

**ISSUED FOR BID
TECHNICAL
SPECIFICATIONS**

**Northwest Water Treatment Plant
Expansion - Phase 1**

St. Johns County, Florida

July 2019



This page intentionally left blank.

PROCUREMENT AND CONTRACTING DOCUMENTS GROUP

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

SPECIFICATIONS GROUP

General Requirements Subgroup

DIVISION 01 - GENERAL REQUIREMENTS

011000	SUMMARY
011011	SPECIAL PROCEDURES FOR MAINTENANCE OF PLANT OPERATION AND SEQUENCE OF CONSTRUCTION
012900	PAYMENT PROCEDURES
013100	PROJECT MANAGEMENT AND COORDINATION
013200	CONSTRUCTION PROGRESS DOCUMENTATION
013233	PHOTOGRAPHIC DOCUMENTATION
013300	SUBMITTAL PROCEDURES
014000	QUALITY REQUIREMENTS
015000	TEMPORARY FACILITIES AND CONTROLS
015639	TEMPORARY TREE AND PLANT PROTECTION
016000	PRODUCT REQUIREMENTS
017300	EXECUTION
017419	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
017700	CLOSEOUT PROCEDURES
017823	OPERATION AND MAINTENANCE DATA
017839	PROJECT RECORD DOCUMENTS
017900	DEMONSTRATION AND TRAINING
018819	TIGHTNESS TESTING PERFORMANCE REQUIREMENTS
019113	GENERAL COMMISSIONING REQUIREMENTS

Facility Construction Subgroup

DIVISION 02 - EXISTING CONDITIONS

024119	SELECTIVE DEMOLITION
--------	----------------------

DIVISION 03 - CONCRETE

030100.61	CONCRETE REPAIRS
030130.71	MODIFICATIONS TO EXISTING CONCRETE
031000	CONCRETE FORMING AND ACCESSORIES
031500	CONCRETE JOINTS AND ACCESSORIES
032000	CONCRETE REINFORCING
033000	CAST-IN-PLACE CONCRETE
033500	CONCRETE FINISHING
033900	CONCRETE CURING
036000	GROUTING

DIVISION 05 - METALS

- 050519 POST-INSTALLED ANCHORS
- 055000 METAL FABRICATIONS
- 055119 METAL GRATING STAIRS
- 055200 METAL RAILINGS
- 055313 BAR GRATINGS

DIVISION 09 - FINISHES

- 099010 SHOP PRIMING
- 099100 PAINTING

Facility Services Subgroup

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

- 233116 FIBERGLASS DUCTWORK AND ACCESSORIES

DIVISION 26 - ELECTRICAL

- 260000 ELECTRICAL WORK - GENERAL
- 260100 ELECTRICAL SYSTEMS ANALYSIS
- 260400 ELECTRICAL APPARATUS
- 260600 GROUNDING SYSTEM
- 260800 ELECTRICAL CONTROL EQUIPMENT

Site and Infrastructure Subgroup

DIVISION 31 - EARTHWORK

- 310515 SOILS AND AGGREGATES FOR EARTHWORK
- 311000 SITE CLEARING
- 312000 EARTHWORK
- 312319 DEWATERING
- 312333 TRENCHING AND BACKFILLING
- 312500 EROSION AND SEDIMENTATION CONTROLS
- 315000 EXCAVATION SUPPORT AND PROTECTION

DIVISION 32 - EXTERIOR IMPROVEMENTS

- 321216 ASPHALT PAVING
- 323113 CHAIN LINK FENCES AND GATES
- 329119 LANDSCAPE GRADING
- 329200 TURF AND GRASSES

DIVISION 33 - UTILITIES

- 330531.16 POLYVINYL CHLORIDE PRESSURE PIPE FOR WATER SERVICE
- 330532 HIGH DENSITY POLYETHYLENE PIPE
- 331216 WATER UTILITY DISTRIBUTION VALVES
- 331300 DISINFECTING OF WATER UTILITY DISTRIBUTION

