top of marker.

a) Provide wording for specific facility as approved by Owner.

4) Manufacturer and Product: Rhino Marking and Protective Systems; A-TAG pavement markers or approved equal.

c. Copper Pavement Markers:

1) Material: Copper material chosen by manufacturer.

2) Diameter: 1-5/32-inch.

3) Wording: Provide facility identification wording stamped on the top such as "Sewer Lateral" as approved by Owner.

4) Manufacturer and Product: Berntsen Concrete Marker; BP2-U or approved equal.

C. Service Lateral 2-inch by 4-inch Markers:

1. S4S Douglas fir, pressure-treated 2-inch by 4-inch lumber, utility grade or better.
2. Grade stamped by an American Lumber Standards certified inspection agency.

PART 3 EXECUTION

3.1 PREPARATION

A. Call Local Utility Line Information service at 1-800-922-1987 not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.

3. Maintain and protect above and below grade utilities indicated to remain.

B. Identify required lines, levels, contours, and datum locations.

C. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.

D. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation in accordance with Section 31 10 00, Site Clearing.

E. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

1. Intent of Drawings and Specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition.

2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material, which is satisfactory to Owner.

F. Potholing / Exploratory Test Pits: Dig such exploratory test pits and perform potholing as may be necessary in advance of trenching to determine the exact location and elevation of subsurface structures, pipelines, duct banks, conduits, and other obstructions which are likely to be encountered or need to be connected to and shall make acceptable provision for their protection, support, and maintenance of their continued operation.

G. Paved or Surfaced Streets:

1. Wherever paved or surfaced streets are cut, saw wheel or approved cutting devices shall be used.

2. Width of pavement cut shall be as shown in the Drawings.

3. Any cut or broken pavement shall be removed from site during excavation.

H. Traffic:

1. Maintain street traffic at all times as required by the Drawings and as specified herein.

2. Erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with the latest edition of Manual of Uniform Traffic Control Devices (MUTCD), Part 6, to protect the traveling public in any area applicable.

3. Provide flaggers as required during active work in roadway areas.

I. Operations shall be confined to rights-of-way and easements provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Engineer.

3.2 EASEMENTS

A. Where portions of the Work are located on private property, easements and permits will be obtained by the Owner. Easements shall provide for the use of property for construction purposes to the extent indicated on the easements.

B. Copies of these easements and permits will be available from the Owner for inspection by the Contractor. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained in every case.

C. Confine construction operations to within the easement limits or street right-of-way limits or make special arrangements with the property owners for the additional area required and notify the Engineer with a copy of the written approval from property owners of any such conditions.

D. Any damage to private property, either inside or outside the limits of right-of-way or easements provided by the Owner, resulting from Work shall be the responsibility of the Contractor. Before the Engineer will authorize final payment, the Contractor will be required to furnish the Owner with written releases from property owners where the Contractor has obtained special agreements or easements or where the Contractor's operations, for any reason, have not been kept within the construction right-of-way obtained by the Owner.

3.3 PROTECTION

A. Existing Facilities:

1. It is the intent of these specifications that all streets, structure, and utilities be left in a condition equal to or better than original condition at the completion of the Project.

2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material to the satisfaction to the Engineer.

3. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.

B. Removal of Water:

1. As specified in Section 31 23 19, Dewatering.

2. At all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work.

3. Keep all excavations dry until the utilities or vaults to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.

4. Dispose of water from the Work in a suitable legal manner without damage to adjacent property or structures.

C. Trench Protection:

1. Provide the materials, labor, and equipment necessary to protect trenches at all times.

2. Trench protection shall provide safe working conditions in the trench and protect the Work, existing property, utilities, pavement, etc.

3. The method of protection shall be according to the Contractor's design.

4. The Contractor may elect to use a combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided the method meets the approval of all applicable local, state, and federal safety codes.

5. Damages resulting from improper shoring, improper removal of shoring, or from failure to shore shall be the sole responsibility of the Contractor.

3.4 LINES AND GRADES

A. Trench excavation for piping, utility vaults, and other utilities shall be performed to the alignment and grade as indicated in the Drawings.

B. Where grades are not shown in the Drawings, utilities shall be laid to grade between control elevations shown.

C. Sewer mains shall be installed with a minimum cover of 8 feet 6 inches.

D. The Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

E. Changes in the grade and horizontal alignment of the pipeline as shown in the Drawings or as provided elsewhere in the Specifications may be necessary due to unanticipated interferences or other reasons.

1. No additional compensation will be allowed the Contractor for changes in horizontal alignment.

2. No additional compensation will be allowed for changes in grade which require additional depth of trench excavation and backfill up to 2 feet from those shown in the Drawings.

F. Use laser-beam instrument with qualified operator to establish lines and grades.

3.5 OBSTRUCTIONS

A. Obstructions to the construction of the trench, such as tree roots, stumps, abandoned pilings, abandoned buildings and concrete structures, logs, rubbish, and debris of all types shall be removed without additional compensation from the Owner.

B. The Engineer may, if requested by the Contractor or Owner, make changes in the trench alignment to avoid major obstructions if such alignment changes can be made within the perpetual easement and right-of-way and without adversely affecting the intended function of the facility or increasing costs to the Owner.

3.6 INTERFERING ROADWAYS AND STRUCTURES

A. Remove, replace and/or repair any damage done during trenching activities to fences, buildings, cultivated fields, drainage crossings, and any other properties without additional compensation from the Owner.

1. Replace or repair these structures to a condition as good as or better than their pre-construction condition prior to commencing work in the area.

B. Paved Roadways:

1. Where paved roadways are cut as part of trenching activities, Class D trench backfill will be required to the bottom of pavement base.

2. New pavement shall be equal to or better than the existing paved surface.

3. New surface shall not deviate by more than 1/4-inch from the existing finish elevation.

C. Existing Structures:

1. If existing structures are encountered as part of trenching activities which will prevent construction and are not adequately shown in the Drawings, the Contractor shall notify the Engineer before continuing with the Work.

2. The Engineer may make such field revisions to the utility alignment as necessary to avoid conflict with the existing conditions.

3. The cost of waiting or "down time" during such field revisions shall be borne by the Contractor without additional cost to the Owner or liability to the Engineer.

4. If the Contactor fails to so notify the Engineer when a conflict of this nature is encountered, but proceeds with construction despite this interference, the Contractor shall do so at the Contractor's own risk with no additional payment.

3.7 TRENCHING

A. Excavate subsoil as required for construction of utilities to elevations shown in the Drawings.

B. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.

C. Open Trench Limit:

1. Do not advance open trench beyond the distance which will be backfilled and compacted the same day.

2. A maximum length of open trench shall not exceed 200 feet at any one time.

3. Temporary resurfacing shall be completed within 300 feet of the associated open trench limit for each main pipe laying operation.

4. Cover or backfill excavations at the end of each day.

5. If the trench is not backfilled at the end of each working day:

   a. Provide means to prevent caving of excavation sides, as necessary, during non-working hours.

   b. Cover the excavation with a system as needed to provide public safety and prevention of entry during non-working hours.

   c. Provide signed and stamped submittal of caving prevention system and cover system.

6. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.

D. Utility Crossings: Avoid horizontal and vertical conflicts with existing utilities.

1. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.

2. Vertical clearance between the new pipe and existing utilities shall be 12 inches minimum, unless otherwise noted on the Drawings.

3. Where existing utility lines are damaged or broken during trenching activities, the utility shall be repaired or replaced. For water or sewer bearing lines, care being taken to insure a smooth flow line and absolutely no leakage at the new joints.

4. All expenses involved in the repair or replacement of leaking or broken utility lines that have occurred due to the Contractor's operations shall be borne by the Contractor, and the amount thereof shall be absorbed in the unit prices of its bid.

E. Water Lines Crossing Sewer Lines: Whenever water lines cross sewer lines, the Contractor shall comply with local Health Department requirements.

1. Wherever possible, the bottom of the water line shall be 18 inches or more above the top of sewer pipe. One full length of the water line pipe shall be centered at the crossing.

2. For clearances less than 1-1/2 feet, the Contractor shall replace the existing sewer pipe with ductile iron or PVC of equal size, centered at the utility crossing, or shall encase existing sewer pipe with concrete for a minimum of 10 feet on both sides of crossing, as directed by the Engineer, at no additional cost to the Owner.

F. Excavate trenches to width and depth as indicated on Drawings. No additional payment will be provided for trenching activities beyond dimensions shown in the Drawings.

1. Excavation for trenches in which pipelines are to be installed shall provide adequate space for workers to place and joint the pipe properly and safely, but in every case the trench shall be kept to a minimum width.

2. The width of the pipe trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall not exceed 12 inches on either side of the pipe.

3. Excavation for utility vaults and other structures shall be wide enough to provide 18 inches between the structure surface and the sides of the excavation.

4. For pipe or utility vaults to have bedding material, excavate to a depth of 6 inches below the bottom of the pipe or utility vault. Care shall be taken not to excavate below depths required.

5. If over digging occurs, the trench bottom shall be filled to grade with compacted bedding material.

G. Remove water or materials that interfere with Work.

1. The trench at all times shall be kept free from water to facilitate fine grading, the proper laying and joining of pipe, and prevention of damage to completed joints.

2. Adequate pumping equipment shall be provided to handle and dispose of the water without damage to adjacent property.

3. Water in the trench shall not be allowed to flow through the pipe while construction work is in progress unless special permission to do so has been given by the Engineer.

4. An adequate screen shall be provided to prevent the entrance of objectionable material into the pipe.

5. Remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the improvements.

   a. Where the excavation activities require the removal of portions of an abandoned pipeline, masonry plugs shall be installed in the open ends of the pipe, unless otherwise noted in the Drawings or by the Engineer.

   b. Coordinate with Engineer prior to plugging.

c. For plugs less than 36 inches in diameter, 8-inch deep masonry units shall be used. For plugs in larger pipelines, 12-inch deep masonry units shall be used.

6. The costs associated with the removal of water and materials noted above will be considered incidental to trench excavation and backfill.

H. Do not interfere with 45 degree bearing splay of foundations.

I. Over-excavation for Unsuitable Trench Foundation Conditions:

1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.

2. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.

3. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

4. Install nonwoven geotextile under trench stabilization material, over the soft or yielding excavated surface.

a. Install the nonwoven geotextile ahead of placement of the trench stabilization material, continuously along the excavation bottom and centered on the pipe centerline.

b. Use nonwoven geotextile width equal to the pipe diameter plus 2 feet.

c. Place laps or splices in the geotextile in the direction of the pipe laying.

J. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

K. Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic or interfere with the function of existing drainage facilities or system operation.

L. Remove excess subsoil not intended for reuse from site.

M. Stockpile excavated material in area designated on site in accordance with Section 31 05 13, Soils for Earthwork.

3.8 TUNNELING

A. In lieu of open cut trenching as specified above, the Contractor may utilize tunnel methods for installation of pipe where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks and other structures.

1. The Engineer must approve tunneling methods prior to utility installation.

2. Where tunneling is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks, and other surface improvements whose replacement is avoided by the tunneling method.

3.9 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, new and existing structures, and adjacent and neighboring properties and to prevent caving, erosion, settlement, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

E. Design sheeting and shoring to be removed at completion of excavation work, unless shown otherwise in the Drawings.

F. Construction Sheeting Left in Place:

1. Furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.

2. Construction sheeting and bracing originally intended for temporary installation, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Engineer. All such sheeting and bracing left in place shall be included in the cost for excavation.

3. Any construction sheeting and bracing which the Contractor has placed to facilitate its work may be ordered in writing by the Engineer to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as

creating an obligation on its part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of its responsibility under the contract.

4. For sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

3.10 COMPACTION

A. Testing will be required to show specified densities of compacted backfill are being achieved by the Contractor's compaction methods.

B. Moisture Control:

1. Moisture condition backfill material to within 2 percent of optimum moisture content required for compaction throughout each lift of the fill.

2. Add moisture to granular backfill by sprinkling during compaction operation.

3. Compaction by ponding or jetting is not permitted.

C. Compact all materials and areas that are not accessible for in-place density testing, as determined by the Engineer, in place by whatever equipment and method is practicable or specified, and as approved by the Engineer.

1. Perform compaction at such moisture content as is required to produce well-filled, dense, and firm material in place that will show no appreciable deflection or reaction under the compacting equipment.

3.11 BEDDING

A. All utility vaults, potable water pipe 4-inch nominal diameter and over, all steel pipe, all concrete sewer pipe, all plastic pipe, all pipe under existing or future structures or roadways, and any and all utilities at a depth greater than 6 feet shall be laid in pipe bedding material.

B. Unless otherwise noted in the Drawings, pipe or conduit of less than 4-inch diameter, outside structure lines and at a depth of less than 6 feet shall be bedded in native material properly shaped as specified below, all as detailed on the Drawings.

C. Compacted bedding material shall be placed the full width of the excavated trench to a depth as shown on the trench detail included in the Drawings.

1. In lieu of a detail, the depth shall be 6 inches.

D. Spread the bedding smoothly over entire width of trench to the proper grade so that the pipe is uniformly supported along the barrel.

E. Hand grade and compact each lift to provide a firm, unyielding surface along the entire pipe length. For rigid pipe, compact to at least 90 percent relative compaction.

F. Excavate bell holes at each joint to permit proper assembly and inspection of the joint.

G. Check grade and correct irregularities in bedding material.

H. Center pipes horizontally in trench width.

3.12 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

D. Place fill material, with the exception of CLSM, in continuous layers and compact in 6- to 8-inch lifts.

1. Prevent pipe from moving either horizontally or vertically during placement and compaction of pipe zone material.

2. Where trenches are under existing or future structures, paved areas, road shoulders, driveways or sidewalks, or where designated on the Drawings or specified elsewhere in these specifications, the trench backfill shall be Class B or Class E and pipe zone backfill shall be Class B or Class E. Class B backfill shall be compacted to 95 percent of maximum density at optimum moisture content.

3. Where trenches are outside existing or future structures, paved areas, road shoulders, driveways or sidewalks, or where designated on plans or specified elsewhere, the trench backfill shall be Class A and pipe zone backfill in these areas shall be Class B. For these locations, compaction of Class B backfill shall be to not less than 90 percent of maximum density at optimum moisture content. Class B backfill shall be compacted to not less than 95 percent of maximum density at optimum moisture content.

E. Employ placement method that does not disturb or damage nearby or adjacent foundation perimeter drainage or utilities in trench.

F. Do not use power-driven impact compactors to compact pipe zone material.

G. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe or conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible, unless otherwise directed by the Engineer.

H. Under no circumstances shall water be permitted to rise in open trenches after pipe has been placed.

I. Do not allow backfill material to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.

J. Use hand compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

K. Placement of Sand:

1. Place medium sand in lifts not exceeding 8 inches in uncompacted thickness.

2. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

L. Placement of CLSM:

1. Discharge from truck-mounted drum-type mixer into trench.

2. Place in lifts not exceeding 2 feet in thickness.

3. No compaction of CLSM is allowed.

4. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed, if it has hardened sufficiently to prevent rutting.

M. New trenching shall not be started when earlier trenches need backfilling or the surfaces of streets or other areas need to be restored to a safe and proper condition.

N. Do not leave trench open at end of working day.

3.13 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of all buried piping, install 24 inches below finished grade. Coordinate with piping installation drawings.

3.14 FIELD QUALITY CONTROL

A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.

B. Perform laboratory material tests in accordance with ASTM D1557 (AASHTO T180).

C. In-place compaction testing of pipeline backfill materials shall be performed at 2-foot elevation increments, one test per 100 lineal feet of pipeline trench as measured along pipe centerline.

   1. The Engineer may reduce the frequency when satisfied with method of compaction.

   2. The Engineer may direct testing at a higher frequency at no additional cost to the Owner upon failure to obtain specified densities or if the Contractor changes compaction equipment or methods of compaction.

   3. The Engineer shall determine all test locations.

D. Perform in place compaction tests in accordance with the following:

   1. Density Tests: ASTM D2922
   2. Moisture Tests: ASTM D3017

E. When tests indicate Work does not meet specified requirements, remove Work, replace and retest at the sole expense of the Contractor.

3.15 SURFACE RESTORATION AND CLEANUP

A. Open Trenches: At the end of each workday, all open trenches shall be backfilled and all trenches within streets shall be temporarily paved or covered to the satisfaction of the Engineer and the local permitting agency.

   1. Temporary paving shall be replaced with permanent street paving at the completion of construction within street rights-of-way, or sooner, if deemed necessary by the ENGINEER.

   2. No gravel-filled trenches shall be left open within the street right-of-way at the end of the workday.

B. Topsoil:

1. Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil to the specified depth and place the material in a stockpile.

2. Topsoil shall not be mixed with other excavated material.

3. After the trench has been backfilled, the topsoil shall be replaced.

C. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. The Contractor shall be responsible for seeing that lawns, shrubs, etc. remain alive and leave premises in condition equal to original condition before construction.

END OF SECTION

SECTION 31 23 19 - DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes temporary dewatering and surface water control systems for open excavations and utility trenches.

B. Section includes:

1. Dewatering systems.
2. Surface water control systems.
3. System operation and maintenance.
4. Water disposal.

1.2 RELATED SECTIONS

A. Section 31 05 16 - Aggregates for Earthwork
B. Section 31 23 16 - Excavation
C. Section 31 23 17 - Trenching

1.3 SUBMITTALS

A. Dewatering Plan:

1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this Section.

2. Plan to be reviewed by the Engineer prior to the beginning of construction activities requiring dewatering. Review by the Engineer of the design shall not be construed as a detailed analysis of the adequacy of the dewatering system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.

1.4 DEFINITIONS

A. Dewatering includes the following:

1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and /or shafts.

2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and /or shafts.

3. Disposing of removed water.

B. Surface Water Control: Removal of surface water within open excavations.

1.5 QUALITY CONTROL

A. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.

B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents.

C. Secure all necessary permits to complete the requirements of this Section.

D. Control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.

E. Where the critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop.

1. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor.

2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 EXECUTION

3.1 DEWATERING

A. Provide all equipment necessary for dewatering.

1. Have on hand, at all times, sufficient pumping equipment and machinery in good working condition.

2. Have available, at all times, competent workers for the operation of the pumping equipment.

3. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.

B. Dewatering for structures and pipelines shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.

C. Site Grading:

1. At all times, site grading shall promote drainage.

2. Surface runoff shall be diverted from excavations.

3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.

D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.

F. Maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.

G. Flotation shall be prevented by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.

H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.

I. Dispose of water from the work in a suitable manner without damage to the environment or adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.

J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.

K. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the work and all costs thereof shall be included in the various contract prices in the bid forms.

END OF SECTION

SECTION 31 50 00 - EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes shoring and support systems of all types necessary to protect existing utility facilities and new utility facilities.

B. The Contractor is responsible for the selection and design of excavation support systems and the design of utility support systems in conformance with Federal, State, and City requirements and the minimum design criteria specified herein.

C. Temporary shoring is to be installed for protection of the existing trees to remain, structures to remain, buried utilities to remain, adjacent roadways and walkways, and surrounding properties.

D. Care must be taken during the planning and construction of earth support systems to minimize settlements and displacements of the shoring system itself and to surrounding properties.

1.2 RELATED SECTIONS

A. Section 31 23 16, Excavation
B. Section 31 23 17, Trenching
C. Section 31 23 19, Dewatering
D. Section 31 23 23, Fill
E. Section 33 31 10, Sanitary Utility Sewerage Piping

1.3 DESIGN CRITERIA

A. Design excavation support systems and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, railroad, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures to minimize ground movement or settlement, and to prevent damage to adjacent structures, roadways, railroads, and utilities.

B. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.

C. Design system so that water seepage is minimized. Provide dewatering and positive means for preventing sloughing and containing material behind lagging.

D. Design system to prevent sloughing and to contain running sand and silt behind the lagging.

E. Vertical support capacity shall be provided for wall systems and internal bracing elements for loads due to vertical force components and live loads on any portion of the system.

F. Design calculations and shop drawings of all excavation support systems.

1. Calculations and shop drawings shall be made and stamped by a registered Professional Civil or Structural Engineer experienced in the design of excavation support systems in the State of Colorado.

2. Comply with the applicable requirements of OSHA and the Colorado equivalent Structural Specialty Code with respect to excavation and construction.

1.4 SUBMITTALS

A. Section 01 33 00, Submittals - Submittal Procedures: Requirements for submittals.

B. Excavation Support Systems

1. Plans and details for trench and excavation support systems.

a. Shop drawings and supporting calculations shall meet the specified design criteria requirements and include the following:

1) Arrangement, size, and details for individual excavation support system.

2) Construction methods and sequencing to be used for the installation and removal of each excavation support system.

3) Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably or if obstructions are encountered in the installation.

2. Provide for Engineer review prior to the beginning of construction activities requiring such systems.

3. No excavations shall be started until the submittal review is complete.

4. Review by the Engineer of the submitted design shall not be construed as a detailed analysis of the adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving overall responsibility and liability for the work.

B. Excavation Support Systems

1. Plans and details for trench and excavation support systems.

    a. Calculations and shop drawings shall be made and stamped by a Colorado-registered Professional Engineer experienced in the design of excavation support systems and shall comply with the applicable requirements of OSHA and the Colorado equivalent Structural Specialty Code with respect to excavation and construction.

        1) Arrangement, size, and details for individual excavation support systems.

        2) Construction methods and sequencing to be used for the installation and removal of individual excavation support systems.

    b. Provide plans, details, and calculations for Engineer review prior to the beginning of construction activities requiring such systems.

    c. Review by the Engineer of the submitted design shall not be construed as a detailed analysis of the adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving overall responsibility and liability for the work.

2. Provide plans, details, and calculations for trench and excavation support systems to the <_____> as required to obtain all necessary construction permits.

3. No excavations shall be started until the submittal review is complete and proper permits are obtained.

C. Excavation Plan

1. Designed to prevent damage to existing and surrounding properties.

D. Settlement Monitoring Plan, to include the following:

1. Detailed location of settlement monitoring points shown on the Drawings.

2. Reference benchmarks <_____> to be employed.

3. Survey procedures (including name of survey crew leader and equipment to be used).

4. Approach to recording surveyed readings and means of reporting of results to the Owner.

E. Contingency Plan

1. Provide alternative procedures to be implemented if the excavation support systems are found to perform unfavorably or if obstructions are encountered in the installation of excavation support systems.

2. Contingency plan is to demonstrate a preparedness to mitigate the effects of movement or settlement.

3. The following minimum requirements for a contingency plan are:

   a. Measures to be taken in order to protect existing facilities and neighboring properties from additional settlement or movement.

   b. Identification of all material, manpower, equipment, and other items to be available and onsite at all times while excavations and dewatering activities are ongoing and reasonably after the work has been completed.

F. Site Conditions Survey

1. Videotape surveys, photographs, and other data significant in noting the pre-construction conditions of the existing project site, as well as the pre-construction conditions of the neighboring properties and their existing structures.

2. Provide to the OWNER for record purposes prior to, but not more than 3 weeks before, commencement of any construction activities.

3. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the Owner and Engineer.

1.5 QUALITY ASSURANCE

A. Contractor is solely responsible for quality assurance of temporary shoring.

B. At each excavation support system location, provide the following:

1. Continual verification system is planned, executed, and maintained in accordance with applicable codes, regulations, and good construction practice.

2. Systematic observation of suitability of shoring materials.

3. Installation, excavation, settlement, and lateral deflection monitoring.

4. Groundwater control.

5. Adjacent construction activities.

6. Other factors, as necessary.

C. Continually verify installation of the shoring is in conformance with the plans prepared by the Contractor's design engineers.

1.6 CONTRACTOR QUALIFICATIONS

A. The work of this Section shall be done by a firm specializing in this type of work. The firm shall:

1. Regularly and presently perform shoring installation as one of their principal services.

2. Have technical qualifications, experience, training, and facilities to properly install shoring.

3. Provide the services of a supervising engineer, registered in the State, with at least 5 years of experience in the design and construction of shoring walls.

4. A foreman or superintendent experienced in the installation and removal shoring walls shall be present while this work is performed.

1.7 PERMITTING

A. Secure all permits necessary to complete the requirements of this Section.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be safe and in good condition and shall conform to local, state, and federal codes.

PART 3 EXECUTION

3.1 GENERAL

A. Provide sheeting, shoring, and other protection and support systems wherever required, in accordance with current local, state, and federal laws, codes, and ordinances.

B. The Contractor is solely responsible for excavation protection and worker safety.

C. The Contractor shall be solely responsible for the protection of existing utilities and structures. Under no circumstance shall work threaten the integrity (physical and operational) of these utilities and/or structures.

3.2 EXCAVATION SUPPORT SYSTEMS

A. The excavation support systems shall not disturb the state of soil adjacent to the trench or excavation and below the excavation bottom.

B. Water control measures shall be provided at all times in accordance with the requirements specified in Section 31 23 19, Dewatering.

C. The support system shall extend below the main excavation bottom elevation to a depth adequate to prevent hydrostatic uplift, seepage and piping, and lateral movement and to adequately support applied vertical loads.

D. Damage to existing utilities or structures during installation of excavation support system shall be avoided. If damage occurs, it shall be repaired at no cost to the Owner and to the satisfaction of the utility owner.

E. A company representative from the excavation support system shall be onsite during initial setup of the system. Install excavation support system in strict conformance with the representative's recommendations.

3.3 CONTINGENCY PLAN IMPLEMENTATION

A. Excess movements or settlements: Work shall be stopped immediately and the causes of excess or detrimental movements evaluated if:

1. Damage is noted to existing site features or surrounding properties.

2. Shoring wall movements exceed the limits specified herein or per submitted calculations.

B. Immediately notify the Engineer and begin the implementation of the approved contingency plan to mitigate the effects of settlement or movement occurred.

3.4 REMOVAL OF SUPPORT SYSTEMS

A. Removal of excavation support systems shall be performed in a manner that does not disturb or damage adjacent new or existing structures or utilities.

B. Fill all voids immediately with specified backfill material.

C. All damage to property resulting from removal shall be promptly repaired at no cost to the OWNER. The Engineer shall be the sole judge as to the extent and determination of the methods and materials for repair.

3.5 SCHEDULE

A. A tight sheet excavation support system selected by the CONTRACTOR shall be provided for the excavation of the following structures, unless otherwise approved by the ENGINEER:

1. Wet Well
2. Valve Vault

END OF SECTION

SECTION 33 01 30.13 - SEWER AND MANHOLE TESTING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes methods for testing of gravity sewer piping, pressure sewer piping, and manholes.

B. Section includes:

1. Testing of Gravity Sewer Piping:

   a. Low pressure air testing

2. Testing of pressure piping

3. Deflection testing of plastic sewer piping

4. Testing of Manholes:

   a. Vacuum testing
   b. Exfiltration testing

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

2. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

B. American Water Works Association (AWWA):

1. AWWA C600 - Installation of Ductile Iron Mains and Their Appurtenances

2. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit following items prior to start of testing:

1. Testing procedures
2. List of test equipment
3. Testing sequence schedule
4. Provisions for disposal of flushing and test water
5. Certification of test gage calibration
6. Deflection mandrel drawings and calculations

C. Test and Evaluation Reports: Indicate results of manhole and piping tests.

PART 2 PRODUCTS

2.1 VACUUM TESTING

A. Equipment:

1. Vacuum pump

2. Vacuum line

3. Vacuum Tester Base:

a. Compression band seal
b. Outlet port

4. Shutoff valve

5. Stopwatch

6. Plugs

7. Vacuum Gage: Calibrated to 0.1-inch hectogram (Hg) (0.34 kilopascal (kPa)).

2.2 EXFILTRATION TESTING

A. Equipment:

1. Plugs
2. Pump
3. Measuring device

2.3 AIR TESTING

A. Equipment:

1. Air compressor
2. Air supply line

3. Shutoff valves
4. Pressure regulator
5. Pressure relief valve
6. Stopwatch
7. Plugs
8. Pressure Gage: Calibrated to 0.1 pounds per square inch (psi)

2.4 HYDROSTATIC TESTING

A. Equipment:

1. Hydro pump
2. Pressure hose
3. Water meter
4. Test connections
5. Pressure relief valve
6. Pressure Gage: Calibrated to 0.1 psi

2.5 DEFLECTION TESTING

A. Equipment:

1. "Go, no go" mandrels
2. Pull/retrieval ropes

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify manholes and piping are ready for testing.
B. Verify trenches are backfilled.
C. Verify pressure piping thrust restraint system is installed, as may be required.

3.2 PREPARATION

A. Obstructions:

1. After backfilling and restoration of surfaces, gravity pipelines shall be inspected for obstructions and shall be cleaned.

2. Pipes less than 24 inches in diameter shall be cleaned using the sewer ball method.

3. Lines larger than 36 inches in diameter may be cleaned by flushing as long as they are first visually inspected to assure that no physical obstructions exist.

a. Flushing shall be such that velocities are at least 2-1/2 feet per second.

B. Lamping:

1. Lamp gravity piping after flushing and cleaning of lines, checking manholes for unfinished work.

2. Perform lamping operation by shining light at one end of each pipe section between manholes.

3. Observe light at the other end.

4. Pipe not installed with uniform line and grade will be rejected.

5. Remove and reinstall rejected pipe sections.

6. Reclean and lamp until pipe section is installed to uniform line and grade.

C. Plugs:

1. Plug outlets, wye branches, and laterals.
2. Brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

A. Testing of Gravity Sewer Piping:

1. Low Pressure Air Testing:

a. Test each reach of gravity sewer piping between manholes.

b. Introduce air pressure slowly to approximately 4 pound-force per square inch gauge (psig).

1) Determine ground water elevation above spring line of piping.

2) For every foot of ground water above spring line of piping, increase starting air test pressure by approximately 0.4 psi.

3) Do not increase pressure above 10 psig.

c. Allow pressure to stabilize for at least 5 minutes.

d. Adjust pressure to 3-1/2 psig or to increased test pressure as determined above when ground water is present.

e. Testing:

1) Determine test duration for reach of sewer with single pipe size from following table; do not make allowance for laterals.

Table 33 01 30.13 -1
Air Testing Duration for Gravity Sewer Piping

NOMINAL PIPE SIZE, INCHES	MINIMUM TESTING TIME, MIN/100 FEET
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

2) Record drop in pressure during testing period.

3) If air pressure drops more than 1.0 psi during testing period, piping has failed.

4) If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.

5) If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.

B. Testing of Pressure Piping:

1. Test system according to AWWA C600 and the requirements of Section 33 13 00, Testing and Disinfection of Water Utility Piping.

C. Deflection Testing of Plastic Sewer Piping:

1. Perform vertical ring deflection testing on PVC and acrylonitrile butadiene styrene (ABS) sewer piping after backfilling has been in place for at least 30 days but not longer than 12 months.

2. Allowable maximum deflection for installed plastic sewer pipe is no greater than 5 percent of original vertical internal diameter:

3. Perform deflection testing using properly sized rigid ball or "go, no go" mandrel.

4. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe, as determined by ASTM standard to which pipe is manufactured; measure pipe diameter in compliance with ASTM D2122.

5. Perform testing without mechanical pulling devices.

6. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

D. Testing of Manholes:

1. Description:

   a. Option of air testing or exfiltration testing.

   b. If air testing, test whenever possible prior to backfilling in order to more easily locate leaks.

   c. Repair both outside and inside of joint to ensure permanent seal.

   d. Test manholes with manhole frame set in place.

2. Vacuum test according to ASTM C1244 and following:

   a. Plug pipe openings; securely brace plugs and pipe.

   b. Inflate compression band to create seal between vacuum base and structure.

   c. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10-inch Hg.

   d. Close valve.

   e. Testing:

      1) Determine manhole testing duration using following table:

MANHOLE DIAMETER (feet)	TEST PERIOD
4	60 seconds
5	75 seconds
6	90 seconds

      2) Record vacuum drop during test period.

3) If vacuum drop is greater than 1-inch Hg during testing period, repair and retest manhole.

4) If vacuum drop of 1-inch Hg does not occur during test period, manhole is acceptable; discontinue testing.

5) If vacuum test fails to meet 1-inch Hg drop-in specified time after repair, repair and retest manhole.

3. Exfiltration Testing:

   a. Plug pipes in manhole.

   b. Remove water from manhole.

   c. Observe plugs over period of not less than two hours to ensure that there is no leakage into manhole.

   d. Determine ground water level outside manhole.

   e. Fill manhole with water to its rim at the start of the test.

   f. Prior to testing, allow manhole to soak from minimum of 4 hours to maximum of 72 hours.

   g. After soak period, adjust water level to rim of manhole.

   h. Leakage in the manhole shall not exceed 0.2 gallons per foot of head above the highest invert after a one-hour test period.

4. If unsatisfactory testing results are achieved, repair manhole and retest until result meets criteria.

5. Repair visible leaks regardless of quantity of leakage.

END OF SECTION

SECTION 33 05 13 - MANHOLES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes cast-in-place and precast concrete manholes and covers for access to subsurface drainage piping or utilities.

B. Section Includes:

1. Cast-in-place concrete manholes with transition to cover frame, covers, anchorage, and accessories.

2. Modular precast concrete manhole with tongue-and-groove joints with precast transition to cover frame, covers, anchorage, and accessories.

3. Bedding and cover materials.

1.2 RELATED SECTIONS

A. Section 03 11 00 - Concrete Work
B. Section 03 21 00 - Reinforcing Steel
C. Section 31 05 13 - Soils for Earthwork
D. Section 31 05 16 - Aggregates for Earthwork
E. Section 31 23 16 - Excavation
F. Section 31 23 23 - Fill
G. Section 33 01 30.13 - Sewer and Manhole Testing

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M-198B – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

B. American Concrete Institute (ACI):

1. ACI 301 – Building Code Requirements for Structural Concrete
2. ACI 315 – Details and Detailing of Concrete Reinforcement
3. ACI 318 – Building Code Requirements for Structural Concrete

C. ASTM International (ASTM):

1. ASTM A48 - Standard Specification for Gray Iron Castings

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

3. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

4. ASTM C55 - Standard Specification for Concrete Building Brick

5. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)

6. ASTM C150 - Specifications for Portland Cement

7. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar

8. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections

10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile

11. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

12. ASTM C913 - Standard Specification for Precast Concrete Stormwater and Wastewater Structures

13. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

14. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

D. Federal Specifications:

1. SS-S-00210 (210-A) – Specification for Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints

E. US Army Corp of Engineers:

1. CRD-C 621 – Specifications for Non-Shrink Grout

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Pre-cast concrete manholes:

   a. Design criteria and calculations.
   b. Details of reinforcement.

2. Steps.

3. Cover and frame construction, features, configuration, dimensions and material specifications.

4. Rubber gaskets.

5. Grout and mortar.

C. Shop Drawings:

1. Indicate manhole by location.

2. Provide dimensions, elevations, joints, location, and type of lifting inserts.

3. Indicate connecting piping material, piping size, piping connection angles and offsets, and sizes of penetrations.

D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Comply with precast concrete manufacturer's instructions and ASTM C913 for unloading, storing, and moving precast manholes and drainage structures.

C. Storage:

1. Store precast concrete manholes as to prevent damage to Owner's property or other public or private property.

2. Repair property damaged from materials storage.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA FOR MANHOLES

A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.

B. Design of Lifting Devices for Precast Components: According to ASTM C913.

C. Design of Joints for Precast Components:

1. According to ASTM C913.
2. Lipped male/female joints.
3. Maximum Leakage: 0.025 gallons per hour per foot of joint at 3 feet of head.

D. Shaft Construction:

1. Reinforced concrete.
2. Concentric with concentric cone top section
3. Sleeved to receive pipe connections.

E. Wall Thickness:

1. Minimum wall thickness shall be 5 inches.
2. Cones shall have the same wall thickness and reinforcement as riser sections.

F. Shape: Cylindrical.

G. Clear Inside Dimensions:

1. As indicated on Drawings.

2. Sections shall consist of circular sections in standard nominal inside diameters of 120 inches.

H. Design Depth:

1. As indicated on Drawings.

I. Clear Cover Opening: As indicated on Drawings, minimum of 30 inches.

J. Pipe Entry: Furnish openings as required and as indicated on the Drawings.

K. Steps:

1. Rungs:

a. Material: Formed polypropylene with 1/2-inch diameter, Grade 60 reinforcing bar.

b. Comply with ASTM C478.

c. Reinforcing bar to comply with ASTM A615.

2. Formed integral with manhole sections.

3. Width: Minimum 12 inches.

4. Spacing: 12 inches on center vertically.

2.2 MANHOLES

A. Precast Concrete Manholes:

1. Sections:

a. Description: Reinforced precast concrete according to ASTM C478.
b. Gaskets: According to ASTM C923.
c. Heights: Multiples of 6 inches.

2. Bases:

a. Base slab integral with sidewalls.
b. Monolithic construction, conforming to ASTM C478.

B. Cast-in-Place Concrete Manholes:

1. Sections: Reinforced cast-in-place concrete as specified in Section 03 30 00 - Cast-in-Place Concrete.

2. Concrete forming in accordance with Section 03 10 00, Concrete Forming and Accessories.

C. Joint Materials:

1. Mortar:

a. Conform to ASTM C387.

b. Admixtures

1) Allowable, not exceeding the following percentages of weight of cement:

a) Hydrated lime, 10 percent
b) Diatomaceous earth or other inert materials, 5 percent

c. Consistency: Shall be such that it will readily adhere to the precast concrete if using the standard tongue and groove type joint.

d. Mortar not used within 30 minutes of initial mixing shall be discarded and not be used.

2. Non-Shrink Grout:

a. Description: Non-metallic, cementitious, commercial grout exhibiting zero shrinkage per ASTM C827 and CRD-C-621.

b. Manufacturers:

1) Preco-Patch
2) Sika 212
3) Euco N-S
4) Five-Star
5) Approved equal

3. Grout shall not be amended with water after initial mixing.

4. Grout not used within 20 minutes of initial mixing shall be discarded and not be used.

5. Commercial Concrete Bonding Agent:

a. Non-shrink grout shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.

b. Bonding agent shall be compatible with the brand of grout used.

c. Water shall not be used as a substitute for the commercial bonding agent.

D. Preformed mastic gaskets for manhole joints shall meet Federal Specifications SS-S-00210 (210-A), AASHTO M-198B and ASTM C990.

E. Reinforcement:

1. Formed steel wire.

2.3 FRAMES AND COVERS

A. Description:

1. Construction: ASTM A48, Class 30B cast iron.

2. Lid:

   a. Machined flat bearing surface.
   b. Removable.

   c. Lockable at locations shown on the Drawings.

3. Cover Design: Closed.

4. Live Load Rating: AASHTO H20 loading.

5. Cover: Molded with "SEWER" cast in.

6. Coefficient of Friction on Outside Face: Minimum of 0.60.

2.4 RISER RINGS

A. Description:

1. Four inches to 6 inches Thick:

   a. Material: Precast concrete.
   b. Comply with ASTM C478.

2. Less than 4 inches Thick:

   a. Material: Cast iron.
   b. Comply with AASHTO M306.

3. Rubber Seal Wraps:

   a. Wraps and Band Widths: Conform to ASTM C877, Type III.
   b. Cone/Riser Ring Joint: Minimum 3 inches overlap.
   c. Frame/Riser Ring Joint: 2 inches overlap.
   d. Additional Bands: Overlap upper band by 2 inches.

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2. Backfill Around Structure: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

3. Soil Backfill from Above Pipe to Finish Grade:

   a. In existing or future roadways, right-of-way:

      1) Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

   b. In non-paved areas outside of footprint of existing or future structures, outside of right-of-way:

      1) Soil Type S1, as specified in Section 31 05 13, Soils for Earthwork.
      2) Subsoil: No rocks over 6 inches in diameter, frozen earth, or foreign matter.

2.6 FINISHES

A. Steel:

1. Galvanizing:

   a. ASTM A123.
   b. Hot dip galvanize after fabrication.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify items provided by other Sections of Work are properly sized and located.
B. Verify built-in items are in proper location and ready for roughing into Work.
C. Verify correct size of manhole excavation.

3.2 PREPARATION

A. Design the method of placement for all precast items and add all reinforcing steel, embeds, bracing, and other items necessary for placement. All portions of embeds which remain embedded in the concrete shall be made of stainless steel.

B. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.

D. Do not install manholes where site conditions induce loads exceeding structural capacity of manhole components.

E. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage; remove and replace damaged units.

F. Subgrade

1. Subgrade shall be compacted to 95 percent of maximum density.

2. Compacted subgrade shall be covered with a minimum of 6 inches of aggregate base compacted to 95 percent of maximum density, extending a minimum of 6 inches beyond the outside limits of the manhole, unless otherwise indicated on Drawings.

3. Grade the aggregate base to a uniform, level surface which will fully support the structure and to an elevation that will ensure proper positioning of the top slab or lid.

3.3 INSTALLATION

A. Excavation and Backfill:

1. Excavate manholes as specified in Section 31 23 16, Excavation in location and to indicated depth.

2. Provide 12 inches of clearance around sidewalls of structure for construction operations.

3. When groundwater is encountered, prevent accumulation of water in excavations and place manholes in dry trench.

B. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Engineer.

C. Base Pad:

1. Place base pad.
2. Trowel top surface level.

D. Backfill excavations for manholes as specified in Section 31 23 23, Fill.

E. Form and place manhole cylinder plumb and level and to correct dimensions and elevations.

F. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.

G. Set cover frames and covers level without tipping and to correct elevations.

H. Coordinate with other Sections of Work to provide correct size, shape, and location.

I. Precast Concrete Manholes:

1. Assembly:

   a. Install precast structures in accordance with the manufacturer's recommendations unless otherwise required by the Contract Documents.

   b. Verify installed manholes meet required alignment and grade.

   c. Lift precast components at lifting points designated by manufacturer.

   d. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.

   e. Set precast structures bearing firmly and fully on crushed stone bedding, compacted as specified in Section 31 23 23, Fill or on other support system as indicated on Drawings.

   f. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.

   g. Place manhole sections plumb and level, trim to correct elevations, and anchor to base pad.

   h. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.

   i. Maintain alignment between sections by using guide devices affixed to lower section.

2. Joints:

   a. Sealing materials may be installed onsite or at manufacturers plant.

   b. All joints shall be sealed watertight by the use of rubber gaskets or other approved preformed sealant.

c. All joints shall then be filled with non-shrink grout on both the inside and outside surfaces to produce smooth interior and exterior surfaces.

3. Concrete Base Installation:

   a. Bases shall be set at the proper grade to allow pipe openings to match the grades for connecting pipes.

   b. Invert shall be constructed to a section identical with that of the sewer pipe.

   c. Where the size of sewer pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces.

   d. Prevent sewage or water from contacting the new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

   e. Manhole bases shall be set level so base gravel fully and uniformly supports them in true alignment with uniform bearing throughout full circumference.

   f. Do not level the base sections by wedging gravel, or other material, under the edges.

   g. Flexible connectors shall be installed in the base section to form a permanently watertight seal.

4. Manhole Riser Sections:

   a. Precast manhole components may be used to construct standard, drop and carry-through manholes. Manholes less than 4 feet in depth measured from the spring line of the pipe to the bottom of the lower riser ring shall be flat-top manholes.

   b. Install manhole riser sections at the location shown on the plans. All sanitary sewer and pollution control manholes joints shall be watertight and shall use rubber gaskets or a preformed sealant. All joints shall then be filled with non-shrink grout inside and out so as to produce smooth interior and exterior surfaces. All manhole penetrations shall be watertight. Complete manholes shall be rigid. Compact backfill in accordance with the provisions stated elsewhere in this document.

   c. All lift holes shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.

d. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the flat slab top or cone.

e. Properly locate and plumb each manhole riser section.

f. Install manhole extensions and top slabs in accordance with manufacturer's specifications and as shown on the plans. Lay section risers with the sides plumb and the tops level. Make joints and penetrations watertight.

g. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.

5. Entrances/Exits:

a. Cut pipe flush with interior of structure.

b. Shape inverts through manhole as indicated on Drawings.

c. All rigid non-reinforced pipe entering or leaving the manhole (new or existing manhole) shall be provided with flexible joints within 1-foot of the structure and shall be placed on compacted bedding.

d. Ribbed HDPE pipe connections shall be grouted watertight with non-shrink grout.

e. PVC pipe shall be connected to manholes using an approved adapter specifically manufactured for the intended service.

1) Adapters shall be Fernco, Kor-N-Seal, or approved equal.

6. Grates, Frames, and Covers:

a. Manhole frames, grates, and covers shall be installed in such a manner as to prevent infiltration of surface or groundwater between the frame and the concrete of the manhole section. Use preformed rubber ring to form a watertight seal.

b. Manhole frames and covers shall be installed to grades shown on the drawings or as directed.

c. Adjustment of manhole castings shall be made using specified precast grade rings and approved rubber ring joints.

d. The maximum depth of adjustment below any manhole casting shall be 16 inches, and a minimum depth of adjustment shall be 4 inches.

J. Cast-in-Place Concrete Manholes:

1. Prepare crushed stone bedding or other support system as indicated on Drawings to receive base slab as specified for precast structures.

2. Erect and brace forms against movement as specified in Section 03 11 00, Concrete Work.

3. Install reinforcing steel as indicated on Drawings and as specified in Section 03 11 00, Concrete Work.

4. Place and cure concrete as specified in Section 03 11 00, Concrete Work.

5. Frames and Covers:

   a. Set frames using mortar and masonry.

   b. Install radially laid concrete brick with 1/4-inch thick vertical joints at inside perimeter.

   c. Lay concrete brick in full bed of mortar and completely fill joints.

   d. If more than one course of concrete brick is required, stagger vertical joints.

   e. Set frame and cover as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. Test concrete manhole and structure sections according to ASTM C497.

B. Perform manhole testing according to Section 33 01 30.13, Sewer and Manhole Testing.

C. Test cast-in-place concrete as specified in Section 03 11 00, Concrete Work.

D. Vertical Adjustment of Existing Manholes:

1. If required, adjust top elevation of existing manholes to finished grades as indicated on Drawings.

2. Reset existing frames, grates, and covers that were carefully removed and cleaned of mortar fragments to required elevation according to requirements specified for installation of castings.

3. When removal of existing concrete wall is required, remove concrete without damaging existing vertical reinforcing bars, clean concrete from vertical bars, and bend into new concrete top slab or splice to required vertical reinforcement as indicated on Drawings.

4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete as specified in Section 03 11 00, Concrete Work.

END OF SECTION

SECTION 33 05 17 - PRECAST CONCRETE VALVE VAULTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete valve vaults.

1.2 RELATED SECTIONS

A. Section 31 05 16, Aggregates for Earthwork
B. Section 31 23 16, Excavation
C. Section 31 23 23, Fill.

1.3 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. ASTM C33 - Standard Specification for Concrete Aggregates.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

11. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

12. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.

13. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

14. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)).

15. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

16. ASTM D4104 - Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests).

17. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 COORDINATION

A. Coordinate Work with utilities within construction area.

B. The drawings identify precast vaults by manufacturer and model number. This information is provided for dimensional information only. Provide precast items in accordance with the requirements of this Section.

1.5 PREINSTALLATION MEETINGS

A. Convene a minimum of 1-week prior to commencing Work of this Section.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on valve vaults.

C. Shop Drawings for Precast Concrete Valve Vaults:

1. Indicate plan, location, and inverts of connecting piping.
2. All interior and exterior dimensions.
3. Location and type of lifting inserts, connection embeds, and joints.
4. Details of reinforcement.
5. Covers or hatches.

6. Ladders and grating.

D. Manufacturer's Certificate: Certify that precast concrete valve vaults meet or exceed ASTM standards and specified requirements.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and inverts of buried pipe, components, and connections.

1.8 QUALITY ASSURANCE

A. Perform Work according to standards identified in Article 1.2 herein.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Transport and handle precast concrete units with equipment designed to protect units from damage.

C. Storage:

1. Store precast concrete valve vaults according to manufacturer instructions.

2. Do not place concrete units in position to cause overstress, warping, or twisting.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Performance and Design Criteria:

1. Watertight, Precast, Reinforced, Air-Entrained Concrete Structures:

a. Manufactured to conform to ASTM C913.

2. Loading:

a. Design to ASTM C890-A16 / AASHTO HS20 live loading and installation conditions.

b. Where vaults are below grade, a dead load of 125 pounds per cubic foot shall be added for the soil.

c. Lateral loads:

1) Static: 105 x Depth of fill per square foot (psf) triangular equivalent fluid pressure plus a surcharge of an additional 3 feet of soil depth in areas subject to vehicular traffic (assume traffic load in all areas, unless indicated otherwise by the Contract Documents).

2) Seismic acceleration: UBC Zone 3 requirements (I = 1.25) where I = importance factor, I = 1.25, but not less than 0.20 grams (g) acting on structure mass. Seismic loading need not be considered simultaneously with traffic surcharge.

3. Minimum 28-Day Compressive Strength: 3,000 pounds per square inch (psi).

4. Honeycombed or re-tempered concrete is not permitted.

5. No knockouts shall be cast into vault walls. All pipe penetrations shall be pre-formed or core-drilled at the required locations.

6. Accessories: Accessories such as ladders, floor grates at sumps, and other features shall be provided as shown on the Drawings.

7. Size: Vault dimensions shall be as required by the Drawings.

2.2 PRECAST CONCRETE VALVES

A. Manufacturers:

1. Furnish materials according to Owner standards as shown in the details of the Drawings.

B. Valve Vault Frames and Covers:

1. Cast Iron Castings:

a. ASTM A48, Class 30 or better.
b. Free of bubbles, sand, air holes, and other imperfections.

C. Access Steps:

1. Steel reinforced formed polypropylene:

a. ASTM C478
b. Reinforced rod: ASTM A615, Grade 60, 1/2-inch diameter

2. Aluminum: ASTM B221, Alloy 6061-T6

3. Width: Minimum 12 inches

4. Spacing: 12 inches on center vertically.

2.3 ACCESS HATCHES AND LIDS

A. Unless noted otherwise elsewhere in the Contract Documents, vaults shall have concrete top slabs with access openings as shown on the Drawings.

B. Vault manufacturer shall provide the access hatches per the requirements of Section 05 50 00, Metal Fabrications.

C. Lids shall have lifting holes.

D. When leveling bolts are used to set the vault top sections, ensure the load from the top slab is transferred through grout to the vault walls so that the load is not carried by the leveling bolts.

2.4 MATERIALS

A. Portland Cement:

1. ASTM C150, Type II

B. Coarse Aggregates:

1. ASTM C33
2. Graded 1 inch to No. 4 sieve

C. Sand:

1. ASTM C33
2. Fineness Modulus: 2.35

D. Water:

1. Potable.

2. Clean and free of injurious amounts of acids, alkalis, salts, organic materials, and substances incompatible with concrete or steel.

E. Air-Entraining Admixtures: ASTM C260

F. Reinforcing Steel:

1. Deformed Bars: ASTM A615, Grade 40 minimum
2. Welded Wire Fabric: ASTM A185

G. Gaskets:

1. Rubber gaskets: ASTM C443

H. Joint Sealant:

1. ASTM C990

I. Bedding:

1. Aggregate Bedding Material: Fill Type A1 as specified in Section 31 05 16, Aggregates for Earthwork. Size as shown in the Drawings.

2.5 FABRICATION

A. Fabricate precast reinforced concrete structures according to ASTM C913, to dimensions indicated on Drawings, and to specified design criteria.

B. Vaults may be formed with separate top and bottom slabs.

C. Walls shall be cast so that all sides are continuous at corners and their full length with no block-outs or knockouts.

D. Horizontal joints may be provided so that walls can be placed in horizontal segments.

E. All horizontal joints shall be keyed to prevent offsets and shall be provided with a watertight gasket.

F. Finish:

1. Formed surfaces shall be smooth and uniform with no fins, bulges, or other irregularities.

2. Any void greater in width than 1/2-inch or deeper than 3/8-inch shall be repaired.

3. Unformed interior slab surfaces shall have a smooth steel trowel finish.

4. Unformed exterior slab surfaces shall have a light broom finish applied to a steel trowel finish.

2.6 MIXES

A. Design concrete mix to produce required concrete strength, air-entrainment, watertight properties, and loading requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping connections, sizes, locations, and inverts are as indicated on Drawings.

3.2 PREPARATION

A. Ream pipe ends and remove burrs.

B. Remove scale and dirt from components before assembly.

C. Establish invert elevations for each component in system.

D. Hand trim excavation to suit valve vaults; remove stones, roots, and other obstructions.

3.3 INSTALLATION

A. Vaults and Bedding:

1. Excavate as specified in Section 31 23 16, Excavation for Work of this Section.

2. Hand trim excavation for accurate placement of vaults to elevations indicated.

3. Place bedding material level in one continuous layer to a minimum compacted depth of 2 inches.

4. Compact bedding material to 95 percent maximum density.

5. Bases for precast concrete structures shall be set level so that bedding material fully and uniformly supports them in true alignment with uniform bearing throughout full perimeter. Do not level bases by wedging gravel under the edges.

6. Backfill around sides of vaults as required by the Drawings.

B. Connect piping.

3.4 FIELD QUALITY CONTROL

A. Request examination of subgrade by Engineer prior to placing aggregate base under precast materials.

B. Compaction Testing: In accordance with Field Quality Control requirements of Section 31 23 23, Fill.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

D. Frequency of Compaction Tests: In accordance with Section 01 45 00, Quality Control.

END OF SECTION

SECTION 33 11 10 - WATER UTILITY DISTRIBUTION AND TRANSMISSION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work under this Section applies to furnishing and installation of pipe materials, fittings, and appurtenances normally encountered with water distribution systems, including potable water and fire water systems.

B. Section includes:

1. Pipe and fittings
2. Flexible couplings
3. Flanged coupling adapters
4. Insulating flanged joints
5. Tapping sleeves and valves
6. Flexible expansion joints
7. Bedding and cover materials

C. Related Requirements:

1. General

a. Furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents.

b. Each buried piping system shall be complete, with all necessary fittings, valves, accessories, lining and coating, testing, excavation, backfill and encasement, to provide a functional installation.

c. Piping layouts shown in the Drawings are intended to define the general layout, configuration, and routing for pipe, as well as the size and type of piping to be installed. The piping plans are not pipe construction or fabrication drawings.

d. The Contractor shall cause the Supplier of pipes, valves, fittings, and appurtenances to coordinate piping installation such that all equipment is compatible and is capable of achieving the performance requirements specified in the Contract Documents.

e. It is the Contractor's responsibility to develop the details necessary to construct all piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, valves, gaskets, fittings, appurtenances etc., for a complete and functional system.

1.2 RELATED SECTIONS

A. Section 03 11 00 - Concrete Work
B. Section 31 05 13 - Soils for Earthwork
C. Section 31 05 16 - Aggregates for Earthwork
D. Section 31 23 16 - Excavation
E. Section 31 23 17 - Trenching
F. Section 31 23 23 - Fill
G. Section 33 05 17 - Precast Concrete Valve Vaults
H. Section 33 12 13 - Water Service Connections
I. Section 33 12 16 - Water Utility Distribution Valves
J. Section 33 12 19 - Fire Hydrants
K. Section 33 13 00 - Testing & Disinfecting of Water Utility Piping

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys

3. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges

4. ASME B31.10 - Standards of Pressure Piping

C. ASTM International (ASTM):

1. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

2. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

3. ASTM A536, Standard Specification for Ductile Iron Castings.

4. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

7. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

8. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

9. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

10. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

13. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast

7. AWWA C153 - Ductile-Iron Compact Fittings

8. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe

9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

11. AWWA C606 - Grooved and Shouldered Joints

12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

13. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm) for Water Transmission and Distribution

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves

F. NSF International (NSF):

1. NSF Standard 61 - Drinking Water System Components – Health Effects
2. NSF Standard 372 - Drinking Water System Components – Lead Content

G. SUBMITTALS

H. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

I. Product Data: Submit data on pipe materials, pipe fittings, restrained joint systems, and accessories.

J. Shop Drawings: Indicate piping layout, including piping specialties.

1. Layout Schedule for applicable segments of proposed transmission main alignment. Schedule shall include layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, pipe supports, and any special provisions required for assembly.

K. Lining and coating data.

L. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

M. Manufacturer's handling, delivery, storage, and installation requirements.

N. Field Quality-Control Submittals:

1. Pipeline hydrostatic testing plan.
2. Indicate results of Contractor-furnished tests and inspections.

O. Preconstruction Photographs:

1. Submit digital files of colored photographs of Work areas and material storage areas.

1.4 CLOSEOUT SUBMITTALS

A. As-Built Drawings:

1. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the project shall be new, of first-class quality and shall be made by reputable manufacturers.

2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.

3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.

4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

B. Markings:

1. Pipes and Fittings: Mark each pipe and fitting at plant. Include date of manufacture, manufacturer's identification, specification standard, inside diameter of pipe, dimension ratio as applicable, pipe class as applicable, pipe number for laying purposes as applicable, and other information required for type of pipe.

2. Bolting materials (washers, nuts, and bolts) shall be marked with material type.

C. Testing:

1. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.

1.6 MATERIAL DELIVERY, STORAGE, AND HANDLING

A. In accordance with manufacturer's written recommendations and as specified in these Contract Documents.

B. Pipe, specials, and fittings delivered to Project Site in damaged condition will not be accepted.

C. Storage:

1. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

2. Pipe and fittings shall not be stored on rocks, gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

3. Do not store materials in direct sunlight.

4. Gaskets: Do not allow contact with oils, fuels, petroleum, or solvents.

D. Handling:

1. Pipe and appurtenances shall be handled in accordance with manufacturer's recommendations or requirements contained in this section or subsequent sections dealing with the specific pipe material, whichever is more stringent.

2. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.

3. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.

4. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

PART 2 PRODUCTS

2.1 WATER PIPING

A. General

1. All piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.

2. All coatings and materials specified herein which may come in contact with potable water shall conform to National Sanitation Foundation (NSF) Standard 61 and 372.

3. Minimum Pressure Ratings: Unless otherwise specified herein or shown in the Drawings, the minimum working pressure rating of all water works materials specified herein shall be 1-1/2 times the operating pressure or 150 pounds per square inch (psi) minimum.

4. Gaskets:

    a. Material: Styrene Butadiene Rubber (SBR) composition.

B. Ductile Iron Pipe:

1. Centrifugally cast, conforming to AWWA Standard C151.

2. Coating: Asphaltic exterior coating in accordance with AWWA Standard C151.

3. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.

4. Pipe Thickness Class:

    a. Comply with AWWA C151.

    b. Class 52, unless shown to be greater in the Plans.

        1) The Contractor shall be aware ductile iron piping with thickness class greater than Class 52 may have long fabrication and supplier lead times. The Contractor shall be responsible for coordinating product submittal and delivery times accordingly such as not to delay construction.

5. Polyethylene Encasement:

    a. Comply with AWWA C105.

    b. Polyethylene film shall be minimum 8-mil thick virgin linear low-density polyethylene (LLDPE).

6. Joints:

    a. Joint types shall be provided as identified in the Drawings and as required for the application.

b. Mechanical Joints:

1) Comply with AWWA C111.

c. Push-on Joints:

1) Comply with AWWA C111.

2) Manufacturers, without exception:

a) Tyton Joint by American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, McWane, and Pacific States Cast Iron Pipe.

b) Fastite Joint by American Cast Iron Pipe Company.

d. Restrained Joints:

1) Joint restraint for pipe shall be accomplished with an integral lock mechanism, except as may be otherwise specified.

a) Any such system shall be a manufacturer's standard proprietary design, shall be as recommended by the manufacturer for the application, and shall be performance proven.

2) Restraining components:

a) Ductile iron complying with AWWA C110 and/or C153, with the exception of a manufacturer's proprietary design dimensions.

b) Push-on joints for such fittings shall comply with AWWA C111.

3) Deflection:

4) The maximum pipe deflection shall not exceed one-half of the manufacturer's stated joint deflection allowance.

5) Manufacturers:

a) "Thrust-Lock", Pacific States Cast Iron Pipe Company.
b) "Fast Grip", American Cast Iron Pipe Company.
c) "TR Flex", United States Pipe and Foundry Company.
d) "Snap-Lok", Griffin Pipe Products Company.
e) "Field-Lok", United States Pipe and Foundry Company.
f) "Super Lock", Clow
g) "Restrained Joint", McWane
h) "MJ-TJ" pipe with "MEGALUGs", Pacific States Cast Iron Pipe Company.
i) "Flex-Ring", American Cast Iron Pipe Company

j) "MEGALUG", EBAA Iron, Inc.

(1) Where any restrained joint system requires the use of a wedge-type mechanical restraint gland for restraint, the glands shall be provided in quantities as may be required and shall be considered incidental to the joint restraint system.

(2) Wedge-type mechanical restraining glands shall not be used to restrain the plain end of plain end ductile iron or cast-iron fittings.

e. Flanged Joints:

1) Flat faced, complying with AWWA C111 and C115, unless otherwise specified.

2) Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.

3) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.

4) Pressure rating of flange joints shall not exceed the rating of the pipe or fitting of which they are a part and the maximum pressure rating of the joint shall be 250 psi.

5) Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.

6) Threaded flanges:

a) Ductile iron pipe spools with threaded flanges shall conform to AWWA C115.

b) Installed only on pipe with a minimum Class 53 wall thickness.

7) Buried flanges:

a) Flanged connections shall not be buried unless shown as such on the Drawings.

b) Buried flanges shall be wrapped with 2 layers of 10-mil tape along edges of flanges.

8) Gaskets:

a) Full faced, composed of synthetic rubber and 1/8-inch thick conforming to ASME B21.1 and AWWA C111.

b) Ring gaskets will be permitted only where specifically noted in the Drawings and Specifications.

c) Gaskets for flanged joints shall be as follows:

(1) Pipe sizes between 6-inch and 24-inch diameter, service pressures of 150 psi or greater shall be Garlock 3760-U or equal.

(2) Pipe sizes 4-inch diameter and under, service pressures of 150 psi or greater shall be Garlock 3505 or equal.

(3) All pipe sizes with service pressures of 150 psi or less shall be Garlock 98206 or equal.

d) Insulating flanged joints:

(1) Full faced, conform to ANSI 16.21.

(2) Material: Non-asbestos.

(3) Suitable for operating and test pressures of the pipe system.

(4) Manufacturer:

(a) Garlock GYLON Style 3505 or equal.

C. PVC:

1. All PVC pressure pipe shall be manufactured with an integral bell design capable of receiving an elastomeric gasket.

2. All PVC pressure pipe shall be dimensionally compatible with standard cast/ductile iron fittings produced according to AWWA C110 or AWWA C153, as applicable.

3. Deflection:

a. PVC pressure pipe may be deflected both horizontally and vertically at the joints after assembly.

b. Deflection by bending of the pipe rather than at the joints is not allowed.

c. The maximum pipe deflection shall not exceed one half of the manufacturer's stated joint deflection allowance.

4. Joints:

    a. Solvent-cement couplings are not permitted.

5. Gaskets: Comply with ASTM F477.

6. Size: 4-inch through 12-inch diameter

    a. Comply with AWWA C900, DR 14, Class 305, unless shown otherwise in the Drawings or specified elsewhere.

7. Size: 14-inch through 48-inch diameter

    a. Comply with AWWA C905, DR 18, Class 235, unless shown otherwise in the Drawings or specified elsewhere.

8. Restrained Joints:

    a. For push-on pipe joint at pipe bells:

        1) Material:

            a) Body: Ductile iron. Comply with ASTM A536.
            b) Bell Restraint Systems: Corten steel tie rods.

        2) Coatings: Shop-applied liquid epoxy.

        3) Construction:

            a) A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.

            b) System shall be designed for a minimum 2 to 1 safety factor.

        4) Manufacturers:

            a) 4-inch through 12-inch diameter: EBAA Iron, Inc. - Series 1900 Bell Restraint Harness.

            b) 14-inch through 48-inch diameter: EBAA Iron, Inc. - Series 2800 Bell Restraint Harness.

    b. At mechanical joint fittings:

        1) Material: Ductile iron. Comply with ASTM A536.

2) Coatings: Shop-applied liquid epoxy.

3) Construction:

a) Restraint accomplished by a restraint device consisting of a follower gland utilizing multiple gripping wedges.

b) The restraint system shall have a sufficient number of fastening bolts to connect the ring to the mechanical joint.

c) System shall be designed for a minimum 2 to 1 safety factor.

4) Fasteners:

a) T-bolts and nuts: High strength, low alloy steel.
b) Comply with AWWA C111.

5) Manufacturers:

a) EBAA Iron, Inc. - MEGALUG, Series 2000PV
b) Romac Industries, Inc. – 470 Series Pipe Restraining System

2.2 FITTINGS:

A. Material: Ductile iron, complying with AWWA Standard C110.

1. Fittings conforming to AWWA C153 may be substituted in lieu of AWWA C110 fittings.

B. Fittings used for joining ductile iron and PVC pipe shall be of the type, size, and strength designated on the Plans, elsewhere in the specifications.

1. Fittings shall be mechanical joint, push-on type, flanged or plain-end as required and shown on the Drawings.

2. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.

C. Pressure ratings: As specified for joining pipe above and as shown on the Drawings.

D. Coating and Lining:

1. Asphaltic exterior coating in accordance with AWWA Standard C110.

2. Cement Mortar Lining: Comply with AWWA C104.

E. Following information cast upon fittings:

1. Manufacturer's identification.
2. Country of manufacture.
3. Pressure rating.
4. For bends, number of degrees and/or fractions of a circle.

F. Owner may require additional metallurgical documentation or other certifications.

2.3 NUTS, BOLTS, AND WASHERS:

A. All bolts shall have heavy hex head with heavy hex nuts.

B. For operating pressures greater than 150 psi:

1. Bolts: Steel alloy composition. Comply with ASTM A193.
2. Nuts: Comply with ASTM A194, Grade 2H.
3. Washers: Comply with ASTM F436.

C. For operation pressures of 150 psi or less:

1. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.
2. Nuts: Comply with ASTM A563A, Heavy Hex.
3. Washers: Comply with ASTM F844.

D. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.

2.4 FLEXIBLE COUPLINGS

A. General

1. All flexible couplings shall be constructed to inside diameters that properly fit the connecting pipes.

2. The Contractor shall be responsible for selecting sleeve lengths appropriate to the application, subject to review and approval of the Engineer, recognizing that longer sleeves allow for larger deflections and may ease installation.

B. Flexible Couplings:

1. Description:

a. Comply with AWWA C219.

b. Type: Bolted, sleeved.

c. Configuration: Straight, transition, or reducing as shown in the Drawings.

d. Center rings and end rings: Ductile iron. Comply with ASTM A536.

e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

f. Bolts and nuts: High strength low alloy steel. Comply with AWWA C111.

g. Lining and coating: Factory-applied fusion bonded epoxy.

h. Working pressure: Up to 260 psi.

2. Manufacturers:

a. For 2-inch to 24-inch diameter:

1) Romac Industries, Inc. – Style 501 or equal.

C. Insulating Flexible Couplings:

1. The Contractor shall be responsible for selecting couplings appropriate to the application, subject to review and approval of the Engineer, recognizing that different pipe materials will require specific sizing and material selection for couplings.

2. Description:

a. Comply with Flexible Coupling specifications above.

b. Insulating Boot: Ethylene propylene diene monomer (EPDM) compounded for water service. Comply with ASTM D2000.

3. Manufacturers:

a. For 4-inch to 14-inch diameter:

1) Romac Industries, Inc. – Style IC501 or equal.

D. Restrained Flexible Couplings:

1. Description:

a. Body: Steel. Comply with ASTM A36.

b. Restrained gland: Ductile iron. Comply with ASTM A536, Grade 65-45-12.

c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

d. Bolts and nuts: All-thread rod, at a minimum complying with ASTM A193 Grade B7. Nuts per ASTM A194 Grade 2H.

e. Lining and coating: Factory-applied fusion bonded epoxy.

f. Working pressure: 250 psi. Test pressure: 400 psi.

2. Manufacturers:

a. Romac Industries, Inc. – Style 400RG
b. EBAA Iron – 3800 MEGA-COUPLING

2.5 FLANGED COUPLING ADAPTERS

A. Flanged Coupling Adapters:

1. All flanged coupling adapters shall be constructed to diameters that properly fit the connecting plain end pipe and the flanged fitting.

2. Description:

a. Comply with AWWA C219.

b. Flange: AWWA Class D Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles.

c. End ring and body:

1) Steel. Comply with ASTM A36.
2) Ductile iron. Comply with ASTM A536, Grade 65-45-12.

d. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

f. Bolts and nuts: High strength low alloy steel bolts and nuts. Comply with AWWA C111 composition requirements.

g. Lining and coating: Factory-applied fusion bonded epoxy.

h. Working pressure rating: Equal to the maximum rating of the flange.

3. Manufacturers:

a. Romac Industries, Inc.

1) Style FCA501

a) For 3-inch to 16-inch diameter.

2) Style FC400.

a) For 12-inch to 96-inch diameter.

B. Restrained Flanged Coupling Adapters:

1. Description:

a. Gland and flange body: Ductile iron. Comply with ASTM A536.

b. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

d. Restraining bolts and lugs: Ductile iron. Comply with ASTM A536.

e. T-bolts, Bolts, and nuts: High strength low alloy steel. Comply with AWWA C111 composition requirements.

f. Lining and coating: Factory-applied fusion bonded epoxy.

2. Manufacturers:

a. Romac Industries, Inc. – RFCA Restrained Flanged Coupling Adapters.

b. EBAA Iron – MEGAFLANGE Restrained Flange Adapter.

2.6 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Description:

a. Type: Dual compression.

b. Material:

1) Body: Stainless steel, Type 304.
2) Flanged outlet: Stainless steel, Type 304.

c. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class 150 and MSS SP-60.

d. Outlet Gasket:

e. Provide with Type 304 stainless steel test plug.

f. Nuts, bolts, and washers: Stainless steel, Type 304.

2. Manufacturers:

a. Romac Industries, Inc. – Model STS 420
b. JMC Industries, Inc.

B. Tapping Valves:

1. Resilient wedge gate valves specified in Section 40 05 61, Gate Valves.

2.7 FLEXIBLE EXPANSION JOINTS

A. Description

1. Installed at locations indicated in the Drawings.

2. End connections: As shown in the Drawings.

3. Material: Ductile iron, AWWA C153.

4. Working pressure: 350 psi, minimum.

5. Construction:

a. An expansion joint designed and cast as an integral part of a double ball and socket type flexible joint.

b. Manufactured of ductile iron, conforming to requirements of AWWA C153 and ASTM A536.

c. Deflection: Minimum of 15 degrees deflection per ball.

d. Expansion:

1) 12-inch diameter and under: 8-inch.
2) Greater than 12-inch diameter: 16 inches.

e. Each flexible expansion joint shall be hydrostatically tested to the manufacturer's published pressure rating prior to shipment.

f. Lining: All interior "wetted" parts shall be shop-lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA

C213 and shall be holiday tested with a 1500-volt spark test conforming to said specification.

g. Coating: Coal tar epoxy.

6. Quality Assurance: Hydrostatically tested to manufacturer's published pressure rating prior to shipment.

7. Appropriately sized polyethylene sleeves, meeting AWWA C105 requirements, shall be included for direct bury applications.

B. Manufacturers

1. EBAA Iron, Inc. – Flex-Tend or equal.

2.8 UNDERGROUND PIPE MARKERS

A. As specified in Section 31 23 17, Trenching.

2.9 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 30 00 - Cast-in-Place Concrete.
2. Type: reinforced, air entrained as shown in the Drawings.
3. Compressive Strength: Minimum 3,000 psi at 28 days.
4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.10 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

a. Material type varies by location, as shown in the Drawings.

b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

c. Subsoil Type S1 as specified in Section 31 05 13, Soils for Earthwork.

2.11 ACCESSORIES

A. Concrete for Thrust Restraints: As specified in Section 03 30 00 - Cast-in-Place Concrete.

B. Manhole and Cover: As specified in Section 33 05 13- Manholes.

C. Miscellaneous Steel Rods, Bolt, Lugs, and Brackets:

1. Comply with ASTM A36 or ASTM A307.
2. Grade A carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

A. Preconstruction Site Photos:

1. Take photographs along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.

2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.

3. Include Project name, date taken, and sequential number of each photograph in physical log or CD.

B. Inspection:

1. All pipe sections, specials, and jointing materials shall be carefully examined for defects.

2. No piping or related materials shall be laid that is known to be defective. Any defective piece installed shall be removed and replaced with a new pipe section in a manner satisfactory to the Engineer at the Contractor's expense.

3. Defective material shall be marked and removed from the job site before the end of the day.

C. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.

2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.

3. Grind edges smooth with beveled end for push-on connections.

4. Prior to assembly of field cut pipe, the reference mark shall be re-established with a pencil or crayon. The location of the reference mark at the proper distance from the bevel end shall be in accordance with the manufacturer's recommendations.

D. Remove scale and dirt on inside and outside before assembly. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, blowing out with compressed air, or washing to remove all foreign matter.

E. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Bedding:

1. Excavation:

a. Excavate pipe trench as specified in Section 31 23 17, Trenching for Work of this Section.

b. All pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.

c. Remove large stones or other hard matter which could damage pipe or impede consistent pipe bedding backfilling or compaction.

d. Trench base shall be inspected prior to placement of pipe.

e. Hand trim excavation for accurate placement of pipe to elevations as indicated on Drawings.

2. Dewater excavation as specified in Section 31 23 19, Dewatering to maintain dry conditions and to preserve final grades at bottom of excavation.

3. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.

4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent of maximum density.

B. Piping:

1. Install pipe according to AWWA C600.

2. Handle and assemble pipe according to manufacturer instructions and as indicated on Drawings.

3. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

4. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.

5. Sanitary Sewer Separation:

   a. Install new water lines and appurtenances in compliance with local and state regulations governing the horizontal and vertical separations between water and sewer facilities.

   b. Variance:

      1) If a variance is proposed due to requested design revisions or if an existing facility has been installed at a different location or elevation than indicated on the Plans, submit written proposal for review and approval by the Engineer.

      2) Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and corrective measures proposed.

      3) Each variance will be considered on a case-by-case basis.

      4) Review Time: Allow a minimum of 5 working days review and response to each proposal.

6. Install ductile iron fittings according to AWWA C600.

7. Joints:

   a. Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining.

   b. Lubricants, primers, adhesives, etc. shall be used as recommended by the pipe or joint manufacturer's specifications.

c. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint.

d. Trenches shall be kept water-free and as dry as possible during bedding, laying and jointing.

e. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.

8. Flanged Joints: Not to be used in underground installations except within structures, unless shown otherwise in the Drawings.

9. Deflection:

   a. PVC pressure pipe may be deflected both horizontally and vertically at the joints after assembly.

   b. Deflection by bending of the pipe rather than at the joints is not allowed.

   c. The maximum pipe deflection shall not exceed one-half of the manufacturer's stated joint deflection allowance.

   d. Set a laser, string line, or other approved alignment guide along the centerline of previously installed pipe to the point where pipe joint deflection is required. The approved alignment guide shall extend to the end of the proposed subsequent pipe length. A measurement will be taken from the alignment guide to the centerline of the subsequent pipe length to determine the amount of pipe joint deflection proposed. Measured deflection shall not exceed the specified allowable deflection for the purposes of aligning the pipe.

10. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb. Re-lay pipe that is out of alignment or grade.

11. High Points:

   a. Install pipe with no high points, unless otherwise shown in the Drawings.

   b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by Engineer.

12. Bearing:

   a. Install pipe to have bearing along entire length of pipe.

b. Excavate bell holes to permit proper joint installation where necessary or as directed by Engineer.

c. Do not lay pipe in wet or frozen trench.

13. Prevent foreign material from entering pipe during placement.

14. Install pipe to allow for expansion and contraction without stressing pipe or joints.

15. Close pipe openings with watertight plugs during Work stoppages.

16. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

17. Install access fittings to permit disinfection of water system performed under Section 33 13 00 – Testing and Disinfecting of Water Utility Piping.

18. Cover:

    a. Establish elevations of buried piping with not less than 102 inches of cover.
    b. Measure depth of cover from final surface grade to top of pipe barrel.

19. Pipe Markers:

    a. Install as specified in Section 31 23 17, Trenching.

C. Tapping Sleeves and Valves:

1. As indicated on Drawings and according to manufacturer instructions.

D. Thrust Restraints:

1. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks at locations shown in the Drawings and as required to facilitate testing of lines.

2. Pour concrete thrust blocks against undisturbed earth.

3. Locate thrust blocks to ensure that pipe and fitting joints will be accessible for repair.

4. Provide thrust restraint bearing area on subsoil as shown in details within the Drawings.

5. Install tie rods, clamps, setscrew retainer glands, or restrained joints.

6. Protect metal-restrained joint components against corrosion with polyethylene film as specified herein.

7. Do not encase pipe and fitting joints to flanges.

E. Backfilling:

1. Backfill of piping systems shall be as specified in Section 31 23 17, Trenching.

F. Testing and Disinfection of Potable Water Piping System:

1. In accordance with AWWA C600, AWWA C651 and as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

2. All chlorinated water used in disinfection of the water main shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the Colorado Department of Public Health and Environment (CDPHE) prior to discharge into any storm drainage system or open drainage way.

3. No chlorinated water shall be discharged into a storm drainage system or open drainage way without a dechlorination under a plan meeting CDPHE's requirements.

3.4 FIELD QUALITY CONTROL

A. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

END OF SECTION

SECTION 33 11 50 - EXISTING PIPE ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the removal of existing buried piping and abandonment in place of existing buried piping.

B. Section includes:

1. Pipe removal.
2. In-place abandonment of pipe.

1.2 RELATED SECTIONS

A. Section 03 60 00, Grouting.
B. Section 31 23 16, Excavation.
C. Section 31 23 17, Trenching.
D. Section 31 23 19, Dewatering.

1.3 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Piping Abandonment Plan:

1. Identify locations specified for pipe abandonment.

2. Provide method to be utilized to abandon the pipe, including whether the pipe will be left in place or removed in its entirety.

C. Non-Shrink Grout: Product data in accordance with Section 03 60 00, Grouting.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the work described herein.

B. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the work and requirements of the General Provisions.

1.5 PROTECTION OF EXISTING WORK

A. Carefully examine the Contract Documents to determine the extent of the work of this Section.

B. Carefully coordinate the work of this Section with all other work and construction.

C. Take all necessary precautions to prevent damage to existing facilities or utilities which are to remain in place and be responsible for any damages to existing facilities or utilities, which are caused by the operations.

1.6 REPAIR OF DAMAGE

A. Work procedures shall provide for safe conduct of the work; careful removal and disposition of materials and equipment; protection of facilities, utilities and property which are to remain undisturbed; coordination with existing facilities and utilities to remain in service.

B. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired to acceptance of Engineer.

C. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

1.7 EXISTING CONDITIONS

A. If the pipe material contains any hazardous materials, such as asbestos, requiring special handling upon removal, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 OWNERSHIP OF EXISTING MATERIALS

A. All materials, equipment, miscellaneous items and debris involved, occurring or resulting from pipe removal work shall become the property of the Contractor at the place of origin, unless otherwise specified in the Drawings or by the Engineer.

PART 3 EXECUTION

3.1 IN-PLACE ABANDONMENT OF PIPING

A. Where identified on the Drawings, abandon pipe in place.

B. All exposed ends of pipes being abandoned in place shall be cut and plugged with a minimum of 2 feet of non-shrink grout.

C. Prior to placing grout, roughen interior pipe surface and apply epoxy bonding agent.

3.2 CLEANUP

A. During and upon completion of work of this Section, promptly remove all unused tools and equipment, surplus materials and debris.

B. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 33 12 13

WATER SERVICE CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes pipe materials, fittings, valves, meters and backflow preventers encountered with service connections 2 inches in diameter and smaller from the main to a water.

B. Section Includes:

1. Pipe and fittings for 2-inch diameter and smaller water service connections.
2. Corporation stop assemblies.
3. Curb stop assemblies.
4. Meter setting equipment.
5. Water meters.
6. Backflow preventers.
7. Sampling stations.
8. Underground pipe markers.
9. Precast concrete vaults.
10. Bedding and cover materials.

C. Related Requirements:

1. Section 31 05 13 - Soils for Earthwork: Backfill soil type.

2. Section 31 05 16 - Aggregates for Earthwork: Bedding and cover material type.

3. Section 31 23 17 - Trenching: Excavation of pipe trench.

4. Section 33 05 17 - Precast Concrete Valve Vaults and Meter Boxes: Valve vaults.

5. Section 33 13 00 - Testing and Disinfection of Water Utility Distribution: Flushing and disinfecting of water system.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Society of Mechanical Engineers:

1. ASME B16.15 - Cast Bronze Threaded Fittings.

C. American Society of Sanitary Engineering:

1. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent.

2. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers.

D. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.

2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

3. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

4. ASTM C858 - Standard Specification for Underground Precast Concrete Utility Structures.

5. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

6. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

7. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

8. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

9. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

10. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

E. American Welding Society:

1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.

F. American Water Works Association:

1. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.

2. AWWA C700 - Cold-Water Meters - Displacement Type, Bronze Main Case.

3. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold-Water Meters.

4. AWWA C800 - Underground Service Line Valves and Fittings.

5. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.

6. AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

G. National Sanitation Foundation International:

1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects

2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.

C. Shop Drawings: Indicate details showing meter boxes, vaults and accessories.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, connections, thrust restraints, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Unless otherwise noted, all water works materials provided shall be new, of first class quality and shall be made by reputable manufacturers.

B. All material of like kind shall be provided from a single manufacturer unless otherwise approved by the Engineer.

C. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage and handling.

D. Where an item is to be used but does not have its quality specified herein, it shall be equal to that specified in the appropriate American Water Works Association (AWWA) Standard Specification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store products and materials off ground and under protective coverings and away from walls.

C. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 PRODUCTS

2.1 GENERAL

A. Service line material shall conform to the latest version of AWWA C800 and as follows:

1. Minimum working pressure rating of all service line material shall be 150 psi.

2. All water works materials provided shall be rated for the test pressures indicated for the water main and as specified in Section 33 13 00, Testing and Disinfection of Water Utility Pipelines.

B. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 WATER PIPING AND FITTINGS

A. Furnish materials according to Section 4.3.2 of the Town of Lyons Construction Design Standards.

2.3 CORPORATION STOP ASSEMBLIES

A. Furnish materials according to Section 4.3.2 of the Town of Lyons Construction Design Standards.

2.4 CURB STOP ASSEMBLIES

A. Furnish materials according to Section 4.3.2 of the Town of Lyons Construction Design Standards.

2.5 METER SETTING EQUIPMENT

A. Furnish materials according to Section 4.3.2 of the Town of Lyons Construction Design Standards.

2.6 WATER METERS

A. Furnish materials according to Section 4.3.2 of the Town of Lyons Construction Design Standards.

2.7 SAMPLING STATIONS

A. Manufacturers:

1. Kupferle Foundry Company, Eclipse No. 88.

B. Sampling Stations:

1. Enclosure: Cast-aluminum. Lockable, non-moveable.

2. Interior Piping: Brass, 3/4-inch diameter FIP.

3. Exterior Piping: Galvanized steel, 3/4-inch diameter FIP. Depth of bury as shown in the Drawings.

4. Vent Tube: Copper, with 1/4-inch diameter pet cock.

2.8 UNDERGROUND PIPE MARKERS

A. As specified in Section 33 11 10, Water Utility Distribution Piping.

2.9 METER BOXES

A. As specified in Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes.

2.10 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

   a. Material type varies by location, as shown in the Drawings.

   b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

   c. Subsoil Type S1 and/or S2, as specified in Section 31 05 13, Soils for Earthwork.

PART 3 EXECUTION

3.1 GENERAL

A. All service lines shall be installed according to Section 4.1.3 of the Town of Lyons Construction Design Standards.

B. Install service pipelines perpendicular to the main, unless shown otherwise.

C. For service renewals, terminate service run inside of existing meter box as described below.

3.2 INSTALLATION

A. Construct the depth of trench for service connection piping to provide a minimum of 54 inches of cover over the top of the pipe, unless otherwise shown.

B. Excavation, backfill and surface restoration shall be performed in accordance with provisions stated in Section 31 23 17, Trenching.

C. Do not damage the main in any way during the service installation.

D. Water Main Tap

1. All direct service taps shall be made with a drilling and tapping machine intended for use on ductile iron pipe as manufactured by Mueller or approved equal. Hand held equipment is not allowed. Coupons shall be removed from pipe.

    a. The drilling and tapping machine shall have alignment tool guides and a placement strap.

2. Direct threaded taps shall engage a minimum of four (4) full threads.

3. Direct taps shall require the use of two (2) layers of 3 mil tetrafluoroethylene (TFE) tape on the threads of the corporation stop. Liquid TFE will not be allowed.

4. Direct taps for 1-inch diameter services are allowed only on mains that are 6 inches in diameter or larger.

5. Service saddles are required on water mains 4 inches in diameter and larger and for all services taps larger than 1-inch diameter.

6. Install corporation stop at a 45-degree angle from the cross section vertical axis of the water main being tapped, unless otherwise shown on the Plans.

7. Install swing joint on all 2-inch diameter services.

E. Piping

1. Cut service pipes using tools specifically designed to leave a smooth, even, and square end on the material being cut.

2. Ream cut ends to the full inside diameter of the pipe.

3. Clean pipe ends to a sound, smooth finish prior to using compression connections which seal to the outside surface of the pipe.

F. Water Meters:

1. Install positive displacement meters according to AWWA M6 and as shown in the Drawings.

G. Backflow Preventers:

1. Install backflow preventers where indicated on Drawings and according to manufacturer instructions.

2. Testing and Installation Requirements: Comply with local water company requirements and plumbing codes.

H. Service Connections:

1. Install water service according to details in the Drawings.

2. Install water meter in precast concrete meter box located on Site as specified in Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes

3. Locate meter box as shown in the Drawings. Final location to be determined in the field by Engineer.

I. Service Renewal:

1. Install service line and angle meter stop from the water main to the inside of existing meter box location.

2. Where service renewals are to be connected to existing meters, stub up and terminate service run at angle meter stop where shown.

3. Where no meter is to be installed, place angle meter stop at 18 inches from face of curb with 12 inches to the springline in an approved box.

4. Owner will connect all service lines at the new meters or to existing service piping as shown.

5. Adjust meter box to finished grade after the service piping has been installed and surface has been restored to the satisfaction of the Engineer.

J. Trenchless Installation:

1. All water service installations under existing pavement, curbs, sidewalks or other surface improvements may be installed by trenchless construction techniques at Contractor option where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks and other structures.

2. The Owner's Representative must approve all trenchless installation methods.

3. Where trenchless pipe installation is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks and other surface improvements whose replacement is avoided by use of a trenchless method, such as tunneling.

3.3 CORROSION PROTECTION

A. Install cathodic protection items where required, including dielectric insulating corporation stops, dielectric insulating joints, tape wrap, and grounding rod as shown in the Drawings.

3.4 FLUSHING AND DISINFECTION

A. Flush and disinfect all service connections and appurtenances in accordance with Section 33 13 00, Testing and Disinfection of Water Utility Distribution Pipelines.

3.5 FIELD QUALITY CONTROL

A. Pressure test water distribution system according to AWWA C600 and Section 33 11 10, Water Utility Distribution Piping.

B. Compaction Testing for Bedding: See Section 33 11 10, Water Utility Distribution Piping for compaction testing requirements. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

END OF SECTION

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes valves and valve boxes for installation with buried water distribution and transmission main, including fire hydrants and tapping sleeves.

B. Section Includes:

1. Valves.
2. Valve boxes.
3. Valve operator extensions.

C. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints

2. Section 33 11 10 - Water Utility Distribution and Transmission Piping: Piping trenching, backfilling, and compaction requirements.

3. Section 33 12 13 - Water Service Connections: Pipe materials, fittings, and service connection appurtenances and installation requirements.

4. Section 33 12 19 - Water Utility Distribution Fire Hydrants: Execution requirements for fire hydrants.

5. Section 33 13 00 - Testing and Disinfecting of Water Utility Distribution: Flushing and disinfection requirements.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys

3. ASME 1.20.1 - General Purpose Pipe Threads (Inch)

B. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service

3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants

4. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

C. ASTM International (ASTM):

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects
2. NSF 372 - Drinking Water System Components - Lead Content

1.3 COORDINATION

A. The Contractor shall cause the Supplier of valves to coordinate installation such that all pipes, valves, fittings, appurtenances, and equipment are compatible and capable of achieving the performance requirements specified in the Contract Documents.

B. Coordinate Work of this Section with Town of Frisco Department of Public Works standards and utilities within construction area.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Lining and coating data.

F. Valve Labeling: Schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the valve.

G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.
B. Operation and Maintenance Data: Submit information for valves.

1.6 QUALITY ASSURANCE

A. Cast manufacturer's name, maximum working pressure, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, American National Standards Institute (ANSI), ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

E. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves and accessories for shipment according to applicable AWWA standards.

B. Seal valve and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

E. Handle products carefully to prevent damage to interior or exterior surfaces.

F. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT WEDGE GATE VALVES

A. As specified in Section 40 05 61, Gate Valves.

B. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 RUBBER-SEATED BUTTERFLY VALVES

A. As specified in Section 40 05 64, Butterfly Valves.

B. Operation:

1. All buried valves shall be provided with 2-inch square operating nuts.

C. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

D. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.4 ACTUATORS

A. Unless otherwise indicated, all valves shall be furnished with manual actuators.

B. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

C. All gear-assisted valves that are buried and submerged shall have the actuators hermetically sealed and grease-packed.

D. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

2.5 VALVE BOXES

A. Provide all buried valves with valve boxes, covers and risers.

B. Valve Boxes:

1. Materials: Cast iron.

2. Construction:

a. Walls not less than 3/16-inch thick at any point.
b. Internal diameter not less than 5 inches.

3. Type: Two-piece extension.

4. Manufacturers:

a. Olympic Foundry.
b. Brooks Products.

C. Covers:

1. Construction:

a. Prevents dislodging and rotation from traffic.

b. Allows a hand-held pry bar to be applied for easy removal.

2. Materials: Cast iron.

3. Lid Inscription: [WATER] [W].

4. Manufacturers: Matching that of valve box.

D. Riser:

1. Polyvinyl Chloride (PVC) Pipe:

a. ASTM D3034, SDR 35 PVC.
b. White, Schedule 40, 8-inch diameter.
c. Length as shown on details in the Drawings.

2.6 VALVE OPERATOR EXTENSIONS

A. As shown in the Drawings.

B. Provide operator extensions to a maximum of 12 inches below grade where depth to valve exceeds 36 inches.

2.7 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect from damage utilities to remain.

D. Access:

1. All valves shall be installed to provide easy access for operation, removal, and maintenance.

2. Avoid conflicts between valve operators and above grade construction such as structural members or handrails.

E. Valve Accessories:

1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.

2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.2 INSTALLATION

A. General:

1. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as shown in the Drawings and as specified herein.

2. Valves shall be firmly supported to avoid undue stresses on the pipe.

3. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment, where applicable.

B. Perform trench excavation, backfilling, and compaction as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Install valves in conjunction with pipe laying.

D. Set valves plumb.

E. Provide buried valves with valve boxes installed flush with finished grade.

1. Valves installed out of paved or otherwise hard-surfaced areas shall be set in a concrete pad at finished grade.

2. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick.

F. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Distribution.

3.3 FIELD QUALITY CONTROL

A. Pressure test valving for water distribution system according to AWWA C600 and in accordance with Section 33 13 00, Testing and Disinfecting of Water Utility Distribution.

END OF SECTION

SECTION 33 12 19 - FIRE HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

A. This Section addresses dry-barrel fire hydrants used in water supply service.

B. Section includes:

1. Fire hydrants used in water main installations.

1.2 RELATED SECTIONS:

A. Section 03 11 00 – Concrete Work
B. Section 31 05 16 – Aggregates for Earthwork
C. Section 31 23 17 – Trenching
D. Section 33 13 00 – Testing and Disinfecting of Water Utility Piping

1.3 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C502 - Dry-Barrel Fire Hydrants
2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

B. National Fire Protection Association (NFPA):

1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.4 COORDINATION

A. All hydrants supplied for the Project shall be of like kind from a single manufacturer.

1.5 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's latest published literature, including illustrations, installation and maintenance instructions, and parts lists.

C. Shop Drawings: Submit description of proposed installation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of fire hydrants and service valves.
B. Operation and Maintenance Data: Submit data for hydrants.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prepare hydrants and accessories for shipment according to AWWA standards.

B. Seal hydrant and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or potential damage.
2. Do not store materials directly on ground.

E. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Manufacturers:

1. Mueller Company, Super Centurion Model A-423

B. Dry-Barrel Breakaway Type:

1. Comply with AWWA C502.
2. Body: Cast iron.
3. Valve: Compression type.
4. Burial Depth: As indicated on Drawings.
5. Inlet Connection Size: 6 inches (150 millimeters).
6. Valve Opening: 5-1/4 inches (133 millimeters) in diameter.
7. End Connections: Mechanical joint or bell end.
8. Bolts and Nuts: Galvanized steel.
9. Interior Coating: Comply with AWWA C550.

10. Direction of Opening: Counterclockwise unless otherwise indicated.

C. Hose Connections:

1. One 4-1/2-inch diameter pumper, two 2-1/2-inch diameter hose nozzles.
2. Obtain thread type and size from local fire department.
3. Attach nozzle caps by separate chains.

D. Finishes:

1. Primer and two coats of enamel.
2. Color: R-1317, Safety Yellow.

2.2 NSF INTERNATIONAL (NSF) REQUIREMENTS

A. All fire hydrants must be NSF/ANSI Standard 61 certified and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.

2.3 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 1 00, Concrete Work.

B. Aggregate: Aggregate for hydrant drainage as specified in Section 31 05 16, Aggregates for Earthwork.

2.4 OUT OF SERVICE COVERS/OUT OF SERVICE RINGS

A. Provide orange plastic bag with reflective tape, or red plastic hydrant out of service rings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify location and size of hydrants from Drawings. Final location of hydrants to be determined by Engineer in the field.

B. Obtain clarification and directions from Engineer prior to execution of Work.

C. If installing a hydrant on an existing water system, verify invert elevation of existing piping is as indicated on Drawings prior to excavation and installation of fire hydrant.

3.2 PREPARATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect from damage utilities to remain.

D. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Owner and Engineer not less than 48 hours in advance of proposed utility interruption.

2. Do not proceed without written permission from Engineer.

3. Only District staff shall operate valves in existing system.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 17, Trenching.

B. Install pier support block and drainage gravel for fire hydrants; do not block drain hole.

1. Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

2. Place textile fabric to cover drain rock prior to placement of backfill.

3. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.

C. Set fire hydrants plumb with pumper nozzle facing roadway.

D. Set fire hydrants with centerline of pumper nozzle 18 inches (450 millimeters) above finished grade, and with safety flange not more than 6 inches (150 millimeters) nor less than 2 inches (50 millimeters) above grade. Install hydrant extensions where required and as approved.

E. Paint hydrants according to color scheme of local authorities having jurisdiction. Touch up paint after hydrant installation and testing.

F. After hydrostatic testing, flush hydrants and check for proper drainage.

G. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

A. Pressure test water distribution system according to AWWA C600.

3.5 CONCRETE HYDRANT PADS

A. When hydrant is place within sidewalks, form and pour-in-place 36-inch by 36-inch by 6-inch, 4,000 pounds per square inch (psi) concrete pad around the hydrant after the hydrant has been installed and set to grade.

B. Center hydrant pad on the hydrant. Set hydrant pad so top of pad is flush with surrounding surface, or as directed by the Engineer.

C. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than 1-foot in any one direction.

3.6 OUT-OF-SERVICE HYDRANTS

A. To indicate that the fire hydrant is NOT operational, secure reflective tape, an orange plastic bag over the entire hydrant assembly or an approved out-of-service cover.

B. An out-of-service ring may also be used in addition to the bag or cover in case of removal of the cover.

C. Maintain the plastic bag up until the waterline is accepted by the Owner.

END OF SECTION

SECTION 33 13 00 - TESTING AND DISINFECTING OF WATER UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes hydrostatic pressure testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.

B. Section Includes:

1. Pressure testing and disinfection of potable water distribution and transmission piping systems and appurtenances.

2. Testing and reporting of results.

C. Related Requirements:

1. Section 33 11 10 - Water Utility Distribution Piping
2. Section 33 12 16 - Water Utility Distribution Valves
3. Section 33 12 19 - Fire Hydrants
4. Section 33 12 13 - Water Service Connections

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites
2. AWWA B301 - Liquid Chlorine
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
5. AWWA C651 - Disinfecting Water Mains
6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

A. Section 01 33 00 –Submittals Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Engineer a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:

1. Testing schedule.

2. Hydrostatic Testing Plan:

   a. Narrative of the proposed process.
   b. Proposed equipment to be used.
   c. Disposal location for excess water used to fill mains.

3. Disinfection Plan:

   a. Narrative of the proposed process.

   b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.

   c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.

   d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.

   e. Proposed plan for testing chlorine levels throughout the length of pipeline.

4. Proposed testing locations.

5. Proposed plan for water conveyance, including flow rates.

6. Proposed plan for water control.

7. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.

8. Proposed measures to be incorporated in the project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

A. Disinfection Report:

1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.

3. Test locations.

4. Name of person collecting samples.

5. Initial and 24-hour disinfectant residuals in treated water in parts-per million (ppm) for each outlet tested.

6. Date and time of flushing start and completion.

7. Disinfectant residual after flushing in ppm for each outlet tested.

1.5 QUALITY ASSURANCE

A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future functions.

B. All temporary thrust restraint and equipment and facilities required for hydrostatic testing will be considered incidental.

C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Engineer.
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as needed and required for the testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Engineer, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.
2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 HYDROSTATIC TESTING OF WATER PIPING

A. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.

B. No section of the pipeline shall be hydrostatically tested until backfill has been placed, compacted, and passed required density testing and all field-placed concrete or mortar has attained full strength.

1. At the Contractor's option, early strength concrete may be used when the full-strength requirements conflict with schedule requirements.

2. All such substitutions and installations shall be approved by the Engineer prior to installation.

C. Provide 72-hour notification to the Engineer and Owner prior to conducting hydrostatic testing.

1. Provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner's existing system during hydrostatic testing and disinfecting procedures.

2. The Contractor shall not operate any part of the existing water systems.

D. Pipe Filling:

1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.

2. Take all required precautions to prevent entrapping air in the pipes.

3. Allow for natural absorption of water by the lining of the pipe to occur.

4. Apply specified test pressure by pumping.

E. Testing of Mains:

1. Ductile Iron: In accordance with AWWA C600.

2. Polyvinyl chloride (PVC): In accordance with AWWA C605.

3. General:

   a. Tests shall be conducted under a hydrostatic test pressure not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, minimum 150 psi, unless otherwise shown in the Drawings.

   b. In no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.

   c. Testing shall be performed by applying the specified test pressure by pumping.

   d. Once the test pressure has been attained, the pump shall be valved off.

   e. The test will be conducted for a 2-hour period with the allowable leakage not to exceed the value as calculated per the Allowable Leakage formula below.

   f. During the test period, there shall be no appreciable or abrupt loss in pressure.

4. Allowable Leakage:

   a. Flanged Joints: Pipe, fittings, and valves with flanged joints shall be completely watertight. No leakage allowed.

   b. Mechanical or Push-on Joints: Pipe, fittings and valves with rubber gasketed joints shall have a measured loss not to exceed the rate given in the following Allowable Leakage formula:

$$AL = \frac{LD(P)^{1/2}}{148{,}000}$$

   In the above formula:

   AL = Allowable leakage, in gallons per hour
   L = Length of pipe tested, in feet
   D = Nominal diameter of pipe, in inches
   P = Average test pressure during the leakage test, in pounds per square inch.

5. Maintaining Pressure:

a. During the test period, operate the pump as required to maintain pressure in the pipe within 5 psi of the specified test pressure at all times.

b. At the end of test period, operate the pump until the specified test pressure is again obtained.

1) The pump suction shall be in a clean, graduated barrel, or similar device or metered so that the amount of water required to restore the test pressure may be accurately measured.

2) Sterilize this makeup water by adding chlorine to a concentration of 25 milligrams per liter (mg/L).

c. The Engineer will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.

d. Each hour's loss stands on its own and will not be averaged.

6. Defects, Leakage, Failure:

a. If the test reveals any defects, leakage in excess of the allowable, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.

b. Correct any visible leakage regardless of the allowable leakage specified above.

c. All leaks shall be repaired in a manner acceptable to the Engineer.

d. The testing of the line shall be repeated until a test satisfactory to the Engineer has been achieved.

3.2 DISINFECTION OF WATER PIPING

A. Disinfection shall be in accordance with the latest version of AWWA C651 following Engineer's acceptance of hydrostatic testing.

B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.

C. Flush all foreign matter from the pipeline, branches and services.

1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.

2. Flushing velocities shall be at least 2.5 feet per second (fps).

3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

D. Chlorine Application:

1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.

2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.

E. Chlorine Residual:

1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.

2. Adjust the dose rate as necessary to maintain the target dose rate.

F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.

1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Engineer.

2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.

3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.

G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.

1. There is no minimum flushing velocity for this step.

H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.

1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.

2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by the Colorado Department of Public Health and Environment (CDPHE).

3.3 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.

B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.

C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.

D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.

1. During the system startup, the Engineer and Contractor shall visually inspect all new fittings, piping, valves and appurtenances for evidence of leakage.

2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Engineer.

3.4 FIELD QUALITY CONTROL

A. Bacteriological Sampling and Testing:

1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.

a. The locations for sample collection shall be at the sole discretion of the Owner and Engineer.

b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.

2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:

a. Bacterial Sampling

1) Option A:

   a) Take an initial set of samples using sampling site procedures outlined herein.

   b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.

   c) Both sets of successive samples must pass for the main to be approved for service.

2) Option B:

   a) Allow main to sit for a minimum of 24 hours without any water use.

   b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.

   c) Both sets of samples must pass for the main to be approved for service.

3) Allow 24 hours for the test results for each sample set.

b. Sampling Locations

1) The Owner will take one bacteriological sample from the end of the main and on each branch.

2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.

c. Sample Testing

1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.

d. Evaluating the Test Results

1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Engineer.

2) When two consecutive sample sets test negative (passing)for coliform bacteria, the bacterial testing is complete.

e. Completion of Bacterial Testing

1) Upon completion of bacterial testing, notify the Owner shall notify the Engineer and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

1) If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

3. Results of the bacteriological testing shall be satisfactory with CDPHE and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 33 31 10 - SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes pipe materials, manholes, and accessories normally used with gravity sanitary sewers.

B. Section includes:

1. Sanitary sewerage pipe and fittings.
2. Pipe markers.
3. Connection to existing manholes.
4. Manholes.
5. Wye branches and tees.
6. Sanitary laterals.
7. Bedding and cover materials.

1.2 RELATED SECTIONS

A. Section 03 11 00 - Concrete Work
B. Section 03 60 00 - Grouting
C. Section 09 80 01 - Protective Coatings
D. Section 31 05 13 - Soils for Earthwork
E. Section 31 05 16 - Aggregates for Earthwork
F. Section 31 23 16 - Excavation
G. Section 31 23 17 - Trenching
H. Section 33 01 30.13 - Sewer and Manhole Testing

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International (ASTM):

1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

6. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.

7. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

7. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

8. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

9. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

10. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

11. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

13. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

15. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

16. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

17. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

7. AWWA C153 - Ductile-Iron Compact Fittings.

8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.4 COORDINATION

A. Notify affected utility companies at least 72 hours prior to construction.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.

B. Shop Drawings:

1. Indicate layout of sewer system and appurtenances.
2. Show size, materials, components of system, and burial depth.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the manufacturer.

D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.

E. Manufacturer Instructions:

1. Indicate special procedures required to install specified products.

2. Submit detailed description of procedures for connecting new sewer to existing sewer line.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the project shall be new, of first-class quality and shall be made by reputable manufacturers.

2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.

3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.

4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Storage:

1. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.

2. Block individual and stockpiled pipe lengths to prevent moving.

3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.

2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 SANITARY SEWERAGE PIPE AND FITTINGS

A. Plastic Pipe:

1. Material:

a. Polyvinyl chloride (PVC), manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454-B.

b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.

2. Fittings: PVC.

3. Pipe and fittings 4 inches to 15 inches in diameter:

a. Comply with ASTM D3034, SDR 35.

4. AWWA C900 Pipe:

a. 4 inches to 12 inches in diameter.
b. DR 25.
c. Pipe shall have minimum stiffness of 149 psi.

5. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.

6. Joints:

a. Integral bell push-on type: Comply with ASTM D3212.

b. For use with AWWA C900 pipe: Integral bell push-on type: Comply with ASTM D3139.

7. Gaskets:

a. Factory installed.
b. Elastomeric gaskets: Comply with ASTM F477.

B. Ductile-Iron Pipe:

1. Comply with AWWA C151.

2. Minimum Special Thickness Class: 52.

3. End Connections: Bell and spigot or plain, as shown in the Drawings.

4. Outside Coating:

a. Type: Asphaltic coating, minimum 1-mil uniform thickness.
b. Comply with AWWA C151.

5. Lining:

a. Cement mortar lined.
b. Comply with AWWA C104.

6. Polyethylene encasement: Comply with AWWA C105.

7. Fittings:

a. Material: Ductile iron.
b. Comply with AWWA C153 or AWWA C110.
c. Lining: Cement-mortar lined according to AWWA C104.

8. Coating:

a. Coat pipe and fittings exposed inside of structures with two coats of bituminous paint to achieve minimum dry film thickness of 6 mils per coat.

b. Material as specified in Section 09 90 00 - Painting and Coating.

9. Joints:

a. Rubber gasket joint devices.
b. Comply with AWWA C111.

2.2 FLEXIBLE COUPLINGS

A. Description:

1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
2. Attachment: Two [Series 300] stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

1. Material: Ethylene propylene rubber (EPDM).
2. Comply with ASTM C923.
3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.
2. Strength: Minimum 3,000 psi at 28 days.
3. Air entrained.
4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.5 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

   a. Material type varies by location, as shown in the Drawings.

   b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

   c. Subsoil Type S1 [and/or S2], as specified in Section 31 05 13, Soils for Earthwork.

2.6 MIXES

A. Grout: As specified in Section 03 60 00, Grouting.

2.7 ACCESSORIES

A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that trench cut, or excavation base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over-excavation in accordance with Section 31 23 17, Trenching.

B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.

C. Protect and support existing sewer lines, utilities, and appurtenances.

D. Utilities:

1. Maintain profiles of utilities.
2. Coordinate with other utilities to eliminate interference.
3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17, Trenching.

2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.

3. Pipe base shall be observed by Engineer prior to placement of the pipe.

4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.

5. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.

6. Placement:

   a. Place bedding material at trench bottom.
   b. Level materials in continuous layer not exceeding 6 inches compacted depth.
   c. Compact to 95 percent of maximum density.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.

    a. PVC: Comply with ASTM D2321.
    b. Ductile Iron: Comply with AWWA C600.

2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

3. Lay pipe to slope gradients and line as indicated on Sheet C-2.

4. Variations:

    a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.

    b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than1/4-inch.

    c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.

5. Begin at downstream end and progress upstream.

6. Assemble and handle pipe according to manufacturer's instructions, except as may be modified on Drawings or by Engineer.

7. Make straight field cuts without chipping or cracking pipe.

8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.

9. Assemble pipe joints in accordance with manufacturer's recommendations/specifications.

10. Cap open ends during periods of Work stoppage.

11. Lay bell and spigot pipe with bells upstream.

12. Polyethylene Pipe Encasement: Conform to AWWA C105.

13. Backfill and compact as specified in Section 31 23 17, Trenching.

14. Do not displace or damage pipe when compacting.

15. Pipe Markers: As specified in Section 31 23 17, Trenching.

C. Joints:

1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.

2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.

3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the pipe manufacturer.

4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.

5. The pipe is then forced "home" firmly and fully.

6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.

D. Connection to Existing Manholes:

1. Drilling:

   a. Core drill existing manhole to clean opening.

   b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.

2. Install watertight neoprene gasket and seal with non-shrink concrete grout.

3. Encasement:

   a. Concrete encase new sewer pipe minimum of 24 inches to nearest pipe joint.

   b. Use epoxy binder between new and existing concrete.

4. Prevent construction debris from entering existing sewer line when making connection.

E. Wye Branches and Tees:

1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.

2. Use standard fittings of same material and joint type as sewer main.

3. Maintain minimum 5-foot separation distance between wye connection and manhole.

4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.

5. Mount saddles with solvent cement or gasket and secure with metal bands.

6. Lay out holes with template and cut holes with mechanical cutter.

F. Sanitary Laterals:

1. Construct laterals from wye branch to terminal point at right-of-way or where otherwise shown in the Drawings.

2. Where depth of main pipeline warrants, construct riser-type laterals from wye branch.

3. Minimum Depth of Cover over Piping: 2 feet.

4. Minimum Separation Distance between Laterals: 5 feet.

5. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral.

6. Marker Stake:

a. Install temporary marker stake extending from end of lateral to 12 inches above finished grade.

b. Paint top 6 inches of stake with fluorescent orange paint.

G. Backfilling:

1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.

2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

A. Request inspection by Engineer prior to and immediately after placing bedding.

B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

2. Pipe Testing: As specified in Section 33 01 30.13, Sewer and Manhole Testing.

3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 40 05 13 - COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping.

1.2 RELATED SECTIONS

A. Section 09 90 00, Painting and Coating
B. Section 31 23 17, Trenching
C. Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes.

1.3 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 Pipe Threads, General Purpose (inch)

2. ASME A13.1 - Scheme for the Identification of Piping Systems.

3. ASME B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys

4. ASME B31.3 - Process Piping.

B. ASTM International (ASTM):

1. ASTM D792 - Test Methods for Specific Gravity and Density of Plastics by Displacement.

2. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

3. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

4. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

5. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.

6. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

7. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

8. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

C. American Water Works Association (AWWA):

1. AWWA C207 - Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.

2. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

3. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

4. AWWA C510 - Double Check Valve Backflow Prevention Assembly.

5. AWWA C511 - Reduced-Pressure Principle Backflow Prevention Assembly.

6. AWWA C606 - Grooved and Shouldered Joints.

7. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

D. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 COORDINATION

A. Coordinate installation of specified items with installation of valves and equipment.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit manufacturer catalog information for each product specified.

C. Shop Drawings:

1. Identification:

    a. Submit list of wording, symbols, letter size, and color coding for pipe identification.

    b. Comply with ASME A13.1.

2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.

3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.

F. Manufacturer Instructions: Submit special procedures and setting dimensions.

G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Drawings:

1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

B. Inspection:

1. All pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. The Contractor shall perform all tests at no additional cost to the Owner.

1.8 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection:

1. Accept materials on Site in manufacturer's original packaging and inspect for damage.

2. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to manufacturer instructions.

2. Store materials off the ground, to provide protection against oxidation caused by ground contact

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.

3. Provide additional protection according to manufacturer instructions.

D. All defective or damaged materials shall be replaced with new materials.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

B. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Material
Exposed < 4"	Class 52 Ductile Iron
Buried < 4"	C900 DR 18 PVC

2.2 DUCTILE IRON PIPE AND FITTINGS

A. See Article 2.1.B, Ductile Iron Pipe of Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS

A. PVC Pipe and Fittings:

1. Four-inch diameter and smaller:

a. Pipe: ASTM D1785, Schedule 40.
b. Fittings: ASTM D2466, Schedule 40.
c. Joints: Socket, solvent-welded, ASTM D2855.
d. Materials: ASTM D1784, minimum cell classification 12545-C.

2. Six-inch diameter and larger:

a. Pipe: AWWA C900, Class 235.
b. Fittings: AWWA C111, cast iron.
c. Joints: ASTM D3139, compression gasket ring.
d. Materials: ASTM D1784, minimum cell classification 12545-C.

2.4 FLEXIBLE COUPLINGS

A. Description:

1. Sleeve-type, couplings. Comply with AWWA C219.

2. Minimum design pressure rating: 150 pounds per square inch (psi).

3. Middle Ring: As required for coupling based upon connecting pipe materials, steel or ASTM A536, ductile iron.

4. Followers: As required for coupling based upon connecting pipe materials, steel or ASTM A536, ductile iron.

5. Gaskets:

   a. Material: Buna-N.
   b. Comply with ASTM D2000.

6. Bolts:

   a. Buried: Steel.
   b. Submerged: Stainless steel.

7. Center Pipe Stop: Required where shown on the Drawings.

B. Finishes:

1. Buried Couplings, Bolts: Factory epoxy coated.

C. Manufacturers:

1. For ductile iron and steel pipe:

   a. Dresser, Style 38.
   b. Romac, Model 501.
   c. Smith-Blair.

2. For PVC pipe:

   a. Romac, Model 501 or approved equal.

3. For flanged steel and ductile pipe:

   a. Dresser, Style 128 or approved equal.

2.5 FLANGED INSULATING JOINTS

A. Set shall include a full faced gasket, a full-length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt.

1. Gaskets:

   a. Full-face, comply with ASME 16.21.

   b. Non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder.

   c. Manufacturer: Garlock, Style 3505, or equal.

2. Insulating sleeves:

   a. G-10 glass epoxy.

   b. Extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.

3. Insulating washers:

   a. G-10 glass epoxy.
   b. One-eighth-inch thickness.

4. Washers:

   a. Buried: Cadmium plated steel.
   b. Submerged: Stainless steel.

B. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.

C. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.

2.6 INSULATING UNION

A. Description:

1. Material: Galvanized malleable iron with a ground joint.

2. Iron pipe threads: Conform to ANSI B2.1.

3. Insulations: Nylon, bonded, and molded onto the metal body.

4. Union: Rated for the operating and test pressures of the pipe system.

5. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.

6. Isolation Barrier: Impervious to water.

2.7 PIPE SUPPORTS

A. Floor Support for Pipe:

1. Flanged Pipe Support:

a. Construction:

1) Adjustable vertical pipe support, flange plate, extension pipe from base cup to top collar cup with threaded stud.

2) Bolts directly to flange.

3) Anchorable base plate.

b. Material: Steel, comply with ASTM A36.

c. Finish: Corrosion resistant, electro-galvanized, or prime coated.

d. Manufacturers:

1) Standon - Model S89.

2. Cradle Pipe Support:

a. Construction:

1) Adjustable vertical pipe support with saddle strap, extension pipe from base cup to top collar cup with threaded stud.

2) Anchorable base plate.

b. Material: Steel, comply with ASTM A36.

c. Finish: Corrosion resistant, electro-galvanized, or prime coated.

d. Manufacturers:

1) Standon - Model S92.

2.8 PIPE PENETRATIONS

A. Sleeves for Pipes through Walls and Floors:

1. Material: Galvanized steel.

2. Thickness: Schedule 40.

3. Inside surface of all wall sleeves shall be coated with coal-tar.

4. Annular space between penetrating pipe and wall sleeve shall be filled with an approved permanently flexible sealant.

5. Diameter of wall sleeve shall be as shown in the Drawings.

B. Mechanical Sleeve Seals:

1. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2. Manufacturer: Link-Seal or approved equal.

C. Pipes Cast-In Walls and Floors:

1. Material: Ductile iron or steel pipe, as required by the Drawings and the intended service.

2. Diameter: As shown in the Drawings.

3. End Type: As shown in the Drawings.

D. Seep Rings:

1. Material: 3/8-inch thick steel plate conforming to ASTM A36, unless otherwise noted.

2. Inside diameter: Equal to the outside diameter of the pipe or sleeve to which it is attached plus 1/4-inch.

3. Outside diameter: As shown in the Drawings.

4. Attach to the pipe or sleeve by means of a continuous seal weld located on both sides of the ring.

2.9 PIPE COATINGS

A. See Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 GENERAL

A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement, to provide a functional installation.

B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Engineer shall be made.

3.2 INSTALLATION

A. Buried Piping Systems:

1. Establish elevations of buried piping with not less than 3 feet of cover.
2. Remove scale and dirt from inside of piping before assembly, as may be required.
3. Excavate pipe trench as specified in Section 31 23 17, Trenching.
4. Install pipe to accurate lines, elevations, and grades as shown on the Drawings.
5. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.
6. Place bedding material at trench bottom to provide uniform bedding for piping.
7. Level bedding material in one continuous layer not exceeding 6 inches compacted depth.
8. Install pipe on prepared bedding.
9. Route pipe in straight line.
10. Install pipe to allow for expansion and contraction without stressing of pipe or joints.

11. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

12. Pipe Cover and Backfilling:

    a. Backfill trench as specified in Section 31 23 17, Trenching.

13. All buried non-ferrous piping shall be installed with detectable tracer tape.

    a. Tape shall be buried 12 inches above the top of the pipe or as recommended by manufacturer.

    b. Tape shall be continuous and labeled the same as the piping system.

B. Interior Piping Systems:

1. Install non-conducting dielectric connections wherever joining dissimilar metals.

2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.

3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.

4. Install water piping according to ASME B31.9.

5. Install unions downstream of valves and at equipment or apparatus connections.

6. Install brass male adapters each side of valves in copper piped system, solder adapters to pipe.

C. Pipe Supports and Hangers

1. Install pipe supports according to MSS SP-58 & ASME B31.10.

2. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment.

3. Special hangers and supports are shown on the Drawings.

4. The Contractor shall be responsible for determining the location of and providing all additional supports.

5. Hanger supports shall be as noted below with at least one support adjacent to the joint for each length of pipe, at each change in direction and at each branch connection. Sufficient hangers shall be provided to maintain proper slope without

sagging. Support spacing shall not exceed manufacturer's recommendations, nor as listed below.

Pipe	Maximum Support Spacing (Feet)
Cast or Ductile Iron	
Under 4 inches	6

6. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall be more than 12 feet.

7. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine threaded. Continuous threaded rods will not be allowed.

8. Clevis or band-type hangers (B-Line FIG B3100) or approved equal shall be provided as required. Strap hangers not permitted.

9. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.

10. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of pipework.

11. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

D. Pipe Penetrations:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals or grout, as shown in the Drawings.

2. Whenever a pipeline of any material terminates at or through a structural wall or floor, install piping or sleeve in advance of pouring of concrete required for the particular installation.

3. Plastic pipe shall not be cast in concrete or masonry walls.

4. Set sleeves in position in forms and provide reinforcing around sleeves.

5. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.

6. Extend sleeves through floors 1-inch above finished floor level and caulk sleeves.

7. Pipe other than concrete, to be cast in water-bearing walls or more than 4 feet below grade shall have seep rings.

8. All buried piping entering structures shall have a flexible connection installed less than 2 feet outside the structure line or as close to the wall as practical.

3.3 CLEANING, TESTING, AND DISINFECTION

A. Testing and Disinfection: Piping shall be hydrostatically tested, flushed, and disinfected as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

END OF SECTION

SECTION 40 05 51 – COMMON REQUIREMENTS RESULTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes basic materials and methods related to valves commonly used for process systems, including pump stations, utility vaults, and water and wastewater treatment. This Section is to be used in conjunction with Section 40 05 51.24, Check Valves, Section 40 05 62, Plug Valves.

B. Section Includes:

1. Valves.
2. Valve actuators.

1.2 RELATED SECTIONS

A. Section 09 90 00, Painting and Coating
B. Section 40 05 13, Common Work Results for Process Piping
C. Section 40 05 51.24, Check Valves
D. Section 40 05 62, Plug Valves

1.3 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

3. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.

4. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

B. ASTM International (ASTM):

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

2. Submit valve cavitation limits.

C. Shop Drawings:

1. Submit description of proposed installation.

2. Provide assembly drawings indicating parts list, materials, sizes, position indicators.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.

F. Lining and coating data.

G. Valve Labeling Schedule: Indicate valve locations and nametag text.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and actuators.
B. Operation and Maintenance Data: Submit information for valves.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.

2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.8 QUALITY ASSURANCE

A. Cast manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.

3. Provide additional protection according to manufacturer instructions.

D. Handle products carefully to prevent damage to interior or exterior surfaces.

E. All defective or damaged materials shall be replaced with new materials at no 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.

PART 2 PRODUCTS

2.1 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.

B. Operation:

1. Open by turning counterclockwise; close by turning clockwise.

2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

C. Valve Construction:

1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.

D. Connecting Nuts and Bolts: Stainless steel.

2.2 VALVE ACTUATORS

A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.

B. Valves in sizes up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer's best standard design.

C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

D. Provide actuators with position indicators for shutoff valves 6 inches and larger.

E. Comply with AWWA C541 and C542, where applicable.

F. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above floor.

G. Provide gear and power actuators with position indicators.

H. Gear-Assisted Manual Actuators:

1. Provide totally enclosed gears.

2. Maximum Operating Force: 60-pound-force (lbf).

3. Bearings: Permanently lubricated bronze.

4. Packing: Accessible for adjustment without requiring removal of actuator from valve.

I. Handwheel:

1. Furnish permanently attached handwheel for emergency manual operation.

2. Rotation: None during powered operation.

3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.

4. Maximum Operating Force: 60 lbf.

J. Chain Actuator:

1. Description: Chain guides and hot-dip-galvanized operating chain extending to 5-1/2 feet above operating floor level.

2. Chain Wheels: Sprocket-rim type.

3. Furnish chain storage if chains may interfere with pedestrian traffic.

K. Valve Actuators in NEC Class I, Group D, Division 1 or 2 Hazardous Locations: UL approved.

2.3 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.3 INSTALLATION

A. Install valves, actuators, extensions, and accessories according to manufacturer instructions.

B. Firmly support valves to avoid undue stresses on piping.

C. Coat studs, bolts, and nuts with anti-seizing lubricant.

D. Clean field welds of slag and splatter to provide a smooth surface.

E. Install valves with stems upright or horizontal, not inverted.

F. Install valves with clearance for installation of insulation and allowing access.

G. Provide access where valves and fittings are not accessible.

H. Comply with Division 40 - Process Integration for piping materials applying to various system types.

I. Valve Applications:

1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

2. Install shutoff and isolation valves.

3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.

4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.

J. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.

2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.

3. Engineer will witness field testing.

END OF SECTION

SECTION 40 05 51.24 - CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Work in this Section includes check valves for use in water and wastewater facilities. Work includes the furnish and install of all swing and silent check valves, complete, as shown on the Drawings and specified herein, including coating and lining, appurtenances, operators, and accessories.

B. Section includes:

1. Swing check valves, 1-inch through 4-inch diameter.

1.2 RELATED SECTIONS:

A. Section 40 05 23 - Common Requirements Results for Process Valves

1.3 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.

5. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

6. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

7. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.

8. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

C. American Water Works Association (AWWA):

1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
B. As required by Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 SWING CHECK VALVES, 1-INCH THROUGH 4-INCH DIAMETER

A. Description:

1. Horizontal T-pattern style.

2. 200# WOG.

3. Capable of functioning in the vertical position.

4. Connections shall be standard threaded or threaded for fire hose connections where shown on plans

B. Materials:

1. Body Cap and Disc: Brass conforming to ASTM B584 C85400.

C. Manufacturer:

1. Val-matic

2. Figure 246 as manufactured by Red White Valve.

2.2 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure, in conformance with requirements of AWWA C508.

2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install check valves according to AWWA C508, Section 40 05 51 Common Requirements Results for Process Valve, and as recommended by manufacturer.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVES

A. Provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 61 - GATE VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes gate valves for use in buried service, pump stations and utility vaults. Coordinate with Section 33 12 16, Water Utility Distribution Valves.

B. Section Includes:

1. Resilient-seated gate valves.

1.2 RELATED SECTIONS

A. Section 33 12 16, Water Utility Distribution Valves
B. Section 33 11 10, Water Utility Distribution and Transmission Piping
C. Section 40 05 13, Common Work Results for Process Piping
D. Section 40 05 51, Common Requirements Results for Process Valves.

1.3 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

3. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. American Water Works Association (AWWA):

1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.

D. NSF International (NSF):

1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. As required by Section 33 12 16 - Water Utility Distribution Valves.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT-SEATED GATE VALVES

A. Description:

1. Comply with AWWA C509.

2. Minimum Pressure Rating:

a. Twelve-inch Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
b. Sixteen-inch Diameter and Larger: 150 psig.

3. End Connections: As shown in the Drawings.

a. Standard mechanical joint ends comply with ANSI/AWWA C111.

b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 & ASME 16.5.

1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear Actuators: Conforming to AWWA C509 for manual valves.

5. Linings and Coatings:

   a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.

   b. All internal and external ferrous surfaces.

   c. Do not coat flange faces of valves.

6. Bi-directional flow.

B. Operation:

1. Non-rising stem.

2. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.

3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Wedge:

   a. ASTM A126, cast iron or ASTM A536, ductile iron.

   b. Fully encapsulated with molded rubber.

2. Body and Bonnet:

   a. ASTM A126, cast iron or ASTM A536, ductile iron.

3. Stem, Stem Nuts, Glands, and Bushings: ASTM B584, bronze.

4. Valve Body Bolting: Stainless steel.

D. Manufacturers:

1. Clow Valve Company.

2. M&H Valve.
3. U.S. Pipe.
4. American Flow Control.
5. Mueller Company.

2.3 SOURCE QUALITY CONTROL

A. Testing: Test gate valves according to AWWA C509.

PART 3 EXECUTION

3.1 INSTALLATION

A. As required by Section 33 12 16, Water Utility Distribution Valves.

B. Install according to manufacturer's instructions.

C. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

SECTION 40 05 62 - PLUG VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes plug valves for use in water and wastewater treatment plants.

B. Section Includes:

1. Eccentric plug valves.

C. Related Requirements:

1. Section 40 05 51 - Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

B. ASTM International (ASTM):

1. ASTM A536 - Standard Specification for Ductile Iron Castings.

2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

C. American Water Works Association (AWWA):

1. AWWA C517 - Resilient-Seated Cast-Iron Eccentric Plug Valves.
2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit catalog information, indicating materials of construction and compliance with indicated standards.

C. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.

PART 2 PRODUCTS

2.1 ECCENTRIC PLUG VALVES

A. Manufacturers:

1. Val-Matic
2. DeZurik, Model PEF
3. Approved equal.

B. Description:

1. Type: Non-lubricated, eccentric.

2. Minimum Working Pressure: 150 pounds per square inch (gauge) (psig).

3. Ports: Round. Passage size shall be 100 percent of the full port area on all sizes for minimum pressure drop.

4. Stem Bearings: Self-lubricating.

5. Stem Seals: Neoprene; V-ring type.

6. Packing and Gland: Accessible and externally adjustable.

7. End Connections: ASME B16.1, flanged.

C. Operation:

1. Greater than 3 inches: Worm gear manual operators.

   a. Provide with handwheel, except when buried.
   b. Actuator mechanism shall be fully isolated from line media.

D. Materials:

1. Body: AWWA C517, cast iron.

2. Wall Thickness: AWWA C504.

3. Plug:

   a. AWWA C517, cast iron.

b. ASTM A 536, ductile iron. lined with resilient coating as recommended by valve manufacturer for service conditions.

4. Seats: Stainless steel.

5. Stem: Type 316 stainless steel.

6. Stem Bearings: Stainless steel.

7. Seals: Cartridge type with two O-rings, or V-cup type, self-adjusting, wear compensating. Packing shall be replaceable without removing the valve bonnet or plug.

8. Connecting Hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 40 05 51, Common Requirements Results for Process Valves.

2.2 SOURCE QUALITY CONTROL

A. Performance Testing:

1. Operate each valve and actuator from fully CLOSED to fully OPEN to fully CLOSED under no-flow conditions.

B. Leakage Testing:

1. Test at indicated working pressure to ensure valves are drip tight. Test with pressure in both directions for 5 minutes each way.

C. Hydrostatic Testing:

1. Perform test at twice rated pressure. Test for at least 1-minute to ensure no leakage.

PART 3 EXECUTION

3.1 LOCATION

A. Valve and actuators shall be located and oriented as shown on the Drawings.

B. When not shown on the Drawings, coordinate positions and orientations of seats and actuators with the Engineer prior to installation.

3.2 INSTALLATION

A. Install valves according to Section 40 05 51, Common Requirements Results for Process Valves, AWWA C517 and as recommended by manufacturer.

B. Install plug valves in horizontal piping with stem horizontal; install plug valves in vertical piping with plug at top when closed.

C. Install such that plugs are on top when OPEN and on pressure side when CLOSED.

END OF SECTION

SECTION 43 07 53

DUPLEX GRINDER PUMP STATION

PART 1 GENERAL

1.1 GENERAL

The contractor shall furnish all labor, materials, equipment and incidentals required to provide a duplex pumping system as specified herein. The system shall be by the same manufacturer as supplying the pump and motor control panel so as to ensure suitability and assurance of experience in matching the equipment together and to insure single source responsibility for the equipment.

System shall consist of two (2) sewage pumps (explosion proof), four (4) level control switches, discharge plumbing with disconnects, lifting chains, NEMA 3R control panel. Structure and dimensions to be shown on the drawings.

A. PUMPS

1. OPERATING CONDITIONS: Each pump shall be rated 5-HP, 120/208 volts, three phase unit operating at 1750 RPM, 77 gpm @ 70' TDH, primary duty point; secondary 130 gpm @ 58 TDH, dead head shall be 87 TDH or higher.

2. CONSTRUCTION: Each pump shall be of the sealed submersible type, Model HPGFHX500FCH (explosion proof, no exception) as manufactured by the Hydromatic Pump Company, or ABS Piranna, or Engineer approved equal. The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 25. All external mating parts shall be machined and Buna N Rubber. O-ring sealed on a beveled edge. Gaskets shall not be acceptable. All fasteners exposed to the pumped liquids shall be 300 Series stainless steel.

3. ELECTRICAL POWER CORD: Electrical power cord shall be water resistant 600 volt, 60oC, UL and or CSA approved and applied dependent on amp draw for size.

   The pump shall be protected with compression fitting and epoxy potted area at the power cord entry to the pump. A separation between the junction box areas of the pump and the motor by a stator lead sealing gland or terminal board shall not be acceptable.

   The power cable entry into the cord cap assembly shall first be made with a compression fitting. Each individual lead shall be stripped down to bare wire, at staged intervals, and each strand shall be individually separated. This area of the cord cap shall then be filled with an epoxy compound potting which will prevent

water contamination to gain entry even in the event of wicking or capillary attraction.

The power cord leads shall then be connected to the motor leads with extra heavy connectors having brass inserts with a screwed wire to wire connection, rather than a terminal board that allows for possible leaks. The cord gap assembly where bolted to the connection box assembly shall be sealed with a Buna N Rubber O-ring on a beveled edge to assure proper sealing.

4. MOTOR: The stator, motor and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F insulation (155oC or 311oF), and a dielectric oil filled motor, NEMA B design (3 phase), NEMA L design (single phase). Because air filled motors do not dissipate heat as efficiently as oil filled motors, they shall not be acceptable.

   The pump and motor shall be specifically designed so that they may be operated partially dry or completely submerged in the liquid being pumped. The pump shall not require cooling water jackets. Dependence upon or use of water jackets for supplemental cooling shall not be acceptable.

   Stators shall be securely held in place with a removable end ring and threaded fasteners so they may be easily removed in the field without the use of heat or a press. Stators held by a heat shrink fit shall not be acceptable. Stators must be capable of being repaired or rewound by local motor service station. Units which require service only by the factory shall not be acceptable. No special tools shall be required for pump and motor disassembly.

   Pump shall be equipped with a heat sensor. The heat sensor shall be a low resistance, bi-metal disc that is temperature sensitive. It (they) shall be mounted directly in the stator and sized to open at 120oC or 130oC and automatically reset at 30o-35oC differential. The sensor shall be connected in series with the motor starter coil so that the starter is tripped as a heat sensor opens. The motor starter shall be equipped with overload heaters, so all normal overloads are protected by external heater block.

B. BEARINGS AND SHAFT

An upper radial bearing and a low thrust bearing shall be required. These shall be permanently lubricated by the dielectric oil which fills the motor housing. Sealed grease packed bearings shall not be acceptable. Bearings which require lubrication according to a prescribed schedule shall not be acceptable. Bearings shall be locally available. Units which require the use of more than two bearings shall not be acceptable.

The shaft shall be machined from a solid 416 stainless steel and be a design which is of large diameter with a minimum overhang to reduce shaft deflection and prolong bearing life.

C. SEALS

The pump shall have two mechanical seals, mounted in tandem, with an oil chamber between the seals. John Crane type seals shall be used with the rotating seal faces being carbon and the stationary seal faces to be ceramic. The lower seal shall be replaceable without disassembly of the seal chamber and without the use of special tools. Units which require the use of tungsten-carbide seals or foreign manufactured seals shall not be acceptable. Seals shall be locally available. A seal combination using an opposing spring will not be acceptable.

The pump shall be equipped with a seal leak detection probe and warning system. This shall be designed to alert maintenance personnel of lower seal failure without having to take the unit out of service for inspection or requiring access for checking seal chamber oil level and consistency.

There shall be an electric probe or seal failure sensor installed in the seal chamber between the two tandem mechanical seals. If the lower seal fails, contaminants which enter the seal chamber shall be detected by the sensor and send a signal to operate the specified warning device.

D. IMPELLER

Impeller shall be of bronze construction and non-overloading. Impeller shall be of the multi-vane, semi-open design with pump-out vanes on the backside of the impeller to prevent grit and other materials from collecting in the seal area. Impeller shall not require coating. Because most impeller coatings do not remain beyond the very early life of the impeller, performance data submitted shall be based on performance with an uncoated impeller. Attempts to improve efficiency by coating impeller shall not acceptable.

Impeller shall be hydraulically and statically balanced. The tolerance values shall be as listed below according to the International Standard Organization grade 6.3 for rotors in rigid frames. The tolerance is to be split equally between the two balance planes which are the impeller shrouds.

RPM	TOLERANCE
1750	.01 in. - oz./lb. of impeller weight

E. PAINTING

The pump shall be painted after assembly, but before testing with lead free air dried enamel. The paint shall be applied in one coat with a minimum mil thickness of 3 to 4 mils.

1.2 BASIN

A. GENERAL

Shell design shall be in accordance with the methods and formulas in AWWA C950 M-45. Design of flat bottoms shall account for both limiting stress and deflection. Design shall be based on industry standard lamination analysis for the glass reinforcement layers and resins system. Design shall determine cylinder and flat bottom thicknesses.

B. LAMINATE PROPERTIES

The minimum flexural modulus in the circumferential direction shall be 2,000,000 psi and in the longitudinal directions shall be 1,000,000 psi.

C. WALL THICKNESS

Wall thickness shall vary with basin/wetwell height. Calculated wall thicknesses shall be based on the following site assumed conditions:

1. Soil Modulus: 700 PSI.
2. Soil Density: 120 Lbs. per cubic foot.
3. Calculations shall employ a Luchers's safety factor of 2.

1.3 MATERIALS

A. Resin: Resins used shall be commercial grade unsaturated polyester type, suitable for the intended service as indicated by usage history or resin manufacturer's recommendation.

B. Cure System: Resin promotion and catalyst system used shall follow resin manufacturers' guidelines.

C. Fillers and additives: No fillers or resin extenders of any type shall be utilized. A maximum of two percent by weight of any commercial grade thixotropic agent may be added to resins for the purpose of viscosity control.

D. Reinforcing Materials: Reinforcing material shall be commercial grade "E" type glass fibers in the form of chopped strand mat, chopped roving, woven roving or continuous roving. Uni-directional glass shall be used in addition to any other glass used. Glass fibers shall be treated with a coupling agent that facilitates bonding between the reinforcement and the resin.

1.4 LAMINATE

A. General: Basin laminates shall consist of three layers (inner surface, interior layer and structural layer).

B. Inner Surface: The inner surface shall consist of a resin rich layer with no exposed fibers.

C. Interior Layer: The interior layer shall consist of a resin rich reinforced layer with a nominal fiber content of 30 percent. Reinforcements shall be chopped strand mat or chopped roving.

D. Structural Layer: The structural layer shall be chop-hoop filament wound consisting of chopped strand and continuous roving reinforcement oriented in the hoop direction. As required, uni-directional roving shall be incorporated into this layer to enhance longitudinal properties. The exterior surface shall be relatively smooth and with no exposed fibers or sharp projections. Nominal fiber content on the structural layer shall be a minimum of 62 percent.

1.5 APPURTENANCES

A. Top Flange: The basin shall have a top flange that is 3" larger in diameter than the interior diameter of the tank.

B. Bottom: The bottom of the wet well shall be built to withstand full exterior water column with a maximum deflection 3/8".

C. Bottom Anti-floatation Flange: The bottom anti-float flange shall be a minimum of 3" larger in diameter than the wet well and be constructed to withstand the maximum uplifting force that could be exerted with an empty wet well and full water column outside the tank.

D. Cover Attachments: Stainless steel threaded inserts shall be installed in the top flange of the basin/wetwell to accommodate attachment of covers. The inserts shall be 3/8 inch diameter in a 6-bolt pattern, 60 degrees apart and secured using polyester resin to permanently hold in place.

1.6 QUALITY ASSURANCE

A. Visual Acceptance: The inner surface shall be free of exposed fiber, crazing and delaminations. No Blisters larger than 1/2 inch or wrinkles more than 1/8 inch in depth will be allowed.

B. Laminate Cure: Laminate cure shall be indicated by means of Barcol hardness measured in accordance with ASTM D2583. The average Barcol hardness shall not be less than 90 percent of the resin manufacturer's recommendation for clear resin castings.

C. Workmanship: All workmanship and materials throughout shall be of the highest quality available.

1.7 BASIN COVER

A. Refer to Section 33 05 13, Manholes.

1.8 DUPLEX PUMP CONTROL PANEL.

A. Contractor shall furnish all labor, materials, equipment and incidentals required to provide motor control panel as specified herein.

B. The motor control panel shall be assembled and tested by a shop meeting U.L. Standard 508 for industrial controls. The motor and control panel shall be assembled and tested by the same manufacturer supplying the pump so as to ensure suitability and assurance of experience in matching controls to motors and to insure single source responsibility for the equipment.

C. The control panel shall comply with the NEC regulations. The panel shall contain all components required by the pump manufacture for starting and protection of the motor. Any features required by the pump manufacture for warranty of the pump shall be included in the control panel.

D. The level control system shall start one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "pump stop level", the system shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level rise to the "lag pump start level", the system shall start the second pump so that both pumps are operating to pump down the well. Both pumps shall stop at the same "stop" level.

1.9 CONSTRUCTION

A. The controls for the pump shall be contained in a painted steel enclosure meeting NEMA 3R requirements with a hinged door and neoprene gasket. The sub-panel shall be painted steel.

B. The enclosure shall have provisions for padlocking. A nameplate shall be permanently affixed to the panel and include the model number, voltage, phase, hertz, ampere rating and horsepower rating. A warning label against electric shock shall be permanently affixed to the outer door.

C. Hand-Off-Auto switches shall be provided for each pump. All switches and push buttons shall be mounted on a corrosion-resistant operator safe dead-front with a corrosion resistant full length hinge.

D. Pilot lights shall be furnished for each pump for run status and seal failure. All pilot lights shall be mounted on the corrosion-resistant operator safe dead-front.

E. All pilot lights and switches shall be properly labeled as to function. The labels shall be ¾" by 3" two layer laminated plastic, white on black background. The labels shall be custom engraved by the control panel manufacturer and fastened to the dead-front.

F. Pump control panel shall incorporate seal failure relays into control operation. Should water penetrate the lower seal of the pump, an adjustable seal failure relay shall be energized via the pump manufacturer's seal fail probe, alerting the operator of impending pump failure. The relay shall energize a pilot light on the operator dead-front. The relay shall be 120VAC and have an adjustment of 4.7 to 100k ohms.

G. The incoming power shall be 230 volts, 3 phase, 60 hertz service. Terminal blocks with box type lugs shall be supplied to terminate all wiring for floats and heat and seal sensors for the pump, if required. The pump leads shall be terminated at the overload relay or at box type terminal blocks. The terminal blocks for the float connections shall be on the pump controller.

H. A circuit breaker shall be used to protect from line faults. The panel shall have a main power disconnect interconnected with a handle on the dead-front for safety, and to disconnect the pump from the incoming power. Circuit breaker shall be thermal magnetic and sized to meet NEC requirements for motor controls.

I. The solid-state reduced-voltage controller shall accept an input voltage from 200V_ 480V AC or 200V AC_ 600V AC three-phase plus 10 percent or minus 15 percent.

J. The solid-state reduced-voltage controller shall have a minimum short circuit current rating of 65 kA when protected with a type CC/J/L fuses (up to 600V)

K. The open-type controller device shall consist of a power structure and a logic component.

1. Power Structure

a. The family of devices must be available from 1_480 A in a line connection

b. The family of devices must be available from 1_ 830 A when connected inside the delta

1) The inside-the-delta connection should be enabled with a DIP switch

c. The power structure shall include an electro-mechanical SCR bypass device.

d. The power structure shall include built-in 3-phase current monitoring and overload protection.

e. There shall be a current transformer on each phase of the device for current measurements.

f. For ratings 1_480 A, SCRs shall have the following minimum repetitive peak inverse voltage ratings

1) 1400V for units rated 200_480V
2) 1600V for units rated 200_600V

2. Logic Component

a. The logic component shall be an integral part of the power structure so it cannot be removed and misplaced.

b. The control module shall provide digital microprocessor control and supervision of all controller operation, including pulse firing of the SCRs.

c. The control module shall consist of the following.

1) Self-tuning power supply accepting control power input from 100_240V AC or 24V AC/DC, 50/60 Hz.

d. Logic control circuitry incorporating a latch circuit for three-wire control.

e. Input / output circuitry

f. DIP switches are to be used for secure setting of the setup parameters

g. A POT setting is to be used for setting up the motor FLA

h. Integrated LED to indicate fault and running status

3. The control terminals shall have the following characteristics

a. The control terminal wiring connector shall be easily accessible and located on the front top of the device.

b. The terminals shall be UL rated for 300 Volts, 10 Amps maximum.

c. The terminals are UL Recognized to accept a maximum of two (2) wires rated #24_#14 AWG.

L. The level control system shall start one pump when the liquid level in the wet well rises to the "pump on level". When the level of the liquid falls below the "pump off level", the system shall stop the pump and this action shall constitute one pumping cycle and will switch the alternator to call the next pump to run in the sequence. Should the first pump fail to start or the wet well level rise to the "high level", the system will fail the

first pump and start the next pump in the sequence, at no time will multiple pumps be able to run at the same time. If the wet well level continues to rise to the high-high level the alarm light and horn will be activated and will remain on until the level falls below the high-high level or is turned off by attending personnel.

M. Control voltage shall be 120 VAC and may be accomplished by the means of a transformer or available line voltage. A control fuse shall protect and isolate the control voltage from the line. Control transformer shall have primary and secondary circuit protection.

N. Wire ties shall be used to maintain panel wiring in neat bundles for maintenance and to prevent interference with operating devices. All wiring shall be color coded to facilitate maintenance and repair of the control panel. Where a color is repeated, number coding shall be added. A schematic shall be permanently attached to the inside surface of the front door.

O. All ground connections shall be made with ring tongue terminals and star washers to assure proper ground.

P. A duplex pump controller shall be provided for control logic. Pump controller shall be relay logic utilizing conventional wiring. The pump control panel shall be completely self-contained and will require no additional hardware, software, or accessories for full operation. The pump controller shall be UL listed for 508A.

Q. The high level alarm shall be the only external light on the pump control panel.

1.10 OPTIONS

Panel shall be equipped with the following additional features.

A. High level alarm light (Flashing)
B. High level alarm horn
C. Test-Off-Auto switch for alarm
D. Elapsed time meter (per pump)
E. Seal failure light
F. Lightning arrestor
G. 110 volt convenience

PART 2 LIFT-OUT RAIL SYSTEM AND INTERNAL DISCHARGE PIPING

The lift-out rail system shall consist of bottom rail supports, upper rail supports, and stainless steel lifting chains for each pump. The rails shall be constructed of minimum 2" stainless steel pipe and not less than 2 rails per pump shall be supplied. Pump Guide Systems that put a downward stress on the lift station cover (top) shall not be acceptable.

The discharge piping shall consist of 3 inch PVC pipe. Discharge from station shall be fitted with plain ends and connected using Smith-Blair Couplings, or equal. Piping configuration and size shall be as drawn on the plans. All piping external to the station shall be installed by the Contractor.

END OF SECTION

Kumar & Associates, Inc.
Geotechnical and Materials Engineers
and Environmental Scientists

ACEC
MEMBER

240 Annie Road | PO Drawer 1887
Silverthorne, Colorado 80498
Fax: (970) 468-5891
Phone: (970) 468-1989
Email: hpksummit@kumarusa.com

Office Locations: Denver (HQ), Colorado Springs, Fort Collins, Glenwood Springs Parker and Summit County, Colorado

GEOTECHNICAL ENGINEERING STUDY
PROPOSED RAW SEWAGE LIFT STATION
FRISCO BAY MARINA, MARINA DRIVE
FRISCO, COLORADO

Prepared by:

James A. Parker, P.E, P.G.

COLORADO LICENSED
JAMES A. PARKER
47281
06/23/20
PROFESSIONAL ENGINEER

Reviewed by:

Steven L. Pawlak, P.E.

PREPARED FOR:

MURRAYSMITH
ATTN: JOEL PRICE, P.E.
850 WEST SOUTH BOULDER ROAD, # 200
LOUISVILLE, COLORADO 80027

joel.price@murraysmith.us

Project No. 20-6-140

June 23, 2020

TABLE OF CONTENTS

SUMMARY

1. The project is located in the Frisco Bay Marina parking area on Marina Drive in Frisco, Colorado. One exploratory boring was drilled near the location of the proposed lift station. Soils encountered in the boring below a shallow depth of organic topsoil consisted of poorly graded silty gravel (GP-GM) with sand, cobbles and scattered boulders to the full depth of exploration of 35 feet. The gravel soils were medium dense to dense in relative density. The relatively dense, native GP-GM soils are generally considered excellent for foundation support when adequately dewatered. The existing topsoil should be removed from development areas during construction.

2. Groundwater was encountered in our exploratory boring at the time of drilling at a depth of about 10 feet below the existing ground surface, and at a depth of 5½ feet when checked 17 days after drilling. Groundwater depths are anticipated to vary seasonally and with changes in flow of Ten Mile Creek and water level of Dillon Reservoir. Significant dewatering, consisting of pumps, well points, or other methods will be necessary to achieve relatively dry and stable subgrade conditions during foundation excavations and fill placement for the structure.

PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for the proposed raw sewage lift station to be located at the Frisco Bay Marina, Frisco, Colorado. A vicinity map is shown on Figure 1 and the proposed site and boring location is shown on Figure 2. The purpose of the study was to develop recommendations for the foundation design. The study was conducted in accordance with our proposal for geotechnical engineering services to Murraysmith, dated February 27, 2020, Proposal P6-20-120.

A field exploration program consisting of an exploratory boring and a site reconnaissance was conducted to obtain information on the surface and subsurface conditions. Samples of the subsoils obtained during the field exploration were tested in the laboratory to determine their classification and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop recommendations for foundation types, depths and allowable pressures for the proposed structure foundations. This report summarizes the data obtained during this study and presents our conclusions, design recommendations and other geotechnical engineering considerations based on the proposed construction and the subsoil conditions encountered.

PROPOSED CONSTRUCTION

Review of preliminary structural drawings, prepared by Martin/Martin Structural Engineers, and conversations with the Project Team, indicate the proposed construction includes a new concrete raw sewage lift station. The lift station will be a buried, two-part, precast concrete structure with a top lid elevation of about 9,030' mean sea level (msl), with pre-cast foundations bearing approximately 23 feet below the lid at about 9,007' msl on a 12-inch thick, crushed rock levelling course. We assume moderate foundation loadings, typical of the proposed type of construction. Excavations of up to about 24 feet below existing grade are anticipated during construction.

SITE CONDITIONS

The project site is in a grass covered, relatively flat median area in the Frisco Bay Marina parking lot, as shown on Fig. 2. The proposed lift station will be located approximately 270 feet south of Dillon Reservoir, and about 130 feet east of the existing Marina buildings. An existing lift station, to be replaced with the new structure, is located about 50 feet north of the proposed new lift station.

FIELD EXPLORATION

The field exploration for the project was conducted on June 2, 2020. One exploratory boring was drilled near the location of the proposed lift station, at the approximate location shown on

Fig. 2, to evaluate the subsurface conditions. The boring was advanced with 4-inch diameter continuous flight augers powered by a truck-mounted CME-45B drill rig, and logged by a representative of Kumar and Associates, Inc.

Samples of the subsoils were taken with a 1 3/8-inch I.D. spoon sampler. The sampler was driven into the subsoils at various depths with blows from a 140-pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D-1586. The penetration resistance values are an indication of the relative density of the subsoils. A disturbed sample of the boring spoils from about 10 to 15 feet below grade was obtained for gradation analysis (Fig. 4). Depths at which the samples were taken, and the penetration resistance values are shown on the Log of Exploratory Boring, Figure 3. The samples were returned to our laboratory for review by the project engineer and testing.

The boring was completed as a temporary monitoring well (piezometer) for the purpose of measuring groundwater levels during the project design phase. The piezometer is constructed of 1½-inch diameter PVC surrounded by filter fabric. The PVC pipe was left exposed and capped flush with the ground surface.

LABORATORY TESTING

Laboratory testing performed on samples obtained from the exploratory boring consisted of natural moisture content and percent passing the No. 200 sieve. A gradation analysis of the minus 1½-inch fraction of the coarse granular soils from the boring is presented on Figure 4. The laboratory test results are presented on the Log of Exploratory Boring, Figure 3, and summarized in Table 1.

SUBSURFACE CONDITIONS

Soil Types Encountered: Graphic logs of the subsurface conditions encountered at the site are shown on Figure 3. Soils encountered in the boring below a shallow depth of organic topsoil consisted of poorly graded silty gravel (GP-GM) with sand, cobbles and scattered boulders extending to the full depth of exploration of 35 feet below the existing site grade. The gravel soils were medium dense to dense in relative density. The relatively clean, granular native soils tended to cave the boring below the groundwater level and prevented sampling in the boring below 25 feet.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

Subsurface data indicates that poorly graded silty gravel with sand, cobbles and scattered boulders, will likely be the predominant material encountered beneath foundation elements.

The soils are dense at anticipated foundation bearing elevations and are generally considered excellent for shallow foundation support when adequately dewatered and stabilized.

Groundwater was encountered in our exploratory boring at the time of drilling at a depth of 10 feet below the existing site grade and at 5½ feet when measured 17 days after drilling. The groundwater depth is anticipated to vary seasonally and with changes in nearby Ten Mile Creek flow and Dillon Reservoir level. Buoyant conditions, based on the anticipated seasonal high groundwater level, should be considered in the design of the structure.

The native gravels are relatively clean, containing 5 to 14 percent material passing the No. 200 sieve (silt and clay particles) in the tested samples, and will have the potential for relatively high transmissivity of groundwater. Significant dewatering, consisting of sumps with pumps, well points, or other methods will be necessary to achieve relatively dry and stable subgrade conditions during foundation excavation and fill placement for the structure. The construction dewatering system should be capable of maintaining a ground water level 2 to 3 feet below the bottom of the excavation.

Based on the location of the proposed structure and anticipated excavation depths, temporary construction shoring will likely be necessary to retain some of the excavation walls. Temporary construction shoring is typically designed by a specialty contractor based on the soil and groundwater conditions and planned construction.

SITE GRADING

The following recommendations should be followed for grading, site preparation, and fill compaction.

1. Where new structural fill is to be placed, existing fill (if encountered), topsoil, loose, wet, or otherwise unsuitable material should be removed prior to placement of new fill. The exposed soils should then be scarified to a depth of 6 inches, moisture conditioned and compacted to the minimum requirements of the overlying fill. Soils should be compacted with appropriate equipment for the lift thickness placed. Lift thickness should be no more than 10 loose inches subsequently compacted at the recommended moisture content and to the minimum required density.
2. All backfill should be processed so that it does not contain fragments larger than 6-inches in diameter and placed at the recommended moisture content.

3. The following compaction requirements are recommended.

TYPE OF FILL PLACEMENT	MOISTURE CONTENT	SOIL TYPE - Compaction Percent (ASTM D698 – Standard Proctor)
Below Foundations	± 2% Optimum	Imported Structural Fill – 100%
Below Grade Wall Backfill	± 2% Optimum	Processed On-Site Soils or Imported Structural Fill – 98%
Utility Trenches	As they apply to the finished area	

Suitability of On-Site Soil

The on-site granular soils, excluding topsoil should be suitable for use as structural backfill for below grade walls after processing to remove over-size rock fragments. Imported granular fill, such as CDOT Class 6 aggregate base course, or similar, is recommended below foundation elements. On-site soils, excavated from below the groundwater level, will require aerating and drying prior to use as structural fill.

Considerable processing will be necessary to reduce the existing fill and on-site soil to fragments of minus 4-inches. Processing may include screening, rock raking and crushing. All on-site soil should be processed, moisture-conditioned or aerated to dry and placed at the minimum required compaction.

Structural Fill

Structural fill used for support of the lift station should consist of imported granular materials, such as CDOT Class 6 ABC or similar. Structural fill used for below grade wall backfill should consist of processed on-site granular soils or a relatively well-graded imported granular material with a liquid limit of 35 or less, a plasticity index of 10 or less, 5 to 25 percent material passing the No. 200 sieve, 60 percent or more passing the No. 4 sieve and no rocks larger than 4 inches. Structural fill should be properly placed and compacted to reduce the risk of settlement and distress. Structural fills should be placed in accordance with the recommendations presented in the SITE GRADING section of this report.

Excavations

It is the responsibility of the Contractor to provide safe working conditions and to comply with the regulations in OSHA Standards, Excavations, 29CFS Part 1926. The presence of water, seepage, fissuring, vibrations or surcharge loads will require temporary excavation to have flatter slopes. A Contractor's competent person should make decisions regarding cut slopes. A qualified Geotechnical engineer should observe any questionable slopes or conditions. Temporary shoring may be necessary.

Temporary Excavations

For excavations where sufficient lateral space is available, unsupported temporary excavations above ground water may be constructed in accordance with OSHA requirements, and other applicable local and state requirements. Based on the OSHA excavation guidelines, the natural granular soils encountered in the boring generally classifies as an OSHA Type C soil. This suggests that temporary excavation slopes may generally be at 1.5:1 (horizontal : vertical). Also, the presence of groundwater will have a destabilizing effect on excavation slopes. As discussed in the Geotechnical Considerations section of this report, the stabilized groundwater level in the piezometer was above preliminary planned excavation level for the structure. Zones of localized perched groundwater may be encountered at elevations higher than the general site groundwater levels in the spring and early summer. Excavations below groundwater will likely require temporary shoring and dewatering.

Surface water runoff into the excavation can act to erode and potentially destabilize the excavation side slopes and result in soft ground conditions at the base of the excavation and should not be allowed. Diversion berms and other measures should be used to prevent surface water runoff into the excavation from occurring. If significant runoff into the excavation does occur, further excavation to remove and replace the soft subgrade materials or stabilize the slopes may be required.

FOUNDATIONS

Considering the subsoil conditions encountered in the exploratory boring and the nature of the proposed construction, a shallow spread footing or structural slab foundation system should be suitable for support of the proposed lift station, bearing on the undisturbed natural granular soils, or compacted structural fill. A minimum 12-inch thick layer of properly compacted select fill, such as CDOT Class 6 aggregate base course (ABC) or equivalent, or crushed rock (as shown on the preliminary plans), is recommended as a levelling course below foundation elements.

The design and construction criteria presented in the table and sections below should be observed for foundation construction bearing on the natural granular soils.

Allowable Bearing Capacity* (pounds per square foot (psf))	4,000 psf
Passive Earth Pressure (pounds per cubic foot (pcf)	300 pcf for submerged conditions
Coefficient of Friction	0.45
Soil Phi Angle (native granular soil)	34°

*One-third increase for transient loading. Minimum footing width 24 inches.

1) Voids created by boulder removal in foundation subgrade areas should be backfilled with properly compacted structural fill or lean-mix concrete to re-establish foundation bearing elevation.
2) The exposed soils in footing areas should be compacted to densify any loose or disturbed materials prior to placement of the levelling course. Foundation excavations should be dewatered prior to placement of structural fill, levelling course or concrete.
3) Structural fill used for support of foundation elements should meet the requirements listed in the SITE GRADING section of this report.
4) A representative of the geotechnical engineer should observe all footing excavations prior to placement of the levelling course and foundation elements to evaluate bearing conditions.
5) Based on experience, we expect settlement of foundation elements designed and constructed as discussed in this section will be about 1 inch or less.

LATERAL EARTH PRESSURES

Restrained retaining structures, such as the walls of the structure, which are laterally supported and can be expected to undergo only a slight amount of deflection, should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of at least 45 pounds per cubic foot (pcf) for non-buoyant condition backfill consisting of processed natural granular soils or suitable granular import. The backfill should not contain rock larger than about 4 inches in diameter.

The lateral resistance of the lift station foundation will be a combination of the sliding resistance of the foundation bearing materials and passive earth pressure against the side of the

foundation. Resistance to sliding at the bottoms of the foundation bearing on granular natural soils or granular structural fill can be calculated based on a coefficient of friction of 0.45. Passive pressure of compacted backfill against the sides of the foundation can be calculated using an equivalent fluid unit weight 300 pcf for submerged conditions. The coefficient of friction and passive pressure values recommended above assume ultimate soil strength. Suitable factors of safety should be included in the design to limit the strain which will occur at the ultimate strength, particularly in the case of passive resistance. Fill placed against the sides of the foundation to resist lateral loads should consist of processed natural granular soils or a suitable imported granular material compacted to at least 98% of the maximum standard Proctor dry density at a moisture content near optimum.

All retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as traffic, construction materials and equipment. The lateral earth pressure recommended above assumes drained conditions behind the walls. The buildup of water behind the lift station walls will increase the lateral pressure imposed on the structure and should be accounted for in design based on the anticipated high seasonal groundwater level.

Backfill should be placed in uniform lifts and compacted to at least 98% of the maximum standard Proctor (ASTM D-698) dry density. Care should be taken not to use large equipment near the structure walls, since this could cause excessive lateral pressure on the structure. Some settlement of deep backfill along the sides of the structure should be expected, even if the material is placed correctly, and could result in distress to facilities constructed in or on the backfill. Flexible pipe connections for below grade utility connections should be considered in the design to accommodate potential backfill settlement and subsequent stress on the pipe connections.

CONTINUING SERVICES

Two additional elements of geotechnical engineering service are important to the successful completion of this project.

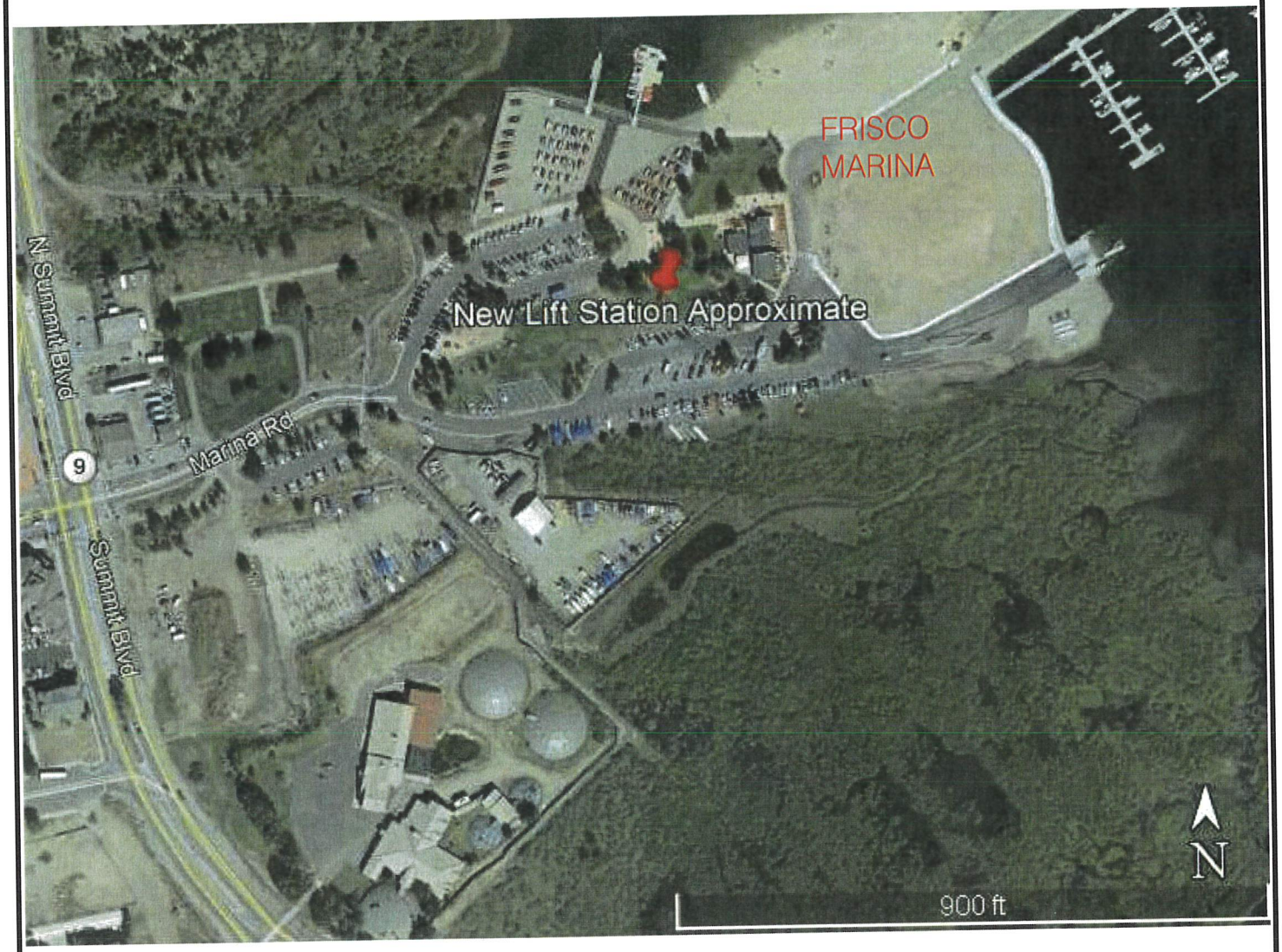
1) Consultation with design professionals during the design phases. This is important to ensure that the intentions of our recommendations are properly incorporated in the design, and that any changes in the design concept properly consider geotechnical aspects.
2) Observation and monitoring during construction. A representative of the Geotechnical engineer from our firm should observe the foundation excavation, earthwork, and foundation phases of the work to determine that subsurface conditions are compatible with those used in the analysis and design and our recommendations have been

properly implemented. Placement of backfill should be observed and tested to judge whether the proper placement conditions have been achieved.

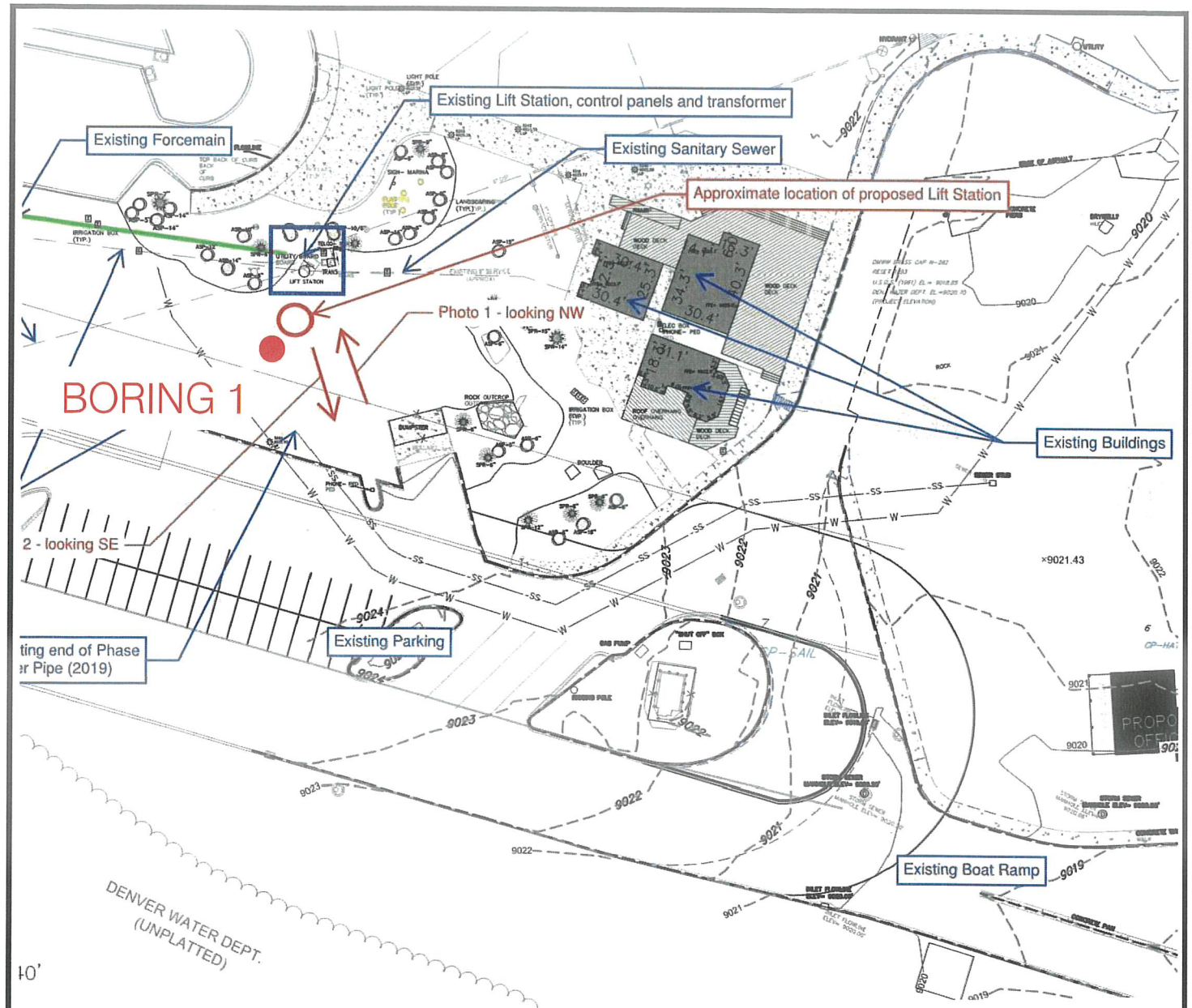
LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory boring at the location indicated on Figure 2, the proposed type of construction and our experience in the area. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory boring and variations in the subsurface conditions may not become evident until excavation is performed. If conditions encountered during construction appear different from those described in this report, we should be notified so that re-evaluation of the recommendations may be made.

This report has been prepared for the exclusive use by our client for design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation and field services during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. Significant project design changes may require additional analysis or modifications to the recommendations presented herein.



20-6-140	Kumar and Associates	VICINITY MAP	FIG. 1



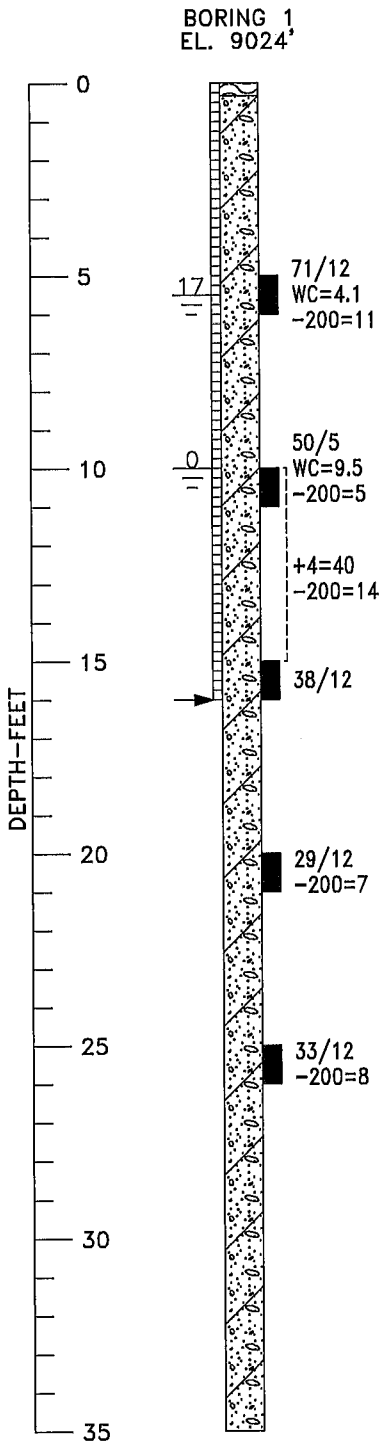
Boring Location is Approximate

Boring No. and Location

Approximate Scale

0 50 100

20-6-140	Kumar and Associates	LOCATION OF EXPLORATORY BORING	FIG. 2



LEGEND

TOPSOIL; SILT, SAND AND GRAVEL, WITH ORGANICS, (GRASS SOD), MOIST, BROWN.

POORLY GRADED SILTY GRAVEL (GP-GM); WITH SAND, COBBLES AND SCATTERED BOULDERS, MEDIUM DENSE TO DENSE, MOIST TO WET, BROWN.

DRIVE SAMPLE, 1 3/8-INCH I.D. SPLIT SPOON STANDARD PENETRATION TEST.

DISTURBED BULK SAMPLE.

SLOTTED PVC PIPE, PLACED IN UPPER 16' DUE TO CAVED BORING.

71/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 71 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

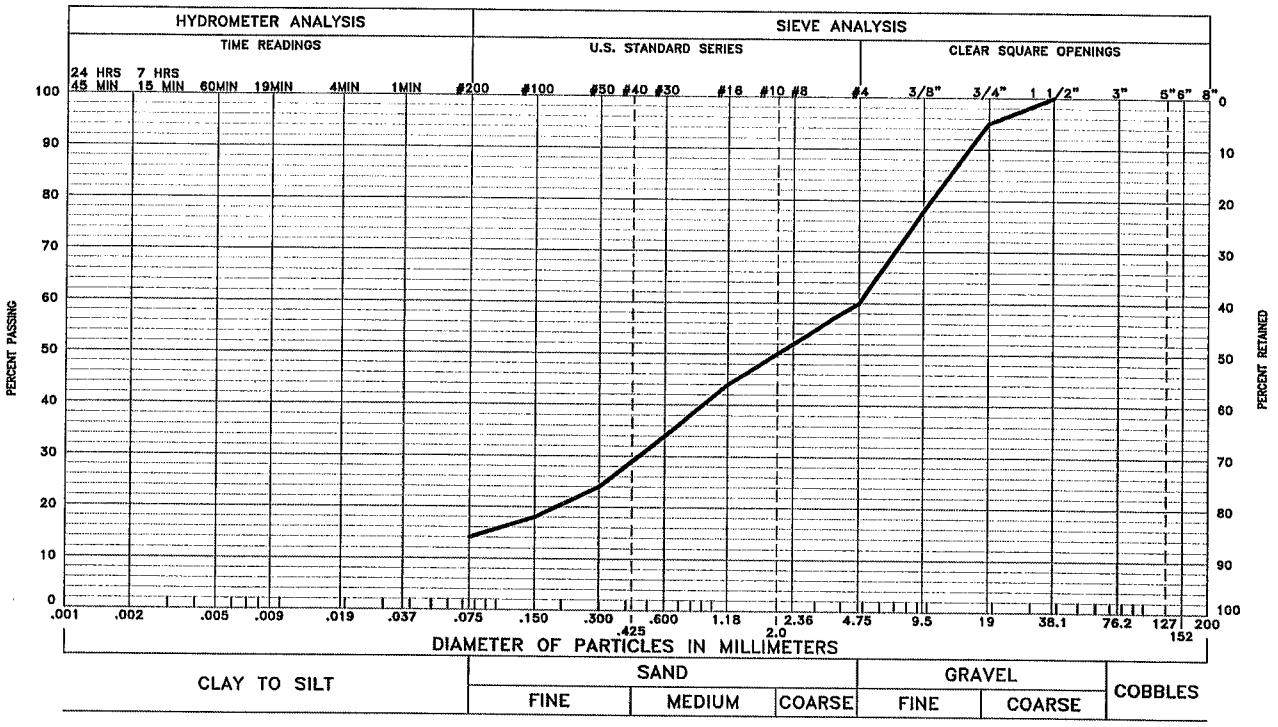
17 DEPTH TO WATER LEVEL AND NUMBER OF DAYS AFTER DRILLING MEASUREMENT WAS MADE.

→ DEPTH AT WHICH BORING CAVED AFTER DRILLING.

NOTES

1. THE EXPLORATORY BORING WAS DRILLED ON JUNE 2, 2020 WITH A 4-INCH DIAMETER CONTINUOUS FLIGHT POWER AUGER.
2. THE LOCATION OF THE EXPLORATORY BORING WAS MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.
3. THE ELEVATION OF THE EXPLORATORY BORING WAS INTERPOLATED FROM CONTOURS ON SITE PLAN.
4. THE EXPLORATORY BORING LOCATION AND ELEVATION SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOG REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
6. GROUNDWATER LEVEL SHOWN ON THE LOG WAS MEASURED AT THE TIME AND UNDER CONDITIONS INDICATED. FLUCTUATIONS IN THE WATER LEVEL MAY OCCUR WITH TIME.
7. LABORATORY TEST RESULTS:
   WC = WATER CONTENT (%) (ASTM D 2216);
   +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D 6913);
   -200 = PERCENTAGE PASSING NO. 200 SIEVE (ASTM D 1140).

20-6-140	Kumar & Associates	LOG OF EXPLORATORY BORING	Fig. 3



GRAVEL 40 % SAND 46 % SILT AND CLAY 14 %

SAMPLE OF: Silty Sand with Gravel FROM: Boring 1 @ 10'-15'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

20-6-140	Kumar & Associates	GRADATION TEST RESULTS	Fig. 4

June 23, 2020 - 06:56am
V:\Projects\2020\20-6-140 New Lift Station-Frisco Marina\Drafting\206140-04.dwg

Kumar & Associates

JOB NO: 20-6-140
JOB NAME: FRISCO BAY MARINA LIFT STATION

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY UNIT WEIGHT	GRADATION			ATTERBERG LIMITS		SWELL-COMPRESSION		HVEEM STABILOMETER (R-VALUE)	WATER SOLUBLE SULFATES	SOIL OR BEDROCK DESCRIPTION
BORING (#)	DEPTH (feet)	(%)	(pcf)	GRAVEL (%)	SAND (%)	SILT & CLAY (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SWELL (%)	SUR-CHARGE (psf)		(%)	
1	5	4.1				11							POORLY GRADED SILTY GRAVEL WITH SAND
	10	9.5				5							POORLY GRADED SILTY GRAVEL WITH SAND
	10-15			40	46	14							SILTY SAND WITH GRAVEL
	20					7							POORLY GRADED SILTY GRAVEL WITH SAND
	25					8							POORLTY GRADED SILTY GRAVEL WITH SAND

Kumar & Associates, Inc.
Geotechnical and Materials Engineers
and Environmental Scientists

ACEC
MEMBER

240 Annie Road | PO Drawer 1887
Silverthorne, Colorado 80498
Fax: (970) 468-5891
Phone: (970) 468-1989
Email: hpksummit@kumarusa.com

Office Locations: Denver (HQ), Colorado Springs, Fort Collins, Glenwood Springs Parker and Summit County, Colorado

GEOTECHNICAL ENGINEERING STUDY
PROPOSED MARINA BUILDING
FRISCO MARINA
MARINA ROAD
FRISCO, COLORADO

Prepared by:

James A. Parker, P.E., P.G.

COLORADO LICENSED
JAMES A. PARKER
47281
4/18/18
PROFESSIONAL ENGINEER

Reviewed by:

Daniel E. Hardin, P.E.

PREPARED FOR:

TOWN OF FRISCO
JEFF GOBLE – PUBLIC WORKS DIRECTOR
0102 SCHOOL ROAD
FRISCO, COLORADO 81443

jeffg@townoffrisco.com

Project No. 18-6-115

April 18, 2018

TABLE OF CONTENTS

SUMMARY

1. A representative of Kumar and Associates, Inc. observed two exploratory borings at the project site. Below a shallow depth of organic topsoil, subsoils consist of dense, poorly graded sand (SP) with gravel and poorly graded gravel (GP) with sand and cobbles to the full depth of exploration of 14 feet below the ground surface. The dense, granular soils are considered good for support of shallow foundations, floor slabs, flatwork and pavement areas.

2. Groundwater was encountered at a depth of 13 feet below the existing site grade in Boring 2. Groundwater depths may vary seasonally corresponding to the nearby Dillon Reservoir levels. Frozen ground can create a perched condition, especially during spring thaw conditions.

PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for a proposed marina building to be located at the existing Frisco Marina, Marina Road, Frisco, Colorado. The project site location is shown on Figure 1. The purpose of the study was to develop recommendations for the foundation design. The study was conducted in accordance with our proposal for geotechnical engineering services to the Town of Frisco, Proposal No. P6-18-123, dated March 15, 2018.

A field exploration program consisting of exploratory borings and a site reconnaissance was conducted to obtain information on the surface and subsurface conditions. Samples of the subsoils obtained during the field exploration were tested in the laboratory to determine their classification and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop recommendations for foundation types, depths and allowable pressures for the proposed structure foundations. This report summarizes the data obtained during this study and presents our conclusions, design recommendations and other geotechnical engineering considerations based on the proposed construction and the subsoil conditions encountered.

PROPOSED CONSTRUCTION

The project consists of the construction of a new marina building. Preliminary project information provided in an email from Matthew Stais Architects on March 14, 2018, indicates the building will be an approximate 3,000 square foot, two story, wood-frame building with a slab-on-grade lower-level. Grading for the marina building is assumed to be relatively minor with approximately 3 to 4 feet of fill planned within the building footprint to elevate the first floor above flood plain level, with a planned finish pad elevation of 9022.5 feet msl. Decks and a boat ramp will also be constructed and supported on concrete pier footings. We assume relatively light foundation loadings, typical of the proposed type of construction.

If construction plans are different than those described above, we should be notified to re-evaluate the recommendations presented in this report.

SITE CONDITIONS

The project site is located south of the boat jetty, between the turn-around at the end of Marina Road and Dillon Reservoir, as shown on Figure 1. The proposed building pad area is undeveloped, and currently used for boat dry-storage. A Conex type storage container was also present on the site at the time of our field exploration. The site topography is relatively level,

with a gentle slope down to the east toward Dillon Reservoir. At the time of our field exploration the project site had about 12 to 18 inches of snow cover.

FIELD EXPLORATION

The field exploration for the project was conducted on March 22, 2018. Two exploratory borings were drilled at the approximate locations shown on Figure 1, to evaluate the subsurface conditions. The borings were advanced with 4-inch diameter continuous flight augers powered by a truck-mounted CME-45 drill rig. The borings were logged by a representative of Kumar and Associates, Inc.

Samples of the subsoils were taken with a 1-3/8-inch I.D. spoon sampler. The sampler was driven into the subsoils at various depths with blows from a 140-pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D-1586. The penetration resistance values are an indication of the relative density of the subsoils. Depths at which the samples were taken, and the penetration resistance values are shown on the Logs of Exploratory Borings, Figure 2. The samples were returned to our laboratory for review by the project engineer and testing.

LABORATORY TESTING

Laboratory testing performed on samples obtained from the exploratory borings consisted of natural moisture content and percent passing the No. 200 sieve. The laboratory test results are shown on the Logs of Exploratory Borings, Figure 2, and summarized on Table 1.

SUBSURFACE CONDITIONS

Soil Types Encountered: Graphic logs of the subsurface conditions encountered at the site are shown on Figure 2. Below a shallow depth of organic topsoil, subsoils consist of medium dense, poorly graded sand (SP) with gravel and poorly graded gravel (GP) with sand to the full depth of exploration of 14 feet below the ground surface. Cobbles and possibly small boulders were abundant in the granular site soils, and practical refusal to auger drilling was encountered on cobbles or boulders in both borings at depths ranging from 1 to 14 feet below the existing site grade. The borings were moved multiple times after encountering shallow auger refusal in an attempt to drill to deeper depths.

Groundwater: Groundwater was encountered at a depth of 13 feet below the existing site grade in Boring 2 at the time of drilling. Groundwater depths may vary seasonally and with varying lake levels. Frozen ground can create a perched condition, especially during spring thaw conditions.

GEOTECHNICAL ENGINEERING CONSIDERATIONS

Subsurface data indicate that dense, granular, sand and gravel (SP and GP) soil will likely be the predominant soil types encountered within the building footprint. The anticipated native soils are considered good for shallow foundation support, and for support of structural fill, provided they are not excessively wet, and that the subgrade stability is verified prior to placement of structural fill or concrete for footings.

A grading and excavation plan was not available at the time of this report which details proposed site grading, cuts and fills. A civil engineer licensed in the State of Colorado should prepare a grading plan for the site. Once foundation plans and elevations have been established by the designer, we should re-evaluate our recommendations. Our recommendations contained in this report are contingent upon reviewing grading plans with finished floor elevations once they are complete.

SITE GRADING

The following recommendations should be followed for grading, site preparation, and fill compaction.

1. Where fill is to be placed, topsoil, loose, wet or otherwise unsuitable material should be removed prior to placement of new fill. The exposed soils should then be scarified to a depth of 6 inches, moisture conditioned and compacted to the minimum requirements of the overlying fill. Soils should be compacted with appropriate equipment for the lift thickness placed. Lift thickness should be no more than 8 inches compacted at the recommended moisture content and to the minimum required density.
2. Following scarification and compaction and prior to placement of structural fill, the subgrade should be proof-rolled with suitable heavy equipment, such as a full 4,000 gallon or larger water truck, or a medium to large loader with a full bucket. Any unstable subgrade areas should be remediated by removal of unstable, and/or wet material and replacement with properly compacted structural fill.
3. Permanent unretained cut and fill slopes should be graded at 2 horizontal to 1 vertical (2:1) or flatter and protected against erosion by revegetation or other means. The risk of slope instability will be increased if seepage is encountered in cuts and flatter slopes may be necessary. If seepage is encountered in permanent cuts, an investigation should be conducted to determine if the seepage will adversely affect the cut stability. This office should review site grading plans for the project prior to construction.
4. Slopes of 4:1 or steeper should be benched to provide a level surface for compaction.
5. All backfill should be processed so that it does not contain fragments larger than 6-inches in diameter and placed at the recommended moisture content.

6. The following compaction requirements should be used:

TYPE OF FILL PLACEMENT	MOISTURE CONTENT	SOIL TYPE - Compaction Percent (ASTM D698 – Standard Proctor)
Below Foundations	± 2% Optimum	Structural Fill – 100%
Foundation Wall Backfill	± 2% Optimum	Processed On-site or Structural Fill – 95%
Below Floor Slabs	± 2% Optimum	Structural Fill – 95%
Landscape Areas	± 2% Optimum	Processed On-site – 90%
Below Concrete Flatwork/Pavements	± 2% Optimum	Structural Fill – 95%
Utility Trenches	As they apply to the finished area	

Suitability of On-Site Soil

The on-site SP and GP soils are suitable as backfill after processing to remove all plus 6-inch material and moisture treatment. The on-site topsoil is not suitable for reuse except in the upper 6 to 12 inches of backfill in landscape areas.

Considerable processing may be necessary to reduce the on-site soil to fragments of minus 6-inches. Processing may include screening, rock raking and crushing. All on-site soil should be processed, moisture-conditioned and placed a the minimum required compaction.

Structural Fill

Structural fill used for support of the building should consist of the on-site processed soils or a relatively well-graded imported granular material with a liquid limit of 35 or less, a plasticity index of 10 or less, 5 to 25 percent material passing the No. 200 sieve, 60 percent or more passing the No. 4 sieve and no rocks larger than 6 inches. CDOT Class 1 structural backfill is acceptable as structural fill. Structural fill should be properly placed and compacted to reduce the risk of settlement and distress. Structural fills should be placed in accordance with the recommendations presented in the SITE GRADING section of this report.

Import Fill

The Geotechnical engineer should evaluate the suitability of any proposed import fill for its intended use.

Excavations

It is the responsibility of the Contractor to provide safe working conditions and to comply with the regulations in OSHA Standards, Excavations, 29CFS Part 1926. The onsite granular soils will classify as "Type C" in accordance with OSHA regulations. The regulations allow slopes of 1½ horizontal to 1 vertical (1½:1) for dry temporary excavations less than 20 feet deep.

The presence of water, seepage, fissuring, vibrations or surcharge loads will require temporary excavation to have flatter slopes. A Contractor's competent person should make decisions regarding cut slopes. A qualified Geotechnical engineer should observe any questionable slopes or conditions. Temporary shoring may be necessary.

FOUNDATIONS

Considering the subsoil conditions encountered in the exploratory borings and the nature of the proposed construction, we recommend the structure be founded with spread footings bearing on the undisturbed SP and GP soil, or properly compacted structural fill.

The design and construction criteria presented below should be observed for a spread footing foundation system.

1) Footings placed on the undisturbed natural granular soils or properly compacted structural fill should be designed for an allowable soil bearing pressure of 3,000 pounds per square foot (psf). Based on experience, we expect settlement of footings designed and constructed as discussed in this section will be about 1 inch or less. Concrete pier footings for decks and boat ramps should be designed with sufficient embedment depth to mitigate potential scour and undermining of the footings. Dewatering of footing excavations may be needed for footings excavated into native soils near the reservoir.
2) The footings should have a minimum width of 18 inches for continuous walls and 2 feet for isolated pads.
3) Exterior footings and footings beneath unheated areas should be provided with adequate soil cover above their bearing elevation for frost protection. Placement of foundations at least 40 inches below exterior grade is recommended for foundations bearing on the SP and GP soil, or properly compacted structural fill. Concrete should not be placed on frost, frozen soil, snow or ice.
4) Continuous foundation walls should be reinforced top and bottom to span local anomalies such as by assuming an unsupported length of at least 10 feet. Foundation walls acting as retaining structures should also be designed to resist lateral earth pressures as discussed in the "Foundation and Retaining Walls" section of this report.
5) Loose, wet or disturbed soils should be removed from footing excavations and the footing bearing level extended down to the relatively undisturbed granular soils or properly compacted structural fill.
6) The exposed soils in footing areas should then be moistened, if necessary, and compacted. If water seepage is encountered, the footing areas should be dewatered before concrete placement and we shall be contacted for further evaluation.

7) Structural fill used for support of the foundation should meet the requirements listed in the SITE GRADING section of this report.
8) A representative of the geotechnical engineer should observe all footing excavations prior to forming footings and concrete placement to evaluate bearing conditions.

FOUNDATION AND RETAINING WALLS

Foundation walls and retaining structures which are laterally supported and can be expected to undergo only a slight amount of deflection should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of at least 50 pounds per cubic foot (pcf) for backfill consisting of the on-site processed soils or suitable granular import. Cantilevered retaining structures which are separate from the foundation and can be expected to deflect sufficiently to mobilize the full active earth pressure condition should be designed for a lateral earth pressure computed on the basis of an equivalent fluid unit weight of at least 40 pcf for backfill consisting of the processed on-site soils or suitable granular import. The backfill should not contain rock larger than about 6 inches in diameter.

The lateral resistance of foundation or retaining wall footings will be a combination of the sliding resistance of the footing on the foundation materials and passive earth pressure against the side of the footing. Resistance to sliding at the bottoms of the footings can be calculated based on a coefficient of friction of 0.45. Passive pressure of compacted backfill against the sides of the footings can be calculated using an equivalent fluid unit weight of 350 pcf. The coefficient of friction and passive pressure values recommended above assume ultimate soil strength. Suitable factors of safety should be included in the design to limit the strain which will occur at the ultimate strength, particularly in the case of passive resistance. Fill placed against the sides of the footings to resist lateral loads should be a suitable granular material compacted to at least 95% of the maximum standard Proctor dry density at a moisture content near optimum.

All foundation and retaining structures should be designed for appropriate hydrostatic and surcharge pressures such as adjacent footings, traffic, construction materials and equipment. The pressures recommended above assume drained conditions behind the walls and a horizontal backfill surface. The buildup of water behind a wall or an upward sloping backfill surface will increase the lateral pressure imposed on a foundation wall or retaining structure. An underdrain should be provided to limit hydrostatic pressure buildup behind walls.

Backfill in patio, pavement, and walkway areas should be placed in uniform lifts and compacted to at least 95% of the maximum standard Proctor (ASTM D-698) dry density. Backfill placed in landscape areas should be compacted to at least 90% of the maximum standard Proctor dry

density at a moisture content near optimum. Care should be taken not to overcompact the backfill or use large equipment near the wall, since this could cause excessive lateral pressure on the wall. Some settlement of deep foundation wall backfill should be expected, even if the material is placed correctly, and could result in distress to facilities constructed on the backfill.

FLOOR SLABS

The natural on-site granular soil, or properly compacted structural fill, placed and compacted as noted in the SITE GRADING section of this report, are suitable to support lightly loaded slab-on-grade construction. To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The requirements for joint spacing and slab reinforcement should be established by the designer based on experience and the intended slab use.

We recommend vapor retarders conform to at least the minimum requirements of ASTM E1745 Class C material. Certain floor types are more sensitive to water vapor transmission than others. For floor slabs bearing on angular gravel or where flooring system sensitive to water vapor transmission are utilized, we recommend a vapor barrier be utilized conforming to the minimum requirements of ASTM E1745 Class A material. The vapor retarder should be installed in accordance with the manufacturers' recommendations and ASTM E1643.

UNDERDRAIN SYSTEM AND DAMP-PROOFING

Groundwater was encountered during our exploration at a depth of 13 feet below the existing site grade,, and is anticipated to occur at shallower depths during seasonal high reservoir levels. It has also been our experience in mountainous areas that groundwater levels can rise and that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. Frozen ground during spring runoff can create a perched condition. Due to site grade flood level constraints, we do not anticipate below grade construction for the marina building. We recommend that retaining walls be protected from wetting and hydrostatic pressure buildup by an underdrain.

The underdrain should consist of drainpipe placed in the bottom of the wall backfill surrounded above the invert level with free-draining gravel. The drain should be placed at each level of excavation and at least 12-inches below lowest adjacent finish grade and sloped at a minimum 1% to a suitable gravity outlet or sump and pump system. Free-draining gravel used in the underdrain system should contain less than 2% passing the No. 200 sieve, less than 50%

passing the No. 4 sieve and have a maximum size of 1-inch. The drain gravel backfill should be at least 1½ feet deep and protected by filter fabric. A typical drain detail is shown on Figure 4.

SURFACE DRAINAGE

The following drainage precautions should be observed during construction and maintained at all times after the building has been completed:

1) Inundation of the foundation excavations and underslab areas should be avoided during construction.
2) Backfill in pavement and slab areas should be compacted to at least 95% of the maximum standard Proctor dry density at a moisture content within 2% of optimum. Exterior backfill placed in landscape areas should be compacted to at least 90% of the maximum standard Proctor dry density at a moisture content near optimum.
3) The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 6 inches in the first 10 feet in unpaved areas and a minimum slope of 2½ inches in the first 10 feet in paved areas.
4) Roof downspouts and drains should discharge well beyond the limits of all backfill.
5) Landscaping which requires regular heavy irrigation should be located at least 5 feet from foundation walls. The upper 2 feet of foundation wall backfill should consist of relatively impervious cover soil.

CONTINUING SERVICES

Three additional elements of geotechnical engineering service are important to the successful completion of this project.

1) Consultation with design professionals during the design phases. This is important to ensure that the intentions of our recommendations are properly incorporated in the design, and that any changes in the design concept properly consider geotechnical aspects.
2) Grading Plan Review. A grading plan was not available for our review at the time of this report. A grading plan with finish floor elevations for the proposed construction should be prepared by a civil engineer licensed in the State of Colorado. Kumar and Associates, Inc. should be provided with grading plans once they are complete to confirm the recommendations contained in this report.
3) Observation and monitoring during construction. A representative of the Geotechnical engineer from our firm should observe the foundation excavation, earthwork, and foundation phases of the work to determine that subsurface conditions are compatible with those used in the analysis and design and our recommendations have been

properly implemented. Placement of backfill should be observed and tested to judge whether the proper placement conditions have been achieved.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings at the locations indicated on Figure 1, the proposed type of construction and our experience in the area. Our services do not include determining the presence, prevention or possibility of mold or other biological contaminants (MOBC) developing in the future. If the client is concerned about MOBC, then a professional in this special field of practice should be consulted. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory borings and variations in the subsurface conditions may not become evident until excavation is performed. If conditions encountered during construction appear different from those described in this report, we should be notified so that re-evaluation of the recommendations may be made.

This report has been prepared for the exclusive use by our client for design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation and field services during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. The recommendations contained in this report are contingent upon review of grading and excavation plans prepared by a civil engineer licensed in the State of Colorado. Review of grading plans may alter our recommendations. Significant design changes may require additional analysis or modifications to the recommendations presented herein.

Dewatering Memorandum

Date: March 12, 2021

Project: Frisco Marina Lift Station & Deep Utilities

Re: Dewatering Clarification for Prospective Bidders

Introduction

This memorandum has been compiled to provide clarification to the Frisco Marina Lift Station & Deep Utilities Plans and Specifications in the interest of economizing dewatering operations during construction of the aforementioned project.

Design Considerations

- The footprint of the valve vault has been economized as much as is feasible and positioned as close to lift station wet well as possible without restricting maintenance operations, see plans for reference.
- The valve vault is located approximately 5-1/2' from the proposed lift station in order to restrict the area of disturbance and thereby limit the amount of dewatering that will be required. The estimated limits of disturbance is shown on Sheet C-1, Erosion Control Plan and encompasses approximately 885 square feet.

Groundwater Level Data

- Kumar & Associates performed a geotechnical investigation for the construction of the proposed lift station in June of 2020 that included a geotechnical boring with a documented depth to groundwater of 10' on June 2, 2020, the day of drilling. The documented depth to groundwater on June 19, 2020 was 5-1/2'. The geotechnical report for this work is provided in the Supplemental Information of the Specifications.
- Kumar & Associates performed a geotechnical investigation for the proposed marina office buildings in March of 2018 that included a geotechnical boring with a documented depth to groundwater of 13' on March 22, 2018, the day of drilling. The geotechnical report for this work is provided in the Supplemental Information of the Specifications.

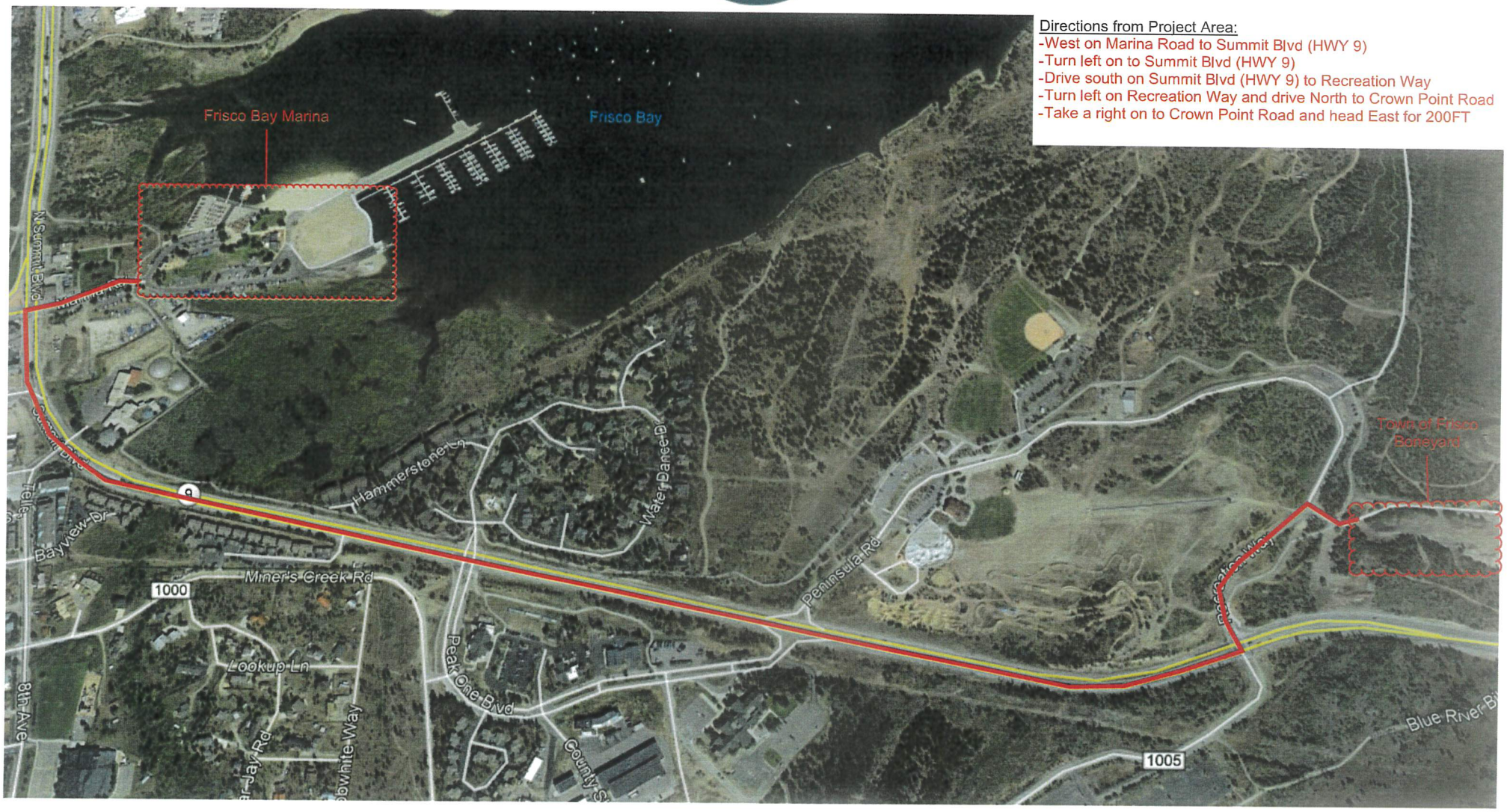
- Piezometers installed near the Marina have also been used to provide a depth to groundwater of 5 to 5-1/2 feet at the time of drilling in May 2020. These piezometers are identified in Sheet C-2, Drywell Plan.

Discharge

- A number of drywells are located throughout the Marina parking lot that drain to a perforated pipe bedded in large cobble to provide filtration for runoff prior to it entering the reservoir. These drywells have been proposed as a discharge point for dewatering to eliminate the need for weird tanks and other methods for settling sedimentation. Where the drywell dimensions are known, they are identified in Sheet C-2, Drywell Plan.

TOWN OF FRISCO
COLORADO

Directions from Project Area:
-West on Marina Road to Summit Blvd (HWY 9)
-Turn left on to Summit Blvd (HWY 9)
-Drive south on Summit Blvd (HWY 9) to Recreation Way
-Turn left on Recreation Way and drive North to Crown Point Road
-Take a right on to Crown Point Road and head East for 200FT



FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT H

NOTICE OF AWARD

NOTICE OF AWARD

Date: April 14, 2021

Josh Livermore
BT Construction, Inc.
9885 Emporia Street
Henderson, CO 80640
Josh.livermore@btconstruction.com

Re: FRISCO BAY MARINA LIFT STATION & DEEP UTILITIES PROJECT

Dear Mr. Livermore:

Thank you for submitting a bid for the Town of Frisco's Frisco Bay Marina Lift Station & Deep Utilities project.

Your firm has been selected as the successful Bidder, and accordingly, this letter is your Notice of Award for the contract amount of $846,125.00 for the above mentioned project.

Enclosed please find an original and duplicate original Construction Agreement. Please review and sign both, then within ten (10) days return both to me along with your Payment Bond and Performance Bonds, each in the full amount of the Contract Price, as well as your Certificate of Insurance in the amounts required by the Agreement. When dating these documents, make sure all dates on all documents are the same. Return all the documents at the same time, in the same envelope.

Upon receipt of the two (2) executed copies of the Construction Agreement, the Town will execute both, then one fully executed original will be returned to you.

Should you have any questions, please contact me at jeffg@townoffrisco.com.

Sincerely,

Jeff Goble
Director of Public Works
Town of Frisco, CO

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT I

NOTICE TO PROCEED

NOTICE TO PROCEED

Date:

_____
_____
_____

Re: _____

Dear _____:

This letter is your Notice to Proceed, effective as of the date of this letter. This notice is in reference to the Construction Agreement between you and the Town of Frisco concerning _____ _____.

Please note that the Work shall commence within ten (10) days from the date of this letter, and that the Work shall be substantially completed within _____ days from the date of this letter.

Should you have any questions, please call me at (____) ___-____.

Sincerely,

_____
Title:_____

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT J

PAYMENT BOND

PAYMENT BOND

Bond No._____

KNOW ALL MEN BY THESE PRESENTS: that

(Firm)_____

(Address)_____
(an Individual), (a Partnership), (a Corporation), hereinafter referred to as "the Principal", and

(Firm)_____

(Address)_____

hereinafter referred to as "the Surety", are held and firmly bond unto the Town of Frisco, Colorado, a municipal corporation, hereinafter referred to as "the Owner", in the amount of _____ Dollars in lawful money of the United States, whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, to the Owner to pay for labor, materials and equipment furnished for use in the performance of that Construction Agreement with the Owner, dated the ____ day of _____, 20___, for the performance of certain Work (the "Construction Contract"), which is by reference made a part hereof,

NOW, THEREFORE, if the Principal shall make payment to all persons, firms, subcontractors and corporations furnishing materials for or performing labor in the prosecution of the work provided for in the Construction Contract, and any authorized extension or modification thereof, including all amounts due for materials, lubricants, repairs on machinery, equipment and tools, consumed, rented or used in connection with the construction of such work, and all insurance premiums on said work, and for all labor performed in such work, whether by subcontractor or otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER,

1. That Surety shall have no obligation to Claimants under this Bond until:

1.1 Claimants who are employed by or have a direct contract with Contractor have given notice to Surety and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

1.2 Claimants who do not have a direct contract with Contractor:

1.2.1 Have furnished written notice to Contractor and sent a copy, or notice thereof to Owner, up to and including the date of final settlement under the Construction Contract, stating with substantial accuracy the amount of the claim and the name of the party to whom materials were furnished or supplied or for whom labor was done or performed; and

1.2.2 Have either received a rejection in whole or in part from Contractor, or not

received within 30 days of furnishing the above notice any communication from Contractor by which Contractor has indicated the claim will be paid directly or indirectly; and

1.2.3 Not having been paid within the above 30 days, have sent a written notice to Surety and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

2. If a notice required by Section 1 is given by Owner to Contractor or to Surety, that is sufficient compliance.

3. When a Claimant has satisfied the conditions of paragraph 1, Surety shall promptly and at Surety's expense take the following actions:

3.1 Send an answer to the Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

3.2 Pay or arrange for payment of any undisputed amounts.

4. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

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

6. Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

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

8. 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 Owner declares Contractor to be in default or within two years after Contractor ceased working or within two years after 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 period of limitation available to Sureties in the State of Colorado shall be applicable.

9. Any notice to the parties required under this Bond shall be in writing, delivered to the person designated below for the parties at the indicated address unless otherwise designated in writing. Only mailing by United States mail or hand-delivery shall be utilized. Facsimile and e-mail addresses may provided for convenience only.

OWNER: The Town of Frisco
Project Manager

P.O. Box 4100
Frisco, CO 80443

PRINCIPAL: _____
_____
_____
_____

SURETY: _____
_____
_____
_____

10. This Bond is to be governed by the laws of the State of Colorado.

11. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

12. Definitions.

12.1 Claimant: Any person, partnership, or corporation, or other entity that has furnished labor, materials, team hire, sustenance, provisions, provender, or other supplies used or consumed by Contractor or its Subcontractor in or about the performance of the Work under the Construction Contract, or that supplies laborers, rental machinery, tools, or equipment to the extent used in the prosecution of the Work, or architectural and engineering services required for performance of the Work of the Contractor and the Contractor's Subcontractors.

12.2 Default: Failure of the Contractor or Owner, as the case may be, that has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

IN WITNESS WHEREOF, this instrument is executed in five (5) counterparts, each one of which shall be deemed an original, this _____ day of _____, 20_____.

ATTEST:

By: _____

Title: _____

PRINCIPAL

By: _____

Title: _____

Address: _____

_____

(Corporate Seal)

SURETY

ATTEST:

Surety:_____

By: _____

By: _____

Attorney-in-Fact: _____

Title: _____

Address:_____

_____

(Surety Seal)

NOTE: Date of Bond must <u>not</u> be prior to date of the Construction Contract and Surety must be authorized to transact business in the State of Colorado and be acceptable to the Owner.

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT K

PERFORMANCE BOND

PERFORMANCE BOND

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS: that

(Firm)_____

(Address)_____
(an Individual), (a Partnership), (a Corporation), hereinafter referred to as "the Principal", and

(Firm)_____

(Address)_____

hereinafter referred to as "the Surety", are held and firmly bond unto the Town of Frisco, Colorado, a municipal corporation hereinafter referred to as "the Owner", in the amount of _____ Dollars in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION are such that whereas the Principal entered into a certain Construction Agreement with the Owner, dated the _____ day of _____, 20___, for the performance of certain Work (the "Construction Contract"), which is by reference made a part hereof,

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions and agreements of said Agreement during the original term thereof, and any extensions thereof which may be granted by the Owner, with or without Notice to the Surety and during the life of the guaranty period, and if shall satisfy all claims and demands incurred under such Agreement, and shall fully indemnify and save harmless the Owner from all cost and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, and then this obligation shall be void;

Otherwise the Principal and Surety shall have the following obligations:

1. If Owner is not in Default under the Construction Contract, Surety's obligation under this Bond shall arise after:

1.1 Owner has notified Principal and Surety at its address listed herein that Owner by seven days' written notice intends to terminate the services of Principal or otherwise declare Principal to be in default of its obligations under the Construction Contract; and

1.2 Owner has declared Principal to be in Default and formally terminated Principal's right to complete the Construction Contract; and

1.3 Owner has agreed to pay the Unpaid Balance of the Contract Price to Surety in accordance with the terms of the Construction Contract or to a Principal selected to perform the Construction Contract in accordance with the terms of the Construction Contract with Owner.

2. When Owner has satisfied the conditions of paragraph 1, Surety shall promptly and at Surety's expense take one of the following actions:

2.1 Arrange for Principal, with consent of the Owner, to perform and complete the Construction Contract; or

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

2.3 Obtain bids or negotiated proposals from qualified Principals acceptable to Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by Owner and the Principal selected with Owner's concurrence, to be secured with the performance and payment bonds executed by a qualified Surety equivalent to the Bonds issued on the Construction Contract, and pay to Owner the amount of damages as described in paragraph 4 in excess of the Unpaid Balance of the Contract Price incurred by Owner resulting from the Principal's Default; or

2.4 Waive its right to perform and complete, arrange for completion, or obtain a new Principal and with reasonable promptness under the circumstances, after investigation, determine the amount for which it is liable to Owner and, as soon as practicable after the amount is determined and approved by Owner, tender payment therefor to Owner.

3. If Surety does not proceed as provided in paragraph 2 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in subparagraph 2.4 and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice, Owner shall be entitled to enforce any remedy available to Owner.

4. After Owner has terminated Principal's right to complete the Construction Contract, and if Surety elects to act under subparagraph 2.1, 2.2, or 2.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Principal under the Construction Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment by Owner of the unpaid balance of the Contract Price and to mitigation of costs and damages on the Construction Contract, Surety is obligated without duplication for:

4.1 The responsibilities of Principal for correction of defective work and completion of the Construction Contract; and

4.2 Additional legal, design professional and delay costs resulting from

Principal's Default, and resulting from the actions or failure to act of Surety under paragraph 2; and

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

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

6. 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 Owner declares Principal to be in default or within two years after Principal ceased working or within two years after 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 period of limitation available to Sureties in the State of Colorado shall be applicable.

7. Any notice to the parties required under this Bond shall be in writing, delivered to the person designated below for the parties at the indicated address unless otherwise designated in writing. Only mailing by United States mail or hand-delivery shall be utilized. Facsimile and e-mail addresses may be provided for convenience only.

OWNER: The Town of Frisco
Project Manager:
P.O. Box 4100
Frisco, CO 80443

PRINCIPAL: _____
_____
_____
_____

SURETY: _____
_____
_____
_____

8. This Bond is to be governed by the laws of the State of Colorado.

9. Definitions.

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

proper payments made to or on behalf of Principal under the Construction Contract.

9.2 Default: Failure of the Principal or Owner, as the case may be, that has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Construction Contract.

IN WITNESS WHEREOF, this instrument is executed in five (5) counterparts, each one of which shall be deemed an original, this _____ day of _____, 20____.

PRINCIPAL

ATTEST:

By: _____

By: _____

Title: _____

Title: _____

Address: _____

_____

(Corporate Seal)

SURETY

ATTEST:

Surety: _____

By: _____

By: _____

Attorney-in-Fact: _____

Title: _____

Address: _____

_____

(Surety Seal)

NOTE: Date of Bond must <u>not</u> be prior to date of Construction Contract and Surety must be authorized to transact business in the State of Colorado and be acceptable to the Owner.

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT L

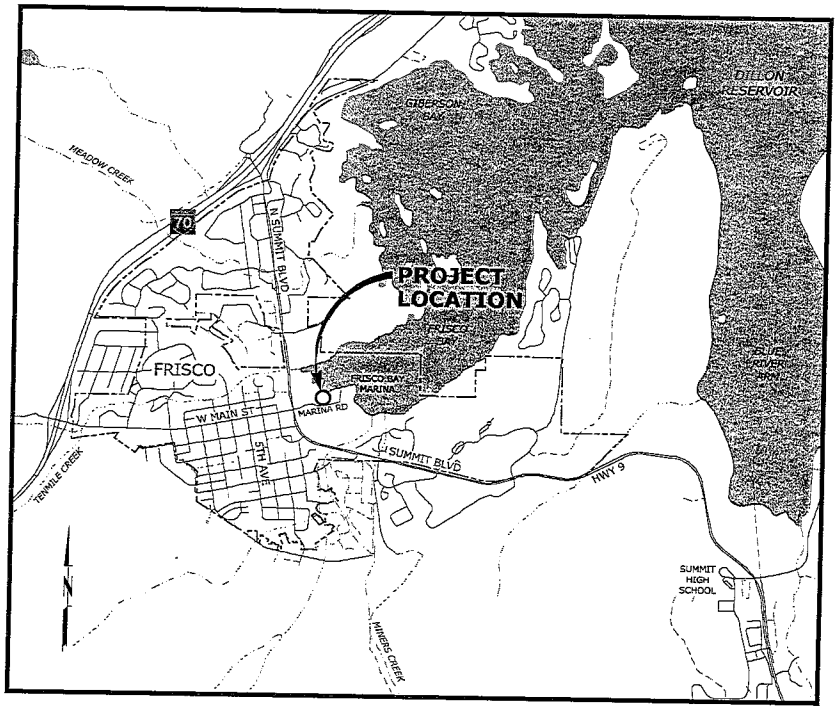
CONSTRUCTION DRAWINGS

TOWN OF FRISCO, COLORADO
FRISCO MARINA LIFT STATION

MARCH 2021

PRICING SET

LIFT STATION - INDEX OF DRAWINGS



VICINITY MAP
SCALE: 1"=1,500'

murraysmith
1157 W CENTURY DRIVE, #220
LOUISVILLE, CO 80027
P 970.567.8020

811 Know what's below. Call before you dig.

20-2802

I:\BOL_Projects\20\2802 - Frisco Marina Lift Station\CAD\Sheets\20-2802-ID-G.dwg G-1 3/10/2021 11:27 PM ADRIENNE.ANGELOS 23.0s (LMS Tech)

PIPE & FITTING SYMBOLS

PLANT | SCHEMATIC

- WELDED JOINT
- FLANGED JOINT
- GROOVED END JOINT
- MECHANICAL JOINT
- PUSH-ON JOINT (RUBBER GASKET)
- FLANGED COUPLING ADAPTER
- DOUBLE BALL FLEXIBLE EXTENSION COUPLING
- FLEXIBLE COUPLING W/ THRUST RING
- 90° BEND UP
- 90° BEND DOWN
- TEE UP
- TEE DOWN
- LATERAL UP
- LATERAL DOWN
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- UNION
- BLIND FLANGE
- CAP
- LONG SLEEVE
- FLEXIBLE COUPLING
- FITTING (45°)

VALVE SYMBOLS

PLANT | SCHEMATIC

- BUTTERFLY VALVE
- GATE VALVE
- GLOBE VALVE
- BALL VALVE
- BALANCING VALVE
- PLUG VALVE (TOP)
- PLUG VALVE (SIDE)
- 3-WAY PLUG VALVE
- CHECK VALVE
- SWING CHECK VALVE
- DOUBLE CHECK ASSEMBLY
- BALL SWING CHECK
- SILENT CHECK VALVE
- PRESSURE REDUCING VALVE
- ALTITUDE CONTROL VALVE
- SOLENOID VALVE
- RELIEF VALVE
- NEEDLE VALVE
- HOSE VALVE
- REDUCED PRESSURE BACKFLOW PREVENTER W/ GATE VALVES
- HOSE BIBB

TOPOGRAPHIC LEGEND

	EXISTING	PROPOSED
WATERLINE	10"W	12"DI W
ELECTRICITY	E	E
GAS	4"G	4"G
TELEPHONE/TELEMETRY	T	T
CABLE TELEVISION	CATV	CATV
SANITARY SEWER LINE	8"SS	8"SS
SANITARY SEWER FORCE MAIN	6"FM	6"FM
STORM DRAIN	8"SD	8"SD
CULVERT		18"D
ABANDON PIPE		
DRAINAGE DITCH		
BARBWIRE FENCE		
CHAIN LINK FENCE		
TEMPORARY SILT FENCE		
GUARDRAIL		
ROCK WALL		
TREE/BUSH LINE		
CENTERLINE		
EASEMENT/PROPERTY LINE		
RIGHT-OF-WAY		
EDGE OF PAVEMENT/AC		
EDGE OF GRAVEL		
CURB		
SIDEWALK	S/W	
STRUCTURE OR FACILITY		
CONTOUR MINOR		
CONTOUR MAJOR	200	200
MANHOLE		
CLEAN-OUT		
CATCH BASIN/FIELD INLET		
THRUST BLOCK		
VALVE		
AIR INJECTION ASSEMBLY		
BLOW-OFF ASSEMBLY		
AIR RELEASE ASSEMBLY		
FIRE HYDRANT ASSEMBLY		
WATER METER		
PULL BOX/JUNCTION BOX		
UTILITY POLE		
GUY WIRE		
LIGHT POST		
MAILBOX		
SIGN		
BENCHMARK/GEOTECH TEST HOLE		
TREE DECIDUOUS		
TREE CONIFEROUS		
TREE TO BE REMOVED		
SURFACE ELEVATION	+ 176.63	+ 176.63

SECTION AND DETAIL DESIGNATIONS

SECTION DESIGNATIONS

A / 2 — SECTION LETTER DESIGNATION; SHEET WHERE SECTION IS SHOWN *

SECTION — SCALE: — A / 2 — SECTION LETTER DESIGNATION; SHEET FROM WHICH SECTION IS TAKEN *

DETAIL DESIGNATIONS

DETAIL — SCALE: — 2 / 2 — DETAIL NUMBER; SHEET FROM WHICH DETAIL IS TAKEN *

* NOTE: IF PLAN AND SECTION FOR DETAIL CALL-OUT AND DETAIL ARE SHOWN ON THE SAME DRAWING, DRAWING NUMBER IS REPLACED WITH A DASH.

MISCELLANEOUS PIPING SYMBOLS

- STRAINER
- SIGHT GLASS
- PRESSURE GAUGE W/ COCK
- PRESSURE SWITCH W/ COCK
- M — METER
- SP — SLIP-ON JOINT PIPE
- R — RESTRAINED JOINT PIPE

PRICING SET

NO.	DATE	BY	REVISION

NOTICE: 0 ½ 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

AMA DESIGNED | AMA DRAWN | JSP CHECKED

MARCH 2021

Murraysmith

TOWN OF FRISCO

FRISCO MARINA LIFT STATION

LEGEND

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2 G-2

GENERAL NOTES:

1. THE CONTRACTOR SHALL POTHOLE AND VERIFY LOCATIONS, ELEVATIONS, TYPES AND SIZES OF ALL EXISTING UTILITIES PRIOR TO CONSTRUCTING NEW PIPING FAR ENOUGH IN ADVANCE TO ALLOW NECESSARY ADJUSTMENTS IN GRADE AND SHALL NOTIFY ENGINEER OF NEED TO ADJUST PIPING INSTALLATION ACCORDINGLY. POTHOLING SHALL SUFFICIENTLY PRECEDE LAYING OF PIPE TO ALLOW REQUIRED ELEVATION ADJUSTMENTS TO BE ACCOMPLISHED WITHOUT REWORK. ELEVATION ADJUSTMENTS SHALL BE EXPECTED AND ARE INCIDENTAL TO THE WORK. DEFLECT PIPE AS REQUIRED AND WITHIN SPECIFIED TOLERANCES TO AVOID EXISTING UTILITIES AND COMPLETE TIE-INS.

2. LOCATIONS OF EXISTING UTILITIES ARE BASED ON INFORMATION SUPPLIED BY THE UTILITIES AND CONSIDERED APPROXIMATE ONLY. AS REQUIRED BY STATE LAW, THE CONTRACTOR SHALL OBTAIN UTILITY LOCATES PRIOR TO COMMENCING CONSTRUCTION.

3. CONTRACTOR SHALL PROVIDE ENGINEER WITH MINIMUM 24 HOURS NOTICE WHEN POTHOLING WILL BE COMPLETE. COORDINATE WITH ENGINEER TO REVIEW UTILITY INVESTIGATIONS AND TO MAKE APPROPRIATE ADJUSTMENTS FOR ANY ALIGNMENT CONFLICTS WHERE CONNECTING TO EXISTING UTILITIES.

4. COLORADO LAW REQUIRES THE CONTRACTOR TO FOLLOW THE RULES ADOPTED BY THE COLORADO UTILITY NOTIFICATION CENTER. THOSE RULES ARE SET FORTH IN C.R.S. 9-1.5-101 THROUGH C.R.S. 9-1.5-108. THE CONTRACTOR MAY OBTAIN COPIES OF THE RULES BY CALLING THE UTILITY NOTIFICATION CENTER AT 303-232-1991.

5. PROVIDE "AS CONSTRUCTED" DRAWINGS INDICATING ALL CHANGES IN GRADE, ALIGNMENT, FITTINGS AND MATERIALS INSTALLED AND ANY OTHER UTILITIES OR OBSTACLES NOT SO INDICATED ON THESE PLANS.

6. CONTRACTOR SHALL PROTECT ALL PROPERTY CORNERS, SURVEY MONUMENTS AND CONTROL SURVEY MONUMENTS, ANY DISTURBED DURING CONSTRUCTION SHALL BE REPLACED AT CONTRACTOR'S EXPENSE, WITH APPROPRIATE SURVEY FILED WITH COUNTY SURVEYOR.

7. CONTRACTOR SHALL SUPPORT AND PROTECT AS NECESSARY ANY PIPE OR CONDUIT EXPOSED AS PART OF THE CONSTRUCTION. CONTRACTOR SHALL MAINTAIN ALL EXISTING UTILITIES IN SERVICE AT ALL TIMES AND SHALL COORDINATE WITH RESPECTIVE UTILITY COMPANIES TO MAINTAIN AND PROTECT SERVICES.

8. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING ANY GROUNDWATER ENCOUNTERED DURING THE CONSTRUCTION OF ANY PORTION OF THIS PROJECT. GROUNDWATER SHALL BE PUMPED, PIPED, REMOVED, AND DISPOSED OF IN A MANNER WHICH DOES NOT CAUSE FLOODING NOR EROSION OF ADJACENT PROPERTY IN ORDER TO CONSTRUCT THE IMPROVEMENTS SHOWN ON THESE PLANS. THE CONTRACTOR IS RESPONSIBLE FOR OBTAINING AND COMPLYING WITH ALL APPLICABLE PERMITS FOR GROUNDWATER DISCHARGE.

9. CONTRACTOR SHALL DISPOSE OF ALL REMOVED OR REPLACED MATERIAL AND EQUIPMENT IN ACCORDANCE WITH ALL APPLICABLE REGULATIONS.

10. CONTRACTOR TO LEAVE ALL AREAS OF PROJECT FREE OF DEBRIS AND UNUSED CONSTRUCTION MATERIAL.

TOPOGRAPHIC SURVEY NOTES:

1. SURVEY WAS COMPLETED BY SCHMIDT LAND SURVEYING, INC. ELEVATIONS ARE BASED ON DENVER WATER DEPARTMENT DATUM WHICH IS HIGHER BY 1.85' THAN U.S.G.S. SEA LEVEL DATUM (1929). CONTROL ELEVATIONS WERE HELD FROM RANGE WEST SURVEYOR'S ORIGINAL TOPOGRAPHY DONE OCTOBER 2012. HORIZONTAL COORDINATES ARE NAD 1983 DATUM.

2. UTILITY INFORMATION SHOWN HEREON IS COMPILED FROM FIELD OBSERVED SURFACE FEATURES, AND FIELD LOCATED PAINT MARK "LOCATES" PERFORMED BY OTHERS. SURVEYOR MAKES NO GUARANTEE THAT UTILITIES SHOWN HEREON COMPRISE ALL POSSIBLE UTILITIES IN THE AREA NOR WARRANTS THAT UTILITIES ARE IN THE EXACT LOCATIONS INDICATED.

3. TOPOGRAPHIC SURVEY INFORMATION IS PROVIDED ONLY. NO BOUNDARY, RIGHT OF WAY OR PARCEL LINE INFORMATION ARE INDICATED.

4. THIS TOPOGRAPHIC SURVEY WAS PERFORMED WITHOUT THE BENEFIT OF A CURRENT TITLE REPORT, AND THEREFORE DOES NOT PURPORT TO SHOW ALL EASEMENTS, ENCUMBRANCES, OR RESTRICTIONS OF RECORD, IF ANY.

5. CONTACT SURVEYOR FOR BASIS OF BEARING.

PROJECT CONTACTS:

OWNER:
TOWN OF FRISCO, DEPT OF PUBLIC WORKS
P.O. BOX 4100 | FRISCO, CO 80443
CONTACT: JEFF GOBLE, CWP
E: JEFFG@TOWNOFFRISCO.COM
P: 970-668-9151

CIVIL ENGINEER:
MURRAYSMITH
1157 W CENTURY DRIVE, #220
LOUISVILLE, CO 80027
CONTACT: JOEL PRICE, PE
E: JOEL.PRICE@MURRAYSMITH.US
P: 970-567-8020

SURVEYOR:
SCHMIDT LAND SURVEYING, INC.
P.O. BOX 5761
FRISCO, CO 80443
CONTACT: ELIZABETH SCHMIDT, PLS
E: LIZ@SCHMIDTLANDSURVEYING.COM
P: 970-409-9963

ELECTRICAL ENGINEER:
BROWNS HILL ENGINEERING & CONTROLS
8119 SHAFFER PARKWAY, UNIT C
LITTLETON, CO 80127
CONTACT: TED WILLE
E: TWILLE@MBROWNSHILLENG.COM
P: 720-344-7771

GEOTECHNICAL ENGINEER:
KUMAR & ASSOCIATES, INC.
240 ANNIE ROAD
SILVERTHORNE, CO 80498
CONTACT: JAMES PARKER, PE PG
E: JPARKER@KUMARUSA.COM
P: 970-230-1016

PRIVATE UTILITIES:
XCEL ENERGY
P.O. BOX 1819
SILVERTHORNE, CO 80498
CONTACT: AMY LAGACE
E: AMY.LAGACE@SCELENERGY.COM
P: 970-262-4033

EROSION CONTROL NOTES:

1. CONTRACTOR SHALL PREPARE, SUBMIT, AND ACQUIRE AN COLORADO DEPARTMENT OF PUBLIC HEALTH AND THE ENVIRONMENT (CPDHE) EROSION CONTROL PLAN AND PERMIT PRIOR TO BEGINNING ANY SITE DISTURBING ACTIVITY. IF DISTURBING GREATER THAN ONE ACRE OF LAND AS PART OF THIS PROJECT, CONTRACTOR SHALL PROVIDE PAYMENT FOR ALL PERMIT FEES.

2. CONTRACTOR SHALL INSTALL AND MAINTAIN EROSION/SEDIMENTATION CONTROL DURING CONSTRUCTION (ANY TIME OF YEAR) IN ACCORDANCE WITH THE CDPHE EROSION PREVENTION AND SEDIMENT CONTROL REQUIREMENTS, THE STANDARD CONSTRUCTION SPECIFICATIONS FOR THIS PROJECT AND THE EROSION CONTROL NOTES INCLUDED BELOW AND WITHIN THESE PLANS. IF DISCREPANCIES BETWEEN STANDARDS OCCUR, THE MORE STRINGENT REGULATION SHALL APPLY.

3. APPROVAL OF THIS EROSION SEDIMENTATION CONTROL (ESC) PLAN DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G.: SIZE AND LOCATION OF ROADS, PIPES, RESTRICTIONS, CHANNELS, RETENTION FACILITIES, UTILITIES, ETC.).

4. THE IMPLEMENTATION OF EROSION/SEDIMENTATION CONTROL (ESC) PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.

5. THE BOUNDARIES OF THE LIMITS OF WORK SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED LIMITS OF WORK SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.

6. ESC FACILITIES MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAINAGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.

7. THE ESC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONALITY.

8. THE ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN 24 HOURS FOLLOWING A STORM EVENT.

9. STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO ENSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.

10. CONTRACTOR SHALL PROVIDE DUST CONTROL AS REQUIRED.

11. SEEDING SHALL BE PERFORMED NO LATER THAN SEPTEMBER 1 FOR EACH PHASE OF CONSTRUCTION. ROUGHEN AND SEED ALL DISTURBED SURFACES OUTSIDE OF CRUSHED ROCK SURFACING TOP DRESSING.

12. ESC MEASURES SHALL BE REMOVED BY THE CONTRACTOR WHEN VEGETATION IS FULLY ESTABLISHED.

13. CONTRACTOR SHALL PROVIDE AND MAINTAIN A CONCRETE WASHOUT FACILITY.

GEOTECHNICAL NOTES:

1. THE EXPLORATORY BORING WAS DRILLED ON JUNE 2, 2020 WITH A 4-INCH DIAMETER CONTINUOUS FLIGHT POWER AUGER.

2. THE LOCATION OF THE EXPLORATORY BORING WAS MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.

3. THE ELEVATION OF THE EXPLORATORY BORING WAS INTERPOLATED FROM CONTOURS ON THE SITE PLAN.

4. THE ELEVATION OF THE EXPLORATORY BORING LOCATION AND ELEVATION SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOG REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.

6. GROUNDWATER LEVEL SHOWN ON THE LOG WAS MEASURED AT THE TIME AND UNDER CONDITIONS INDICATED. FLUCTUATIONS IN THE WATER LEVEL MAY OCCUR WITH TIME.

7. LABORATORY TEST RESULTS:
WC = WATER CONTENT (%) (ASTM D 2216);
+4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D 6913);
-200 = PERCENTAGE PASSING NO. 200 SIEVE (ASTM D 1140)

PRICING SET

NO.	DATE	BY	REVISION

NOTICE
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

AMA DESIGNED
AMA DRAWN
JSP CHECKED

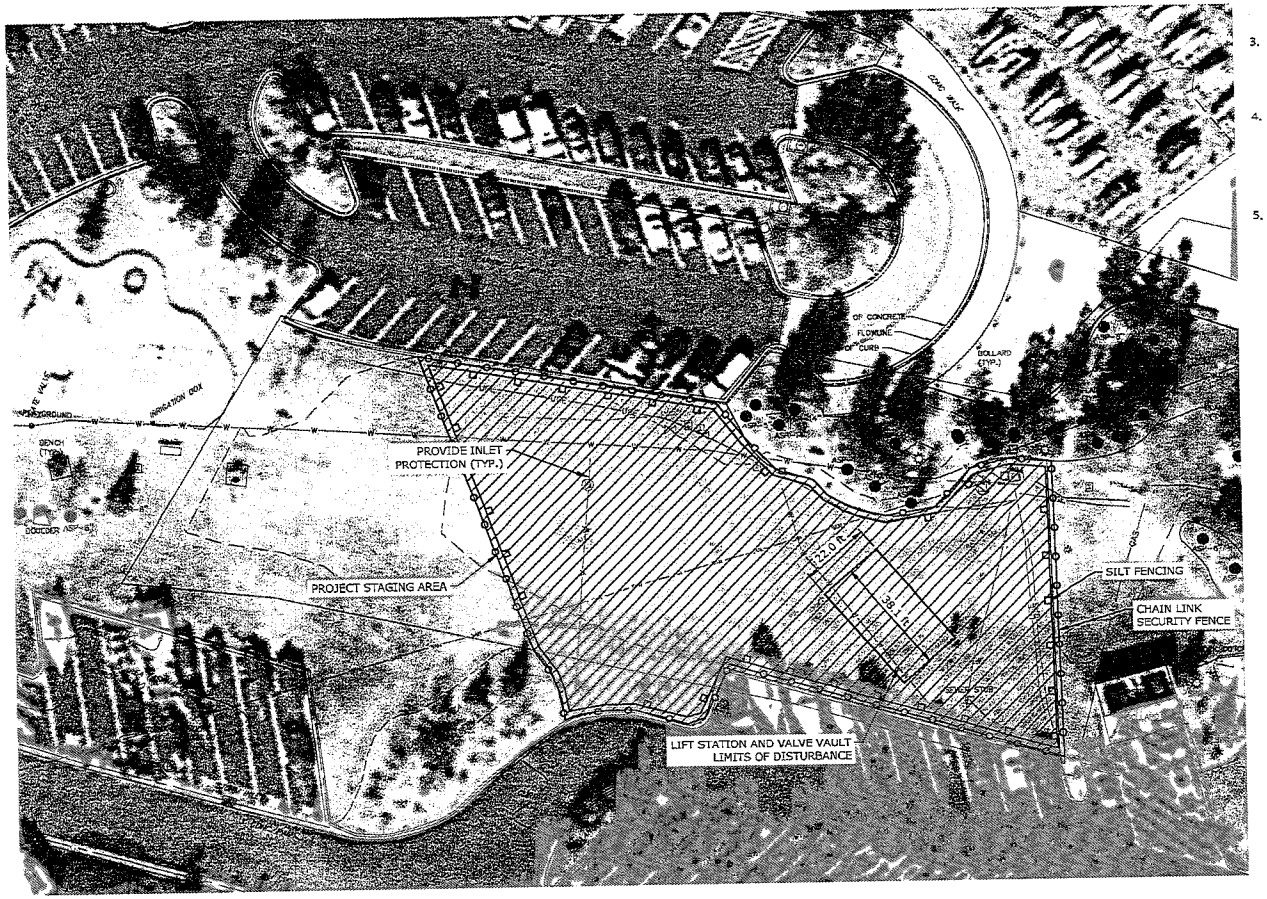
MARCH 2021
Murraysmith

FRISCO MARINA LIFT STATION

GENERAL AND EROSION CONTROL NOTES

SHEET 2 G-3

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021



CONSTRUCTION NOTES:

1. PROTECT EXISTING SITE FEATURES, INCLUDING BUT NOT LIMITED TO CURB AND GUTTER, TRANSFORMER, FIRE HYDRANT, TREES AND LANDSCAPE FEATURES.
2. EACH STORM SEWER INLET IN OR IMMEDIATELY ADJACENT TO THE PROJECT DISTURBANCE LIMITS WILL HAVE A TEMPORARY INLET SEDIMENT TRAP CONSTRUCTED AROUND IT. IN PAVED AREAS, THIS TRAP CONSISTS OF WIRE MESH SOCKS TO FILTER RUNOFF AND ALLOW SILT TO SETTLE OUT.
3. SILT FENCING AND SEDIMENT CONTROL LOGS SHALL BE CONSTRUCTED ALONG THE DOWNHILL EDGE OF THE PROJECT DISTURBANCE LIMITS AND AT ALL POINT DISCHARGE AREAS WHETHER SHOWN OR NOT. SILT FENCE AND SEDIMENT CONTROL LOGS SHALL BE MAINTAINED AS NEEDED THROUGHOUT THE CONSTRUCTION PROCESS. THE TEMPORARY SILT FENCE AND SEDIMENT CONTROL LOGS WILL REMAIN UNTIL THE DISTURBED AREA HAS BEEN RESTORED AND GROUND COVER IS EFFECTIVE.
4. CONTRACTOR SHALL STORE CONSTRUCTION MATERIALS AND EQUIPMENT IN CONFINED AREAS ON SITE FROM WHICH RUNOFF WILL BE CONTAINED AND FILTERED. MATERIALS WILL BE STORED OFF THE GROUND AND PROTECTED FROM THE WEATHER BY A COVER OR STORED IN A CONTAINER SUCH AS A VAN OR TRAILER. AN EARTHEN DIKE WILL BE CONSTRUCTED AROUND THE PERIMETER OF THE FUEL STORAGE AREA TO PREVENT MATERIALS FROM CONTACT WITH SURFACE RUNOFF. EQUIPMENT MAINTENANCE WILL BE PERFORMED IN A DESIGNATED AREA AND STANDARD MAINTENANCE PROCEDURES, SUCH AS THE USE OF DRIP PANS, WILL BE USED TO CONTAIN PETROLEUM PRODUCTS.
5. EROSION CONTROL MEASURES WILL BE INSPECTED DAILY DURING CONSTRUCTION BY THE CONTRACTOR AND AFTER EACH RAIN EVENT. ALL INSPECTIONS SHALL BE DOCUMENTED AND SHALL INCLUDE THE DATE OF INSPECTION, ANY INCIDENCES OF NON-COMPLIANCE, SIGNED CERTIFICATION THAT THE SITE IS IN COMPLIANCE, AND ANY NOTES, DRAWINGS, MAPS, ETC. PERTAINING TO REPAIRS. COPIES OF ALL DOCUMENTATION SHALL BE DISTRIBUTED TO THE OWNER ON A REGULAR SCHEDULE AS SPECIFIED BY THE OWNER.

N

20 10 0 20 40
SCALE IN FEET

PRICING SET

NO.	DATE	BY	REVISION

NOTICE
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EROSION CONTROL PLAN

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2 C-1

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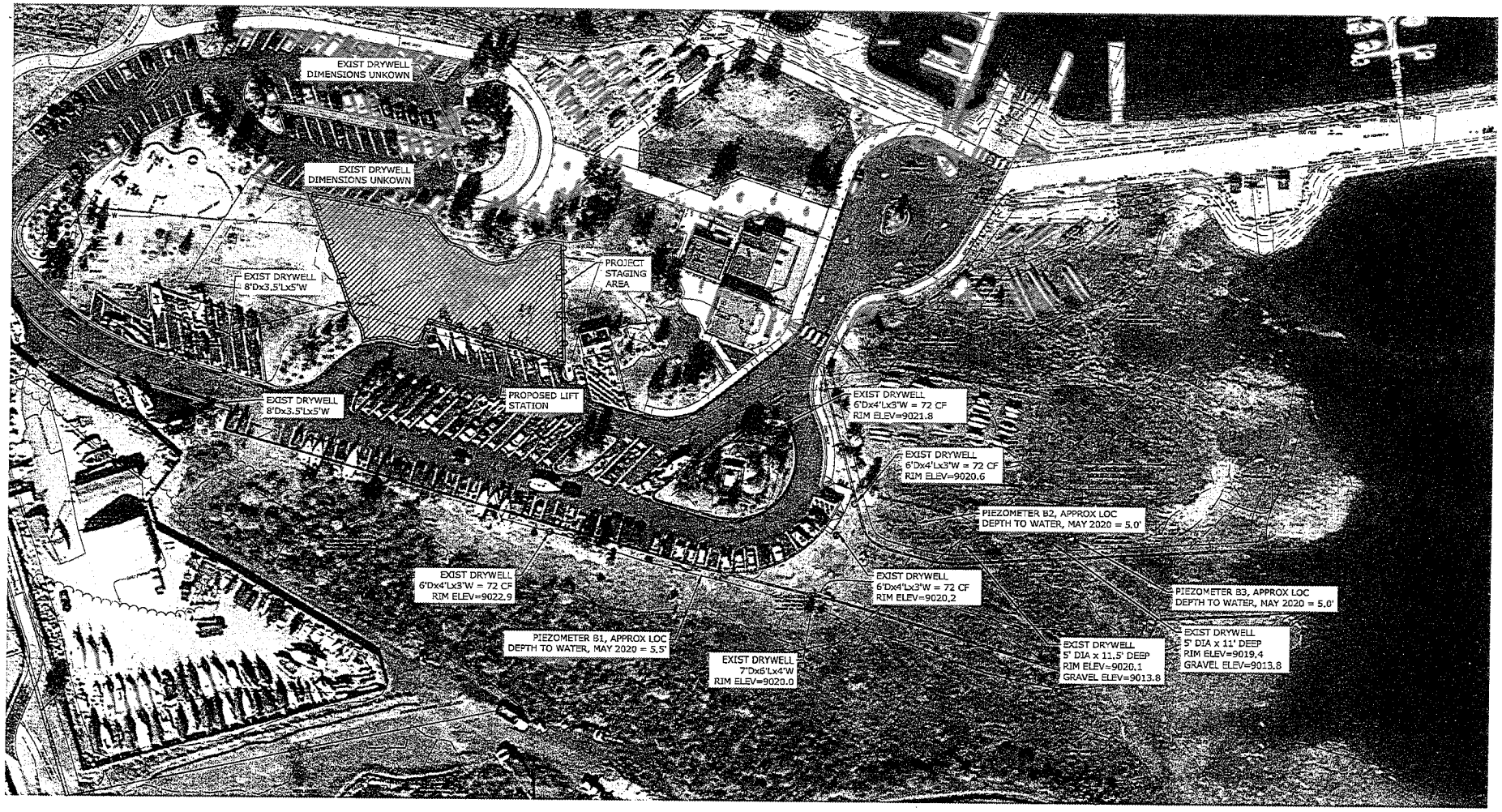

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EXISTING DRYWELL PLAN

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SHEET 2 C-2

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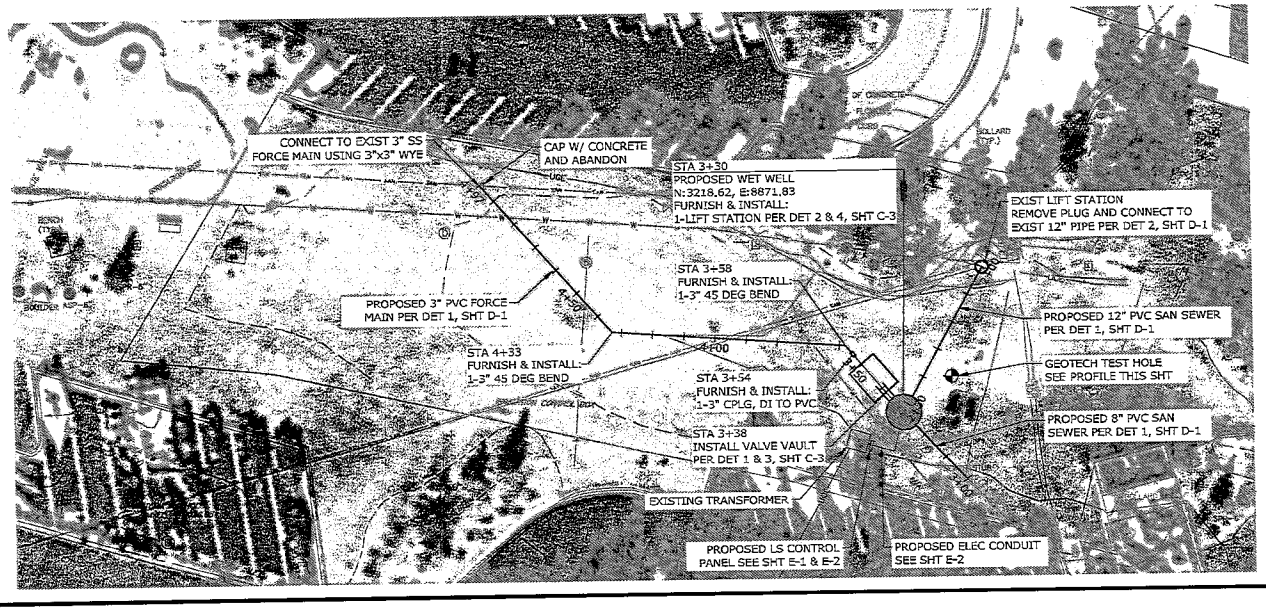

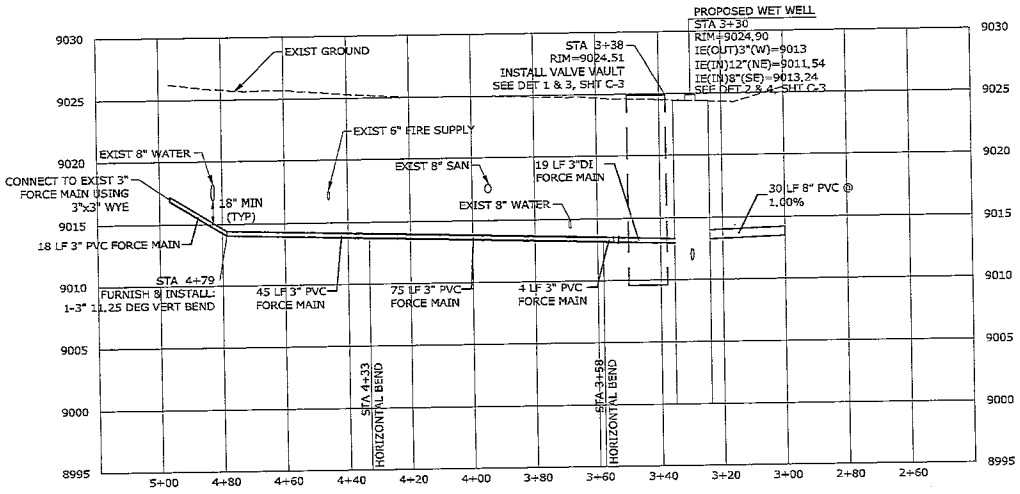

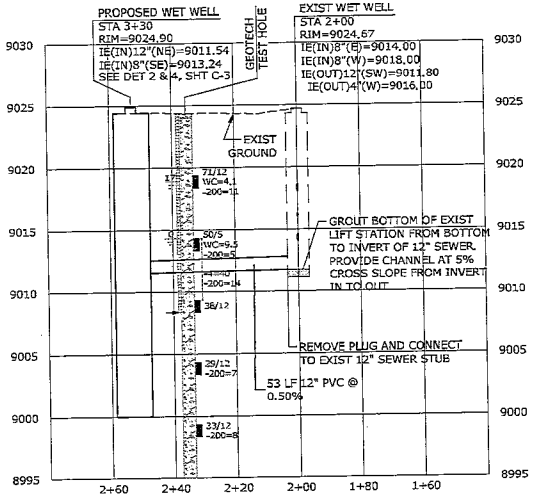

GEOTECHNICAL LEGEND

WORK PERFORMED ON JUNE 2, 2020

- TOPSOIL; SILT, SAND AND GRAVEL, WITH ORGANICS, (GRASS SOD), MOIST, BROWN
- POORLY GRADED SILTY GRAVEL (GP-GM); WITH SAND, COBBLES AND SCATTERED BOULDERS, MEDIUM DENSE TO DENSE, MOIST TO WET, BROWN
- DRIVE SAMPLE, 1 3/8-INCH ID SPLIT SPOON STANDARD PENETRATION TEST
- DISTURBED BULK SAMPLE
- SLOTTED PVC PIPE, PLACED IN UPPER 16' OUT TO CAVED BORING
- 71/12 — DRIVE SAMPLE BLOW COUNT, INDICATES THAT 71 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES
- 17 — DEPTH TO WATER LEVEL AND NUMBER OF DAYS AFTER DRILLING MEASUREMENT WAS MADE
- DEPTH AT WHICH BORING CAVED AFTER DRILLING

PRICING SET

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LIFT STATION PLAN & PROFILE

SHEET 2 C-3

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

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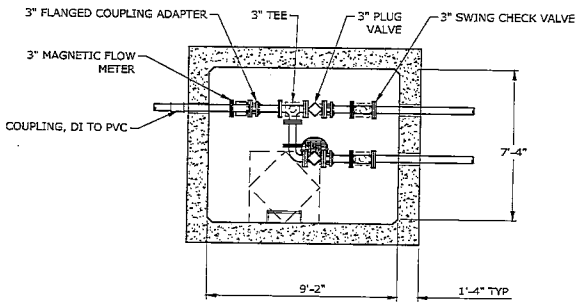
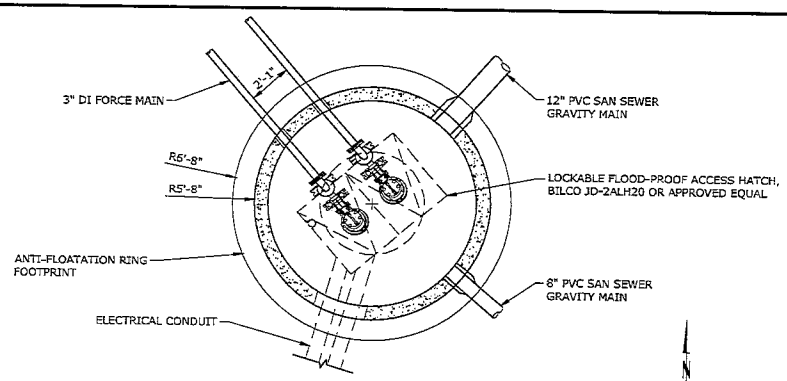
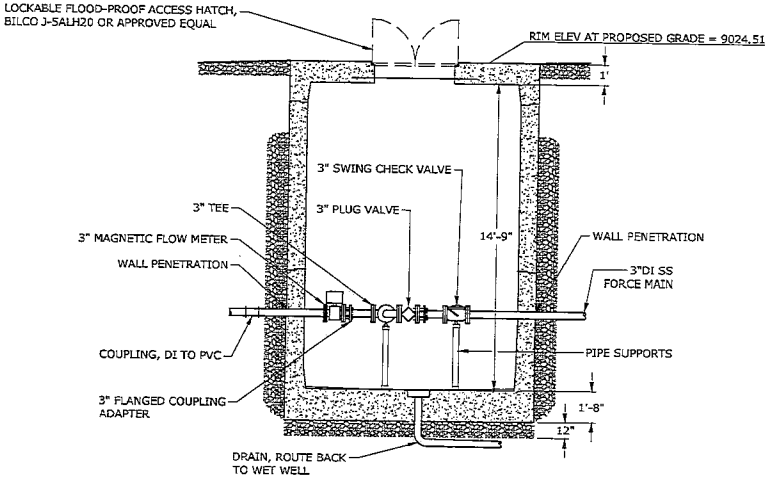


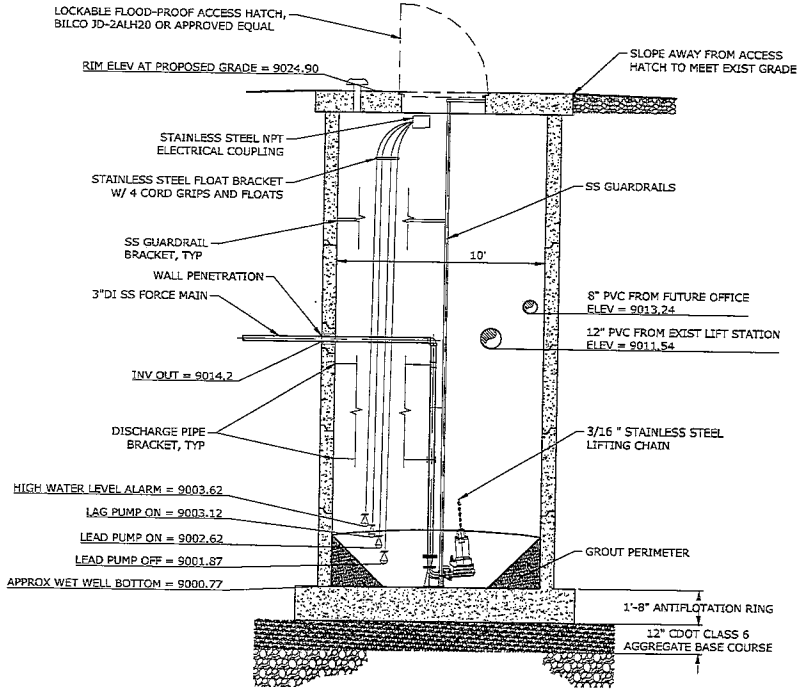
VALVE VAULT PLAN VIEW
SCALE: 1"=3'
1 C-2



LIFT STATION PLAN VIEW
SCALE: 1"=3'
2 C-2



VALVE VAULT SECTION VIEW
SCALE: 1"=3'
3 C-2



LIFT STATION SECTION VIEW
SCALE: 1"=3'
4 C-2

PRICING SET

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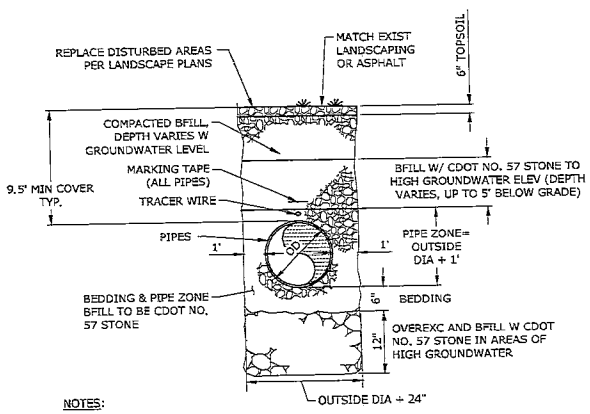
TOWN OF FRISCO

FRISCO MARINA LIFT STATION

SEWER LIFT STATION SECTIONS

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2 C-4



NOTES:

1. USE BEDDING AND PIPE ZONE BACKFILL WHERE SHOWN ON DETAIL. COMPACT TO ACHIEVE 95% OF MAXIMUM DENSITY IN ACCORDANCE WITH AASHTO T-310.

2. INSTALL COMMON BACKFILL TO PAVEMENT BASE OR EXISTING GRADE. COMPACT ALL BACKFILL IN LIFTS TO ACHIEVE 95% OF MAXIMUM DENSITY IN ACCORDANCE WITH AASHTO T-310.

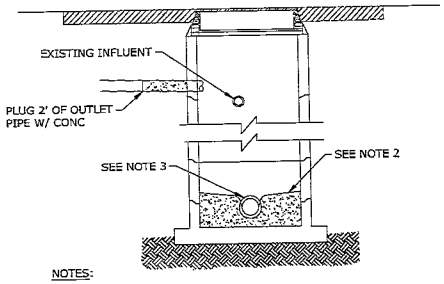
3. REFER TO SPECIFICATIONS FOR OTHER BACKFILL/BEDDING REQUIREMENTS.

4. FURNISH & INSTALL MARKING TAPE ABOVE ALL PIPELINES INCLUDING SERVICES.

5. PIPE DIAMETERS AS SHOWN PER PLAN.

SINGLE PIPE TRENCH DETAIL (1 / -)

SCALE: NTS



NOTES:

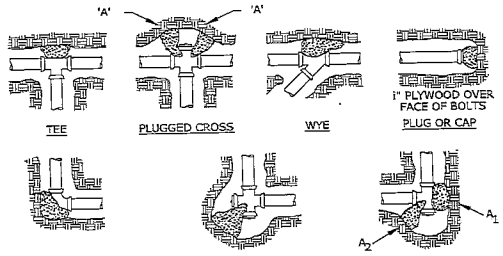
1. REMOVE EXISTING PUMPS. CONTRACTOR SHALL ALLOW THE TOWN TO INSPECT THE REMOVED PUMPS AND THE TOWN SHALL DETERMINE IF THEY SHOULD BE RETAINED. TOWN STAFF TO COORDINATE REMOVAL AND DISPOSAL OF ALL SEWAGE REMAINING WITHIN THE EXISTING WET WELL AT AN APPROPRIATE SITE.

2. POUR GROUT AND INSTALL CONCRETE CHANNEL TO DRAIN TOWARDS 12" SEWER OUTLET

3. INSTALL RUBBER RING OR GASKET COLLAR WHERE PIPE IS IN CONTACT WITH MANHOLE BASE AND MANHOLE CHANNEL IN ORDER TO ENSURE A WATER TIGHT SEAL.

EXISTING WET WELL ABANDONMENT (2 / -)

SCALE: NTS



BEARING AREA, 'A', OF THRUST BLOCKS IN SQUARE FEET							
FITTING SIZE	TEE, WYE, PLUG OR CAP	90°BEND, PLUGGED CROSS	TEE PLUGGED ON RUN		45° BEND	22 1/2° BEND	11 1/4° BEND
	A	A	A_1	A_2	A	A	A
3 OR 4	1.9	2.5	3.6	2.5	1.3	-	-
6	3.7	5.3	7.5	5.3	2.8	1.5	-
8	6.4	9.1	12.8	9.1	4.9	2.5	1.2
10	9.7	13.7	19.3	13.7	7.5	3.7	1.9
12	13.7	19.3	27.2	19.3	10.5	5.3	2.7
14	18.4	26.0	36.7	26.0	14.1	7.2	3.6
16	23.7	33.6	47.3	33.6	18.1	9.3	4.7
18	29.9	42.3	59.6	42.3	22.8	11.6	5.9
20	36.7	51.9	73.1	51.9	28.0	14.3	7.2
24	52.3	74.0	104.4	74.0	40.0	20.4	10.3

*ABOVE BEARING AREAS BASED UPON TEST PRESSURE OF 200 P.S.I. AND AN ALLOWABLE SOIL BEARING STRESS OF 2000 POUNDS PER SQUARE FOOT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURES AND SOIL BEARING STRESSES, USE THE FOLLOWING EQUATION: BEARING AREA=(TEST PRESSURE/200) X (2000/SOIL BEARING STRESS) X (TABLE VALUE).

NOTES:

1. CONCRETE THRUST BLOCKING SHALL BE POURED AGAINST UNDISTURBED EARTH.

2. KEEP CONCRETE CLEAR OF JOINT AND ACCESSORIES. INSTALL ISOLATION MATERIAL BETWEEN PIPE AND/OR FITTINGS BEFORE POURING BLOCKING.

3. THE MINIMUM REQUIRED THRUST BEARING AREAS FOR SPECIAL CONNECTIONS ARE SHOWN ON THE PLANS; e.g. 15 SF INDICATES 15 SQUARE FEET BEARING AREA REQUIRED.

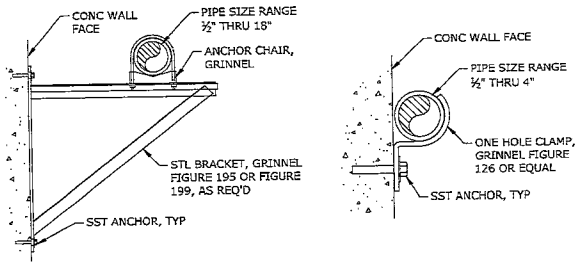
4. IF NOT SHOWN ON PLANS, REQUIRED BEARING AREAS AT FITTING SHALL BE AS INDICATED IN TABLE BELOW, ADJUSTED IF NECESSARY, TO CONFORM TO THE TEST PRESSURE(S) AND ALLOWABLE SOIL BEARING STRESS(ES) STATED IN THE SPECIFICATIONS.

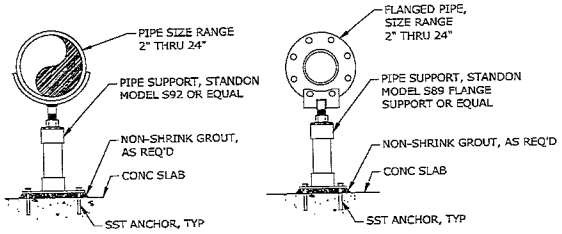
5. BEARING AREAS AND SPECIAL BLOCKING DETAILS SHOWN ON PLANS TAKE PRECEDENCE OVER BEARING AREAS AND BLOCKING DETAILS SHOWN ON THIS DETAIL.

6. CONCRETE SHALL BE 3000 PSI MIN. 28 DAY COMPRESSIVE STRENGTH.

STANDARD THRUST BLOCK DETAIL (3 / -)

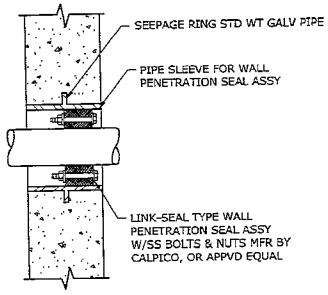
SCALE: NTS





PIPE SUPPORTS AND HANGERS (4 / -)

SCALE: NTS



WALL PENETRATION (5 / -)

SCALE: NTS

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TOWN OF FRISCO

FRISCO MARINA LIFT STATION

DETAIL SHEET 1

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2 D-1

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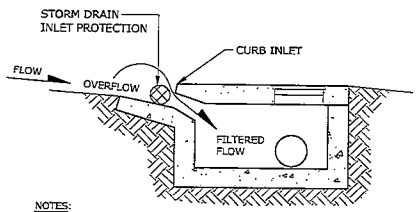


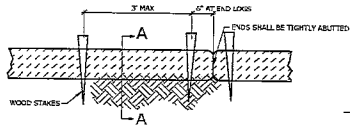
NOTES:

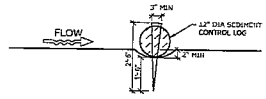
1. INLET PROTECTION DEVICE SHALL EXTEND 12 INCHES PAST EACH END OF THE INLET.

STORM DRAIN INLET PROTECTION TYPE I

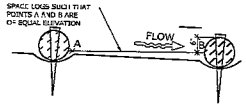
SCALE: NTS

1 / -





SECTION A-A



SEDIMENT CONTROL LOG MAINTENANCE NOTES:

1. THE SEDIMENT CONTROL LOGS SHALL BE INSPECTED DAILY, DURING AND AFTER ANY STORM EVENT, AND REPAIRED OR HAVE ANY UPSTREAM SEDIMENT REMOVED.

2. SEDIMENT ACCUMULATED UPSTREAM OF SEDIMENT CONTROL LOGS SHALL BE REMOVED WHEN THE UPSTREAM SEDIMENT DEPTH IS WITHIN 1/2 THE HEIGHT OF THE CREST OF LOG.

3. ALL SEDIMENT CONTROL LOGS SHALL BE REMOVED AT THE END OF CONSTRUCTION. IF ANY DISTURBED AREA EXISTS AFTER REMOVAL, IT SHALL BE DRILL SEEDED AND CRIMP MULCHED OR OTHERWISE ACCEPTABLY STABILIZED.

SEDIMENT CONTROL LOG INSTALLATION NOTES:

1. SEE PLAN VIEW FOR LOCATION AND EXTENT OF SEDIMENT CONTROL LOGS.

2. SEDIMENT CONTROL LOGS SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES AND AS REQUIRED DURING CONSTRUCTION.

3. SEDIMENT CONTROL LOGS SHALL CONSIST OF STRAW, COMPOST, EXCELSIOR, OR COCONUT FIBER.

4. NOT FOR USE IN CONCENTRATED FLOW AREAS.

5. THE SEDIMENT CONTROL LOG SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 2".

SEDIMENT CONTROL LOGS

SCALE: NTS

2 / -

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DETAIL SHEET 2

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2 D-2

9 of 11

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ONE LINE DIAGRAM LEGEND

- 1500KVA 2.4KV-480Y/277 3Ø, 60 HZ — TRANSFORMER WITH PRIMARY AND SECONDARY VOLTAGE, AND KVA RATING AS NOTED.
- 20 — 2# 3#8, #10G 3" — CIRCUIT NO. 22 WITH #8 INSULATED CONDUCTORS, 1#10 BARE GROUND WIRE ALL IN 2" CONDUIT TO 20 HP MOTOR.
- AUXILIARY ITEMS MAY NOT BE SHOWN COMPLETELY — ONE-LINE SHOWING POWER AND CONTROL TO A PACKAGE UNIT, AS FOR EXAMPLE A STEAM GENERATOR OR AN AIR HANDLING UNIT. SHALL IMPLY THAT ANY AND ALL ASSOCIATED EQUIPMENT SHALL ALSO BE INSTALLED AND WIRED AS REQUIRED BY THE EQUIPMENT FURNISHED.
- 15 — INDICATES THAT ALL OR PART OF CIRCUIT MAY BE ROUTED IN DUCT BANK OR UNDERGROUND. CONDUIT SIZE SHOWN ON ONELINE IS ABOVE GROUND AND/OR INSIDE OF STRUCTURE. SEE DUCT BANK SCHEDULE AND SECTIONS FOR CONDUIT SIZE OF UNDERGROUND PORTION OF CIRCUIT.
- HIGH VOLTAGE DRAWOUT AIR OR VACUUM CIRCUIT BREAKER.
- 3P-20 — LOW VOLTAGE AIR CIRCUIT BREAKER, 3 POLE, 20 AMPERE.
- S4 — SIZE 4 COMBINATION MAGNETIC MOTOR STARTER.
- S4 — SIZE 4 REDUCED VOLTAGE SOFT STARTER.
- LOW VOLTAGE DRAWOUT AIR CIRCUIT BREAKER.
- HIGH VOLTAGE DRAWOUT CONTACTOR.
- FUSE AND DISCONNECT SWITCH.
- S2 — SIZE 2 COMBINATION MAGNETIC MOTOR STARTER, REVERSING OR 2 SPEED.
- POTENTIAL TRANSFORMER.
- CURRENT TRANSFORMER.

CONDUIT & WIRING INSTALLATION LEGEND

- CONDUIT EXPOSED.
- CONDUIT CONCEALED.
- CONDUIT TURNING UP. CONDUIT TURNING DOWN.
- CONDUIT PLUGGED FLUSH. CONDUIT CAPPED.
- L2-5 — TYPICAL FOR HOME RUN TO BE ROUTED TO LIGHTING PANEL L2 AND CONNECTED TO CIRCUIT #5 (MINIMUM NO. 12 AWG CONDUCTORS & ¾" CONDUIT.)
- A — LIGHTING FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE.
- 11 — FLUORESCENT FIXTURE. REFER TO NUMBER OR LETTER IN FIXTURE SCHEDULE.
- LP1-3 — RECEPTACLE POWERED FROM LIGHTING PANEL LP1. CIRCUIT 3.
- A LP2-2 — LIGHTING FIXTURE POWERED FROM LIGHTING PANEL LP2. CIRCUIT 2 (NON-SWITCHED.)
- LPA-4 / 11 — LIGHTING FIXTURE POWERED FROM LIGHTING PANEL LPA. CIRCUIT 4
- A / 11 — LIGHTING FIXTURE POWERED VIA SWITCH A.
- E — UNDERGROUND CONCRETE ENCASED ELECTRICAL DUCT BANK.
- UNDERGROUND CONCRETE ENCASED ELECTRICAL BANK ROUTED BENEATH SLAB-ON-GRADE.
- EE — DIRECT BURIED CONDUIT.
- GROUND CONDUCTOR.

SCHEMATIC SYMBOLS

- WIRE CONNECTION POINT
- NORMALLY OPEN CONTACT
- NORMALLY CLOSED CONTACT
- STARTER, CONTACTOR OR RELAY COIL
- NORMALLY OPEN PUSH BUTTON
- NORMALLY CLOSED PUSH BUTTON
- MAINTAINED PUSH BUTTON
- NORMALLY CLOSED GEARED LIMIT SWITCH
- NORMALLY OPEN GEARED LIMIT SWITCH
- INDICATING LIGHT
- FUSE
- CONTROL POWER TRANSFORMER
- SWITCH
- MS — MANUAL STARTER
- OL — OVERLOAD
- FLOAT SWITCH (CLOSING ON RISING LEVEL)
- FLOAT SWITCH (OPENING ON RISING LEVEL)
- PRESSURE SWITCH (CLOSING ON RISING PRESSURE)
- PRESSURE SWITCH (OPENING ON RISING PRESSURE)
- VACUUM SWITCH (CLOSING ON INCREASING VACUUM)
- VACUUM SWITCH (OPENING ON INCREASING VACUUM)
- TEMPERATURE SWITCH (CLOSING ON RISING TEMPERATURE)
- TEMPERATURE SWITCH (OPENING ON RISING TEMPERATURE)
- FLOW ACTUATED SWITCH (CLOSING ON INCREASE IN FLOW)
- FLOW ACTUATED SWITCH (OPENING ON INCREASE IN FLOW)
- ON TIME DELAY SWITCH (NORMALLY OPEN WITH TIME DELAY CLOSING AFTER COIL IS ENERGIZED)
- ON TIME DELAY SWITCH (NORMALLY CLOSED WITH TIME DELAY OPENING AFTER COIL IS ENERGIZED)
- OFF TIME DELAY SWITCH (NORMALLY OPEN WITH TIME DELAY OPENING AFTER COIL IS DE-ENERGIZED)
- OFF TIME DELAY SWITCH (NORMALLY CLOSED WITH TIME DELAY CLOSING AFTER COIL IS DE-ENERGIZED)
- TORQUE SWITCH (NORMALLY OPEN)
- TORQUE SWITCH (NORMALLY CLOSED)
- LIMIT SWITCH (NORMALLY OPEN)
- LIMIT SWITCH (NORMALLY OPEN, HELD CLOSED)
- LIMIT SWITCH (NORMALLY CLOSED)
- LIMIT SWITCH (NORMALLY CLOSED, HELD OPEN)
- DIFFERENTIAL PRESSURE SWITCH (NORMALLY OPEN, CLOSING ON INCREASING DIFF.)
- DIFFERENTIAL PRESSURE SWITCH (NORMALLY CLOSED, OPENING ON INCREASING DIFF.)
- 24 VDC SURGE PROTECTION

SWITCH & OUTLET SYMBOLS

- S — SINGLE POLE SWITCH. A=SWITCH DESIGNATION
- S — TWO POLE SWITCH. A=SWITCH DESIGNATION
- S — THREE-WAY SWITCH. A=SWITCH DESIGNATION
- S — FOUR-WAY SWITCH. A=SWITCH DESIGNATION
- S — WEATHERPROOF SWITCH. A=SWITCH DESIGNATION
- S — KEY OPERATED SWITCH. A=SWITCH DESIGNATION
- S — EXPLOSION PROOF SWITCH. A=SWITCH DESIGNATION
- DUPLEX RECEPTACLE 120 VOLT
- 240V, 1 PHASE RECEPTACLE, TYPICAL AMPERE RATING NOTED
- 480V, 3 PHASE WELDING RECEPTACLE, TYPICAL AMPERE RATING NOTED

MISCELLANEOUS SYMBOLS

- E — ETHERNET PORT
- T — THERMOSTAT
- J — JUNCTION BOX
- DISCONNECT SWITCH
- COMBINATION STARTER
- POWER PANEL
- LIGHTING PANEL
- MISCELLANEOUS PANEL

ABBREVIATIONS

A	AMBER, AMPERE, ALARM
AC	ALTERNATING CURRENT
ADD	ADJUSTABLE FREQUENCY DRIVE
AFF	ABOVE FINISHED FLOOR
AM	AMMETER
ATO	AUTOMATIC THROWOVER
AWG	AMERICAN WIRE GAUGE
C	CLOSE, COUNTER, CONTACTOR
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CD	CONTROL DAMPER
CKT	CIRCUIT
CL2	CHLORINE
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CS	CONTROL STATION
CT	CYCLE TIMER, CURRENT TRANSFORMER
CTM	CYCLE TIMER MOTOR
2IC	2 CONDUCTOR
4"C	4" CONDUIT
DC	DIRECT CURRENT
DM	DAMPER MOTOR, DEMAND METER
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DPS	DIFFERENTIAL PRESSURE SWITCH
DS	DISCONNECT SWITCH
E	ELECTRIC OPERATOR FOR CONTROL DAMPER OR VALVE
EMH	ELECTRICAL MANHOLE
ETM	ELAPSED TIME METER
EX	EXISTING
F	FORWARD
FS	FLOW SWITCH
G	GREEN, GROUND
GFI	GROUND FAULT INTERRUPTER
GLS	GEARED LIMIT SWITCH
#8G	#8 GROUND WIRE
H	HIGH, HUMIDISTAT
HH	HANDHOLE
HMT	HIGH MOTOR TEMPERATURE
HOA	HAND-OFF-AUTO
HOR	HAND-OFF-REMOTE
HP	HORSEPOWER
HWCO	HIGH WATER CUTOFF
HZ	HERTZ (CYCLE)
I/O	INPUT/OUTPUT
J	JUNCTION BOX
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVAR
KW	KILOWATT
KWH	KILOWATT HOUR
L	LOW, LEVEL
LA	LIGHTNING ARRESTOR
LAN	LOCAL AREA NETWORK
LP	LIGHTING PANEL
LS	LIMIT SWITCH, LEVEL SWITCH
LWCO	LOW WATER CUTOFF
M	MAGNETIC MOTOR STARTER
MA	MILLIAMPERE
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCM	THOUSAND CIRCULAR MIL
MD	MOISTURE DETECTOR
MH	MANHOLE, MOUNTING HEIGHT
MOV	MOTOR OPERATED VALVE
MS	MANUAL MOTOR STARTER
MSH	MOTOR SPACE HEATER
N	NEUTRAL
NC	NORMALLY CLOSED
NO	NORMALLY OPEN, NUMBER
O	OPEN
OL	OVERLOAD
PB	PUSH BUTTON, PULL BOX
PF	POWER FACTOR METER
PH	PHASE (CHEMICAL TERM)
PLC	PROGRAMMABLE LOGIC CONTROLLER
PP	POWER PANEL
PS	PRESSURE SWITCH
PT	POTENTIAL TRANSFORMER, PROGRAM TIMER
2P	2 POLE
R	RED, RAISE, RELAY, REVERSE
RECP	RECEPTACLE
RGS	RIGID GALVANIZED STEEL
RTD	RESISTANCE TYPE TEMP DETECTOR
RTU	REMOTE TERMINAL UNIT
RVSS	REDUCED VOLTAGE SOLID STATE STARTER
S2	SIZE 2 STARTER
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SP	SINGLE POLE
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SS	SELECTOR SWITCH
SV	SOLENOID VALVE
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
T	THERMOSTAT, TIMER, TOTALIZER
TACH	TACHOMETER
TB	TERMINAL BLOCK
TD	TIME DELAY RELAY
TEMP	TEMPERATURE
TQ	TORQUE
TS	TEMPERATURE SWITCH
UG	UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTS
VA	VOLT AMPERE
VLS	VALVE LIMIT SWITCH
VM	VOLTMETER
W	WHITE, WATTS
WH	WATTHOUR METER
WM	WATT METER
WP	WEATHERPROOF
XFMR	TRANSFORMER
XP	EXPLOSION PROOF
Y	YELLOW
Z	AUXILIARY RELAY
ZS	POSITION SWITCH

AREA DESIGNATIONS

THE SPECIAL AREA DESIGNATION BOXES, AS DERIVED BELOW, ARE LOCATED ON THE PLAN DRAWINGS TO DEFINE ELECTRICAL INSTALLATION REQUIREMENTS. DESIGNATION BOXES ARE LOCATED WITHIN ROOM OR BELOW ROOM NUMBER. ALL INDOOR AREAS NOT INDICATED OTHERWISE ARE AREA TYPE 1 AND MINIMUM NEMA TYPE 1 ENCLOSURES.

- AREA TYPE 1 — INDOOR AND DRY AREA. REQUIRES MINIMUM NEMA TYP 1 ENCLOSURES FOR ALL EQUIPMENT AND GASKETED FITINGS IN CONDUIT SYSTEMS.
- AREA TYPE "A" — CORROSIVE CHEMICAL FEED AND STORAGE ROOMS. CONDUIT SYSTEM SHALL BE EXPOSED PVC COATED CONDUIT WITH FITTINGS, AND ACCESSORIES.
- AREA TYPE 4 — INDOOR WET LOCATIONS SUCH AS VAULTS, HOSEDOWN AREAS, BASEMENTS, ETC. MINIMUM NEMA TYPE 4 ENCLOSURE FOR EQUIPMENT AND GASKETED FITTINGS IN A CONDUIT SYSTEM.
- AREA TYPE "B" — CLASS 1, DIVISION 1 AREA AS DERIVED BY NEC. ALL EQUIPMENT AND CONDUIT SYSTEMS SHALL BE RATED FOR USE IN THIS AREA.
- AREA TYPE "C" — CLASS 1, DIVISION 2, GROUP C AND D (METHANE, GASOLINE) AS DEFINED BY NEC. EQUIPMENT AND CONDUIT SYSTEMS SHALL BE RATED FOR USE IN THIS AREA.
- AREA TYPE 12 — INDOOR, DRY, DIRTY AREA. REQUIRES MINIMUM NEMA TYPE 12 GASKETED ENCLOSURES FOR ALL EQUIPMENT AND GASKETED FITTINGS IN CONDUIT SYSTEMS.
- AREA TYPE "X" — OUTDOOR AND INDOOR WET LOCATIONS SUBJECT TO CORROSION. CONDUIT SYSTEM SHOULD BE PVC COATED RIGID GALVANIZED STEEL WITH PVC COATED FITTINGS, BOXES, AND STAINLESS STEEL HARDWARE.

GENERAL REQUIREMENTS

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ROUTING ALL CONDUITS NOT SHOWN ON THE PLANS. THIS SHALL INCLUDE ALL CONDUITS SHOWN ON THE ONELINES AND HOME-RUNS SHOWN ON THE PLAN DRAWINGS. CONDUITS SHALL BE ROUTED AS DERIVED IN THE SPECIFICATIONS.
2. SPARE WIRES SHALL BE TAPED AND COILED.
3. IF EQUIPMENT SUPPLIED BY MANUFACTURER HAS A LARGER LOAD THAN VALUE SHOWN, THE CABLE CONDUIT AND ELECTRICAL EQUIPMENT SHALL BE ENLARGED, AS REQUIRED, TO ACCOMODATE THE HIGHER VALUE.
4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING PROPERLY SIZED STARTER OVERLOADS FOR EQUIPMENT FURNISHED.
5. LIGHTING AND RECEPTACLE CIRCUITS DESIGNATED ON THE FLOOR PLANS ARE NOT SHOWN ON THE ONE-LINES. CONDUCTORS FOR LIGHTING, RECEPTACLES, AND MISCELLANEOUS 120VAC CIRCUITS SHALL BE MINIMUM NO. 12 AWG. CONDUIT FOR LIGHTING, RECEPTACLES, AND MISCELLANEOUS 120VAC CIRCUITS SHALL BE MINIMUM ¾".
6. IN AREAS WHERE THERE ARE OVERHEAD BRIDGE CRANES, HOISTS, ETC., NO CONDUITS SHALL BE RUN OVERHEAD THAT WILL INTERFERE WITH THE OPERATION OF THE EQUIPMENT.

GENERAL NOTES

1. SOLID LINES —— INDICATE NEW WORK OR EQUIPMENT.
2. DOTTED LINES . . . INDICATE EXISTING WORK OR EQUIPMENT.
3. DASHED LINES — — INDICATE FUTURE WORK OR EQUIPMENT.
4. THIS IS A GENERAL LEGEND SHEET. SOME SYMBOLS AND ABBREVIATIONS MAY NOT BE UTILIZED ON THIS SPECIFIC PROJECT.
5. INFORMATION RELATED TO CIRCUIT IDENTIFICATION, WIRE & CONDUIT SIZES, AND ROUTING, IS ON THE FOLLOWING DRAWING TYPES.
   - A. ONE-LINE DIAGRAMS SHOW CIRCUIT IDENTIFICATION, WIRE QUANTITY AND SIZES, AND CONDUIT SIZE WITHIN STRUCTURES. ONE-LINE DIAGRAMS ALSO INDICATE ORIGIN AND DESTINATION OF CIRCUITS, AND IDENTIFY CIRCUITS ROUTED UNDERGROUND.
   - B. FOR CIRCUITS WITHOUT UNDERGROUND PORTIONS, BUILDING FLOOR PLANS SHOW LOCATION OF EQUIPMENT FOR DETERMINING CIRCUIT LENGTH WITHIN THE STRUCTURE. FOR CIRCUITS WITH UNDERGROUND PORTIONS, ANTICIPATED PENETRATION OF UNDERGROUND CONDUITS ARE SHOWN ON STRUCTURE PLANS FOR DETERMINING THE LENGTH OF IN-STRUCTURE PORTIONS OF CIRCUITS. BUILDING FLOOR PLANS MAY ALSO SHOW HOME RUNS FOR LIGHTING, RECEPTACLE, AND OTHER MISCELLANEOUS EQUIPMENT CIRCUITS.
   - C. SITE PLANS INDICATE THE GENERAL ROUTING OF UNDERGROUND CONDUITS AND DUCT BANKS. CIRCUITS ROUTED IN UNDERGROUND CONDUITS OR DUCT BANKS ARE INDICATED IN DUCT BANK SECTIONS REFERENCED ON THE SITE PLAN.
   - D. DUCT BANK SECTIONS AND SCHEDULES IDENTIFY CONDUIT SIZE, CONDUIT MATERIAL, ARRANGEMENT OF THE UNDERGROUND CONDUITS, AND CIRCUITS ROUTED IN EACH UNDERGROUND CONDUIT.
6. CLOUDED MARKINGS INDICATE WORK IN EXISTING AREAS THAT IS NEW OR NEW WORK ON AN EXISTING PIECE OF EQUIPMENT.

PRICING SET

NO.	DATE	BY	REVISION

NOTICE: 0 ½ 1 — IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

AMA DESIGNED | AMA DRAWN | JSP CHECKED

MARCH 2021

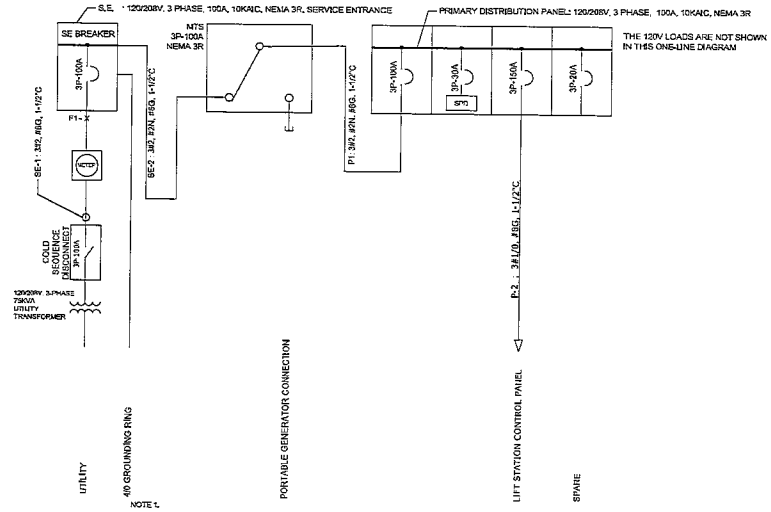
Murraysmith

FRISCO MARINA LIFT STATION

ELECTRICAL LEGEND

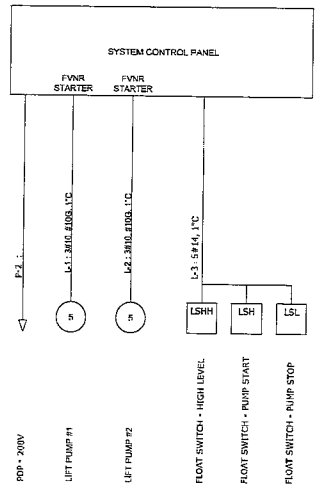
PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2 E-1



SERVICE ENTRANCE & ATS
ONE-LINE DIAGRAM

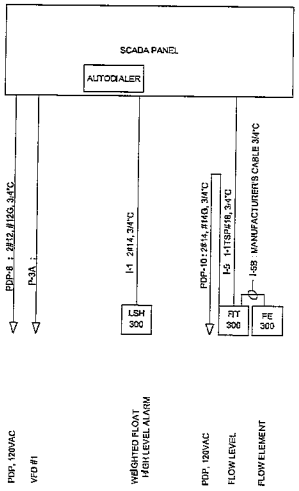
PRIMARY DISTRIBUTION PANEL
ONE-LINE DIAGRAM



LIFT STATION CONTROL PANEL
ONE-LINE DIAGRAM

FAULT CURRENT	
UTILITY	13,000A
F1	9,853A

NOTES:
1. BONDING AND GROUNDING SHALL INCLUDE CONNECTIONS TO THE PROCESS PIPE AND 2 GROUND RODS AS PER N.E.C.
2. ALL 120VAC CONDUCTORS WITH 20 AMP BREAKER SHALL BE 3#12, 3/4"C, ALL OTHER CONDUCTORS SHALL BE SIZED TO OVER CURRENT PROTECTION.



SCADA PANEL PANEL
ONE-LINE DIAGRAM

NAME:	PDP			BUS:		COPPER				MAINS:	3P-100A		
SERVICE:	120/208 VAC			RATING:		100A				LOCATION:	OUTSIDE		
MOUNTING:	SURFACE, NEMA 3R			AIC RATING:		10,000A							
V.A.						CIRCUIT NUMBER					V.A.		
A	B	C	LOAD	PHASE	BREAKER			BREAKER	PHASE	LOAD	A	B	C
12000			LIFT STATION CONTROL PANEL	3	150	1	2	30	3	SPD	0		
	12000		-	-	-	3	4	-	-	-		0	
		12000	-	-	-	5	6	-	-	-			0
0			SPARE	3	20	7	8	15	1	SCADA PANEL	150		
	0		-	-	-	9	10	15	1	FLOW METER		25	
		0	-	-	-	11	12	20	1				0
180			CONVENIENCE RECPT	1	20	13	14	20	1		0		
	0			1	20	15	16	20	1			0	
		0		1	20	17	18	20	1				0
0				1	20	19	20	20	1		0		
	0			1	20	21	22	20	1			0	
		0		1	20	23	24	20	1				0
0				1	20	25	26	20	1		0		
	0			1	20	27	28	20	1	GENERATOR - BLOCK HEATER		1500	
		0		1	20	29	30	20	1	GENERATOR - BATTERY CHARGER			40
12180	12000	12000	TOTALS PER PHASE PER SIDE								150	1525	40
12330	13525	12040	TOTALS PER PHASE										
	37895		PANEL TOTAL										

PRICING SET

NO.	DATE	BY	REVISION

NOTICE
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

AMA DESIGNED
AMA DRAWN
JSP CHECKED

MARCH 2021
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TOWN OF FRISCO

FRISCO MARINA
LIFT STATION

ONE-LINE ELECTRICAL DIAGRAMS

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 12 MARCH 2021

SHEET 2
E-2

I:\BOL Projects\20\2802 - Frisco Marina Lift Station\CAD\Sheets\20-2802-1D-D.dwg E-2 3/5/2021 2:23 PM ADRIENNE.ANGELOS 23.0s (LMS Tech)

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT M

DOCUMENTS SUBMITTED BY CONTRACTOR

PRIOR TO NOTICE OF AWARD

COLORADO BID BOND

BOND NO. **Bid Bond**
AMOUNT OF BOND: $**Five Percent (5%) of the Total Amount Bid**

KNOW ALL MEN BY THESE PRESENTS, that **BT Construction, Inc.**, hereinafter called the PRINCIPAL, and **Hartford Fire Insurance Company**, a corporation duly organized under the laws of the State of **Connecticut**, having its principal place of business at **One Hartford Plaza,Hartford** in the State of **Connecticut**, and authorized to do business in the State of Colorado, as SURETY, are held and firmly bound unto the Town of Frisco, hereinafter called the OBLIGEE, in the sum of **Five Percent (5%) of the Total Amount Bid** DOLLARS ($ **5%**), for the payment of which we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents as follows:

THE CONDITION OF THIS BOND IS SUCH THAT:

WHEREAS, the PRINCIPAL is herewith submitting his Bid for:

Marina Lift Station and Deep Utilities

(Describe project)

said Bid, by this reference thereto being hereby made a part hereof; and

WHEREAS, the OBLIGEE has required as a condition for receiving said Bid that the PRINCIPAL furnish the OBLIGEE with security as provided herein;

NOW, THEREFORE, if the PRINCIPAL shall, within sixty (60) days after Bid Opening:

(A) On the prescribed forms presented to him for signature, enter into a written Formal Contract with the OBLIGEE in accordance with his Bid as accepted, give Performance and Payment Bonds with good and sufficient Surety or Sureties as is required upon the forms prescribed in the Contract Documents, and deliver the certificates of insurance required by the Contract Documents, or

(B) Pay to the OBLIGEE the said sum of this bond as liquidated damages, and not as a penalty,

THEN, this obligation shall be void and of no effect; otherwise to remain in full force and effect.

Signed and sealed this **23rd** day of **March**, 2021.

PRINCIPAL **BT Construction, Inc.**
By: Josh Livermore
VICE PRESIDENT

SURETY **Hartford Fire Insurance Company**
By: Ashlea McCaughey
Attorney-In-Fact **Ashlea McCaughey**

BT CONSTRUCTION, INC. 1980 SEAL COLORADO

POWER OF ATTORNEY

Direct Inquiries/Claims to:
THE HARTFORD
BOND, T-11
One Hartford Plaza
Hartford, Connecticut 06155
Bond.Claims@thehartford.com
call: **888-266-3488** *or fax:* **860-757-5835**

KNOW ALL PERSONS BY THESE PRESENTS THAT:

Agency Name: HOLMES MURPHY AND ASSOC LLC
Agency Code: 34-346205

- [X] **Hartford Fire Insurance Company**, a corporation duly organized under the laws of the State of Connecticut
- [X] **Hartford Casualty Insurance Company**, a corporation duly organized under the laws of the State of Indiana
- [X] **Hartford Accident and Indemnity Company**, a corporation duly organized under the laws of the State of Connecticut
- [ ] **Hartford Underwriters Insurance Company**, a corporation duly organized under the laws of the State of Connecticut
- [ ] **Twin City Fire Insurance Company**, a corporation duly organized under the laws of the State of Indiana
- [ ] **Hartford Insurance Company of Illinois**, a corporation duly organized under the laws of the State of Illinois
- [ ] **Hartford Insurance Company of the Midwest**, a corporation duly organized under the laws of the State of Indiana
- [ ] **Hartford Insurance Company of the Southeast**, a corporation duly organized under the laws of the State of Florida

having their home office in Hartford, Connecticut, (hereinafter collectively referred to as the "Companies") do hereby make, constitute and appoint, ***up to the amount of*** Unlimited :

Donald E. Appleby, Todd Bengford, Sarah C. Brown, Ashlea McCaughey, Jessica Jean Rini, Mark Sweigart of GREENWOOD VILLAGE, Colorado

their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign its name as surety(ies) only as delineated above by ☒, and to execute, seal and acknowledge any and all bonds, undertakings, contracts and other written instruments in the nature thereof, on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

In Witness Whereof, and as authorized by a Resolution of the Board of Directors of the Companies on May 23, 2016 the Companies have caused these presents to be signed by its Assistant Vice President and its corporate seals to be hereto affixed, duly attested by its Assistant Secretary. Further, pursuant to Resolution of the Board of Directors of the Companies, the Companies hereby unambiguously affirm that they are and will be bound by any mechanically applied signatures applied to this Power of Attorney.

Shelby Wiggins

Shelby Wiggins, Assistant Secretary

Joelle L. LaPierre, Assistant Vice President

STATE OF FLORIDA
COUNTY OF SEMINOLE } **SS.** Lake Mary

On this 13th day of February, 2020, before me personally came Joelle LaPierre, to me known, who being by me duly sworn, did depose and say: that (s)he resides in Seminole County, State of Florida; that (s)he is the Assistant Vice President of the Companies, the corporations described in and which executed the above instrument; that (s)he knows the seals of the said corporations; that the seals affixed to the said instrument are such corporate seals; that they were so affixed by authority of the Boards of Directors of said corporations and that (s)he signed his/her name thereto by like authority.

Jessica Ciccone

Jessica Noelle Ciccone
My Commission #FF029702
Expires June 20, 2021

I, the undersigned, Assistant Vice President of the Companies, DO HEREBY CERTIFY that the above and foregoing is a true and correct copy of the Power of Attorney executed by said Companies, which is still in full force effective as of 03/23/2021.

Signed and sealed in Lake Mary, Florida.

Keith Dozois

Keith D. Dozois, Assistant Vice President

FRISCO BAY MARINA

LIFT STATION & DEEP UTILITIES PROJECT

EXHIBIT A TO CONSTRUCTION AGREEMENT

GENERAL CONDITIONS

ATTACHMENT N

ADDENDA 1 THROUGH 2

PROJECT DISCLOSURE

ADDENDUM NO. 1

TO THE

CONTRACT DOCUMENTS

FOR

FRISCO MARINA LIFT STATION AND DEEP UTILITIES

FOR

TOWN OF FRISCO

THIS ADDENDUM IS HEREBY MADE A PART OF THE CONTRACT DOCUMENTS TO THE SAME EXTENT AS THOUGH IT WERE ORIGINALLY INCLUDED THEREIN.

BIDDERS MUST ACKNOWLEDGE RECEIPT OF ALL ADDENDA ON THE BID PROPOSAL FORM. BID PROPOSALS THAT FAIL TO ACKNOWLEDGE ALL ADDENDA MAY BE CONSIDERED IRREGULAR AND MAY BE REJECTED.

ISSUED THIS 19th DAY OF MARCH 2021.

MURRAYSMITH, INC.
1157 W Century Drive, Suite 220
Louisville, CO 80027

ITEM NO. 1 – BIDDING AND CONTRACT DOCUMENTS – SECTION 01 22 23, UNIT PRICE MEASUREMENT AND PAYMENT

A. **REPLACE** Item S with the following:

"S. Erosion Control, Landscape and Surface Restoration: Payment for this bid item, including all materials, labor, tools, and equipment necessary to install and maintain temporary erosion control and sediment maintenance measures and chain-link security fencing throughout the life of the project, complete work in accordance with the approved permits, and to remove the temporary erosion control and fencing, general surface restoration other than streets, sidewalks and curbs including stripping and stockpiling topsoil, regrading to original contours, bark mulching planting areas, reseeding where necessary and cleanup following construction as required including resurfacing gravel surfaces as required, will be on a square yard basis."

ITEM NO. 2 – BIDDING AND CONTRACT DOCUMENTS – SECTION 26 05 00, BASIC ELECTRICAL MATERIALS AND METHODS

A. After Subsection 2.1.B.19, **INSERT** the following Subsection 2.1.B.20:

"20. Manual Transfer Switch

a. General:

1. Double throw safety switch
2. Square D or Cutler-Hammer

b. Enclosure:

1. Outdoor: NEMA 3R
2. Padlocked external operating handle, padlockable in any position

c. Switch:

1. 10,000 amp symmetrical withstand
2. Poles to match equipment served
3. 240 VAC
4. Continuous current rating not less than the serving branch circuit over current protection
5. Non-fusible except where fusing is required by the served equipment or as noted on the drawings"

B. **REPLACE** paragraph of 3.E.4.b with the following:

"Underground conduits shall be direct buried and not concrete encased."

ITEM NO. 3 – BIDDING AND CONTRACT DOCUMENTS – SECTION 26 36 23, 208 VOLT AUTOMATIC TRANSFER SWITCH

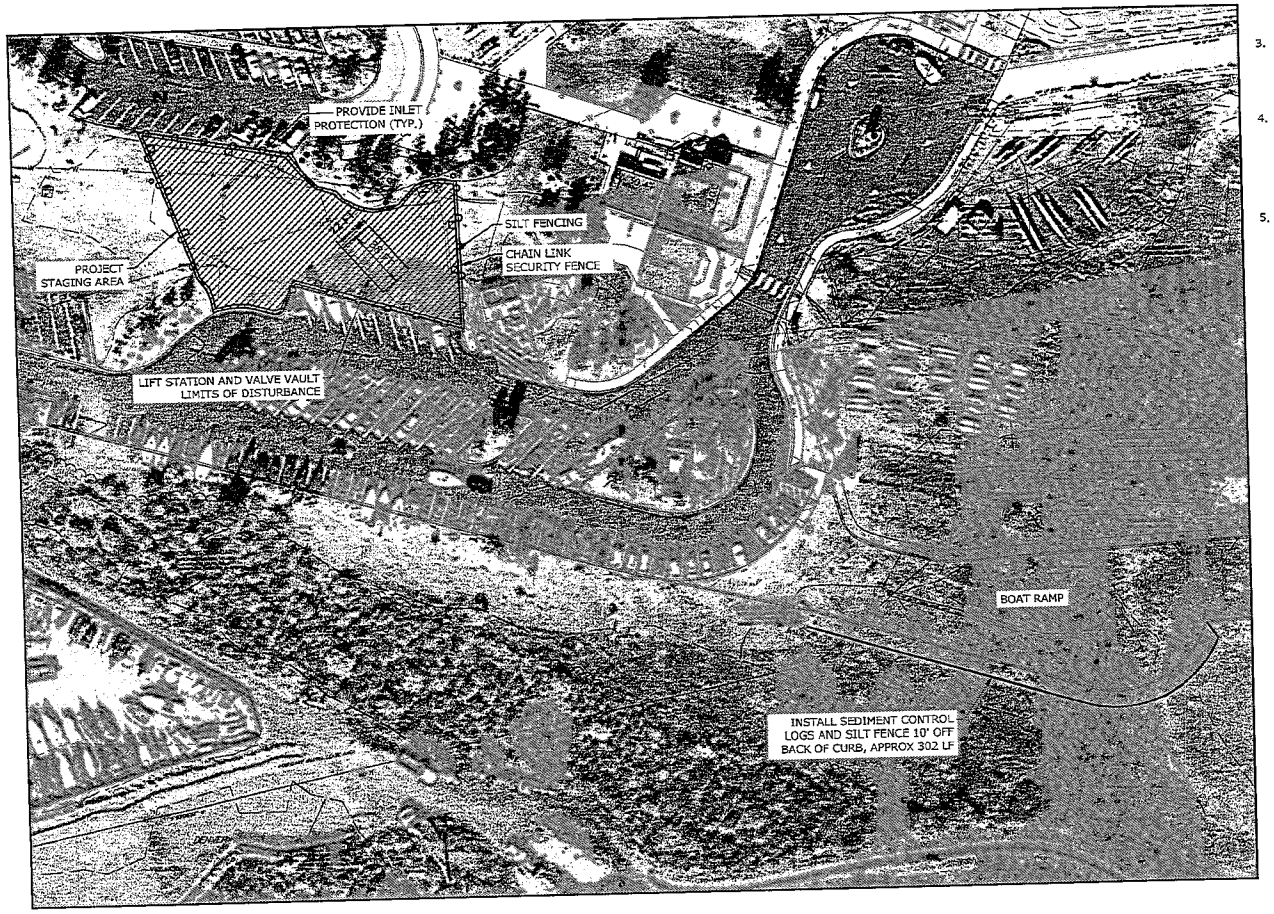
A. **DELETE** section 26 36 23, 208 Volt Automatic Transfer Switch.

ITEM NO. 4 – DRAWINGS - SHEET C-1

A. **REPLACE** Sheet C-1 with the attached, revised Sheet C-1 to include additional sediment control measures near the boat ramp.

ITEM NO. 5 – DRAWINGS - SHEET E-2

A. **REPLACE** Sheet E-2 with the attached, revised Sheet E-2.



CONSTRUCTION NOTES:

1. PROTECT EXISTING SITE FEATURES, INCLUDING BUT NOT LIMITED TO CURB AND GUTTER, TRANSFORMER, FIRE HYDRANT, TREES AND LANDSCAPE FEATURES.
2. EACH STORM SEWER INLET IN OR IMMEDIATELY ADJACENT TO THE PROJECT DISTURBANCE LIMITS WILL HAVE A TEMPORARY INLET SEDIMENT TRAP CONSTRUCTED AROUND IT. IN PAVED AREAS, THIS TRAP CONSISTS OF WIRE MESH SOCKS TO FILTER RUNOFF AND ALLOW SILT TO SETTLE OUT.
3. SILT FENCING AND SEDIMENT CONTROL LOGS SHALL BE CONSTRUCTED ALONG THE DOWNHILL EDGE OF THE PROJECT DISTURBANCE LIMITS AND AT ALL POINT DISCHARGE AREAS WHETHER SHOWN OR NOT. SILT FENCE AND SEDIMENT CONTROL LOGS SHALL BE MAINTAINED AS NEEDED THROUGHOUT THE CONSTRUCTION PROCESS. THE TEMPORARY SILT FENCE AND SEDIMENT CONTROL LOGS WILL REMAIN UNTIL THE DISTURBED AREA HAS BEEN RESTORED AND GROUND COVER IS EFFECTIVE.
4. CONTRACTOR SHALL STORE CONSTRUCTION MATERIALS AND EQUIPMENT IN CONFINED AREAS ON SITE FROM WHICH RUNOFF WILL BE CONTAINED AND FILTERED. MATERIALS WILL BE STORED OFF THE GROUND AND PROTECTED FROM THE WEATHER BY A COVER OR STORED IN A CONTAINER SUCH AS A VAN OR TRAILER. AN EARTHEN DIKE WILL BE CONSTRUCTED AROUND THE PERIMETER OF THE FUEL STORAGE AREA TO PREVENT MATERIALS FROM CONTACT WITH SURFACE RUNOFF. EQUIPMENT MAINTENANCE WILL BE PERFORMED IN A DESIGNATED AREA AND STANDARD MAINTENANCE PROCEDURES, SUCH AS THE USE OF DRIP PANS, WILL BE USED TO CONTAIN PETROLEUM PRODUCTS.
5. EROSION CONTROL MEASURES WILL BE INSPECTED DAILY DURING CONSTRUCTION BY THE CONTRACTOR AND AFTER EACH RAIN EVENT. ALL INSPECTIONS SHALL BE DOCUMENTED AND SHALL INCLUDE THE DATE OF INSPECTION, ANY INCIDENCES OF NON-COMPLIANCE, SIGNED CERTIFICATION THAT THE SITE IS IN COMPLIANCE, AND ANY NOTES, DRAWINGS, MAPS, ETC. PERTAINING TO REPAIRS. COPIES OF ALL DOCUMENTATION SHALL BE DISTRIBUTED TO THE OWNER ON A REGULAR SCHEDULE AS SPECIFIED BY THE OWNER.

N

40 20 0 40 80
SCALE IN FEET

PRICING SET

NO.	DATE	BY	REVISION
A	03/19/2021	JSP	REV 1, ADDENDUM NO. 1

NOTICE
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

AMA DESIGNED
AMA DRAWN
JSP CHECKED

MARCH 2021
Murraysmith

murraysmith

TOWN OF FRISCO

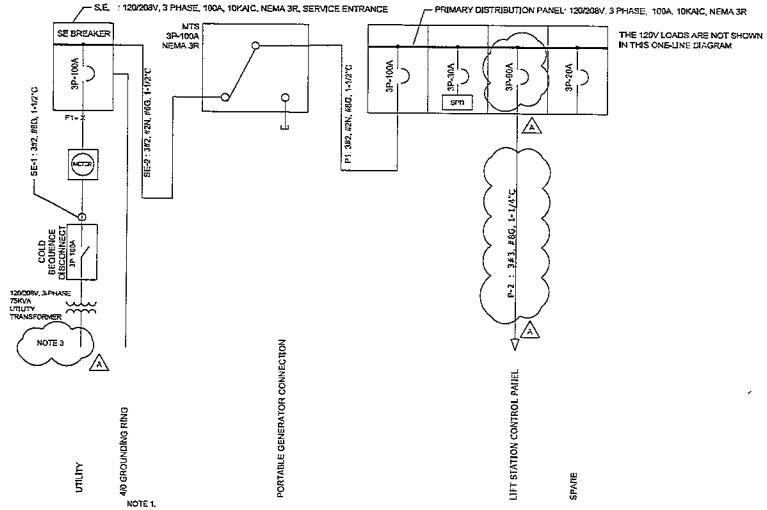
FRISCO MARINA LIFT STATION

EROSION CONTROL PLAN

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 19 MARCH 2021

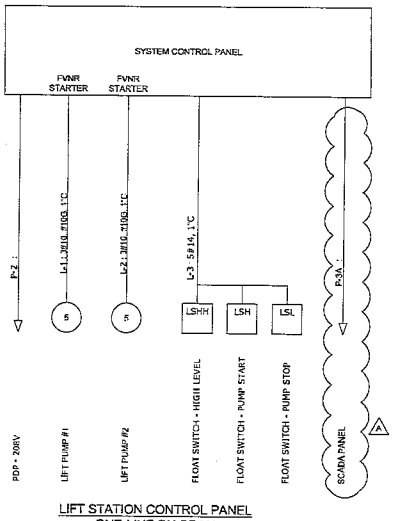
SHEET 2 C-1

I:\BOL_Projects\20\2802 - Frisco Marina Lift Station\CAD\Sheets\20-2802-10-C.dwg C-1 3/19/2021 11:58 AM SEAN.WALMSLEY 23.0s (LMS Tech)



SERVICE ENTRANCE & ATS
ONE-LINE DIAGRAM

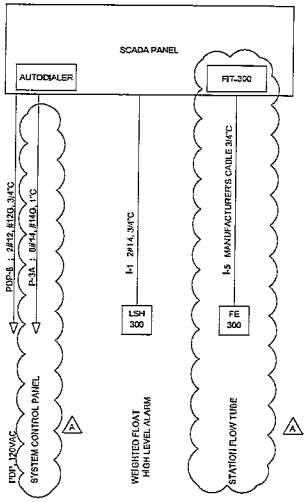
PRIMARY DISTRIBUTION PANEL
ONE-LINE DIAGRAM



LIFT STATION CONTROL PANEL
ONE-LINE DIAGRAM

FAULT CURRENT	
UTILITY	13,000A
F1	9,852A

NOTES:
1. BONDING AND GROUNDING SHALL INCLUDE CONNECTIONS TO THE PROCESS PIPE AND 2 GROUND RODS AS PER N.E.C.
2. ALL 120VAC CONDUCTORS WITH 20 AMP BREAKER SHALL BE 3#12, 3/4"C. ALL OTHER CONDUCTORS SHALL BE SIZED TO OVER CURRENT PROTECTION.
3. THE UTILITY TRANSFORMER HAS ALREADY BEEN INSTALLED AND IS SHOWN ON SHEET C-3 AS THE "EXISTING TRANSFORMER" NEAR THE NEW LIFT STATION.
4. ALL THE ELECTRICAL PANELS ASSOCIATED WITH THIS PROJECT SHALL BE MOUNTED ON A RACK CONSTRUCTED WITH UNISTRUT NEAR THE UTILITY TRANSFORMER AS SHOWN ON SHEET C-3 AS "PROPSED LS CONTROL PANEL".
5. THE CONVENIENCE RECEPTACLE SHALL BE LOCATED NEXT TO THE SCADA PANEL ON THE UNISTRUT RACK. THE RECEPTACLE SHALL BE PROVIDED AND INSTALLED UNDER THIS CONTRACT. THE RECEPTACLE SHALL BE A GFI RECEPTACLE IN AN FD CAST BOX WITH A WEATHERPROOF IN-USE COVER.



SCADA PANEL PANEL
ONE-LINE DIAGRAM

NOTE 5

NAME:			PDP	BUS		COPPER				MAINS	3P-100A		
SERVICE:			120/208 VAC	RATING:		100A				LOCATION:	OUTSIDE		
MOUNTING:			SURFACE, NEMA 3R	AIC RATING:		10,000A							
V.A.											V.A.		
A	B	C	LOAD	PHASE	BREAKER	CIRCUIT NUMBER		BREAKER	PHASE	LOAD	A	B	C
12000			LIFT STATION CONTROL PANEL	3	150	1	2	30	3	SPD	0		
	12000		-	-	-	3	4	-	-	-		0	
		12000	-	-	-	5	6	-	-	-			0
0			SPARE	3	20	7	8	15	1	SCADA PANEL	150		
	0		-	-	-	9	10	15	1			0	
		0	-	-	-	11	12	20	1				0
180			CONVENIENCE RECPT	1	20	13	14	20	1		0		
	0			1	20	15	16	20	1			0	
		0		1	20	17	18	20	1				0
0				1	20	19	20	20	1		0		
	0			1	20	21	22	20	1			0	
		0		1	20	23	24	20	1				0
0				1	20	25	26	20	1		0		
	0			1	20	27	28	20	1	GENERATOR - BLOCK HEATER		1500	
		0		1	20	29	30	20	1	GENERATOR - BATTERY CHARGER			40
12180	12000	12000	TOTALS PER PHASE PER SIDE								150	1500	40
12330	13500	12040	TOTALS PER PHASE										
	37870		PANEL TOTAL										

PRICING SET

NO.	DATE	BY	REVISION
A	3-19-2021	TFW	ADDENDUM A

NOTICE
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

AMA DESIGNED
AMA DRAWN
JSP CHECKED

MARCH 2021
Murraysmith
www.murraysmith.us

murraysmith

TOWN OF FRISCO

FRISCO MARINA
LIFT STATION

ONE-LINE ELECTRICAL
DIAGRAMS

PROJECT NO.: 20-2802 | SCALE: AS SHOWN | DATE: 19 MARCH 2021

SHEET 2
E-2

I:\190_Projects\20\2802 - Frisco Marina Lift Station\CAD\Sheets\20-2802-1D-D.dwg E-2 3/5/2021 2:23 PM ADRIENNE.ANGELOS 23.0s (LMS Tech)

FRISCO BAY MARINA

LIFT STATION / DEEP UTILITIES PROJECT

REQUEST FOR PROPOSALS (RFP)

ADDENDUM #2

This Addendum #2, dated March 23, 2021, is to insert additional language and information into the Invitation to Bid section of the Contract Documents. The Town will be conducting the public bid opening virtually due to COVID-19 restrictions currently in place. Due to this the Town sees the need to provide all potential bidders further instructions for the submittal of bids and to provide all potential bidders a link to the virtual meeting to be held on Friday, March 26, 2021 at 12:30PM MST.

Additional bidding instructions to be added to the Invitation to Bid are as follows:

1. The following information must be included in the subject line of the message: "FBM - LIFT STATION / DEEP UTILITIES PROPOSAL – (insert bidder/ company name here).
2. All proposals must be in a PDF format and attached to the message.
3. All proposals shall have the bid form as the cover sheet of the proposal to facilitate a more efficient virtual bid opening.
4. Proposals will be opened on a screen that will be shared will all attendees and the bidders name and total proposal amount will be read aloud.
5. A bid tabulation report will be generated and placed in the project folder no later than 12:00PM MST Monday, March 29, 2021.
6. All bids must be received via electronic email to jeffg@townoffrisco.com no later than 12:00PM MST Friday, March 26, 2021.

Information to attend the Bid Opening is as follows:

Jeff Goble is inviting you to a scheduled Zoom meeting.

https://zoom.us/j/94112324567?pwd=RnZ5aXM3a0VtQ3BMdEFsSFc3bkR4Zz09

Meeting ID: 941 1232 4567

Passcode: 560463

Find your local number: https://zoom.us/u/acVHx0gOON

END OF ADDENDUM

Project(s) Disclosure

The construction plans for the Frisco Bay Marina contain; utilities, lift station, civil construction and office building. It should be known by all prospective bidders that the selected contractors will have to know these plans to the best of their abilities and knowledge, in the event that two contractors are working on site at the same time.

It is the duty of the Town of Frisco, to distribute this information to prospective bidders, in an effort to pinpoint any areas where two contractors may interact throughout the course of any of the three projects which are being advertised.

There is one set of Plans for all work being performed at the Frisco Marina. This bid is in reference to the Lift Station and Deep Utilities plans only. The plans associated with this scope of work are as follows:

- G-1, G-2, and G-3
- C-1, C-2, C-3, and C-4
- D-1, and D-2
- E-1 and E-2
- C104, C105, C106 for Water and Sewer and all appurtenances.