331310 DOUBLE CONTAINMENT CHEMICAL PIPING

Process Equipment Subgroup

DIVISION 40 - PROCESS INTERCONNECTIONS

- 400506 COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING
- 400507 HANGERS AND SUPPORTS FOR PROCESS PIPING
- 400519 DUCTILE IRON PROCESS PIPE
- 400551 COMMON REQUIREMENTS FOR PROCESS VALVES
- 400553 IDENTIFICATION FOR PROCESS PIPING
- 400561 GATE VALVES
- 400563 BALL VALVES
- 400564 BUTTERFLY VALVES
- 400565.23 SWING CHECK VALVES
- 400578.13 AIR/VACUUM VALVES FOR WATER SERVICE
- 406100 PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS
- 406121.01 PROCESS CONTROL SYSTEM TESTING
- 406126 PROCESS CONTROL SYSTEM TRAINING
- 406263 OPERATOR INTERFACE TERMINALS
- 406343 PROGRAMMABLE LOGIC CONTROLLERS
- 406643 WIRELESS NETWORK EQUIPMENT
- 406717 INDUSTRIAL ENCLOSURES
- 406733 PANEL WIRING
- 407000 INSTRUMENTATION FOR PROCESS SYSTEMS
- 407243 PRESSURE AND DIFFERENTIAL PRESSURE TYPE LEVEL METERS
- 407276 LEVEL SWITCHES
- 407313 PRESSURE AND DIFFERENTIAL PRESSURE GAUGES
- 407506 SINGLE PARAMETER ANALYZER TRANSMITTER
- 407513 PH/ORP ANALYZERS
- 407853 RELAYS
- 407856 ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS
- 407859 POWER SUPPLIES

DIVISION 43 - PROCESS GAS AND LIQUID HANDLING PURIFICATION AND STORAGE EQUIPMENT

- 432359 HORIZONTAL SPLIT-CASE CENTRIFUGAL HIGH SERVICE PUMPS
- 432427 CORROSION RESISTANT SUMP PUMPS AND FRP WETWELL
- 432516 VERTICAL TURBINE PUMPS

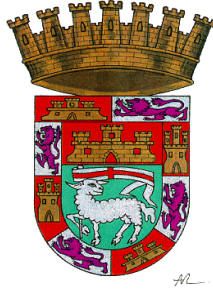
DIVISION 44 - POLLUTION AND WASTE CONTROL EQUIPMENT

- 443133 BIOTRICKLING FILTER SYSTEM

DIVISION 46 - WATER AND WASTEWATER EQUIPMENT

- 460753 FORCED DRAFT STRIPPING TOWER (DEGASIFIER)
- 463143 CARBON DIOXIDE GAS FEED EQUIPMENT
- 463342 DIAPHRAGM-TYPE METERING PUMPS

END OF TABLE OF CONTENTS



**Board of County Commissioners
St. Johns County Florida**

BID NO: 19-83

NORTHWEST WTP PHASE 1 (6 TO 9 MGD) EXPANSION

**BID DOCUMENTS
PROJECT SPECIFICATIONS**

**St. Johns County Purchasing Department
500 San Sebastian View
St. Augustine FL 32084
904.209.0150**

FINAL: 7/25/19

BID NO: 19-83; NORTHWEST WTP PHASE 1 (6 TO 9 MGD) EXPANSION

TABLE OF CONTENTS

FRONT END BID DOCUMENTS

Section 00020 - Notice to Bidders

Section 00100 - Instruction to Bidders

Section 00300 - Official County Bid Form with Attachments

Attachment "A" – St Johns County Board of County Commissioners Affidavit

Attachment "B" – Certificate as to Corporate Principal

Attachment "C" – License/Certification List

Attachment "D" – List of Proposed Sub-Contractors/Suppliers

Attachment "E" – Conflict of Interest Disclosure Form

Attachment "F" – Certificate of Compliance with Florida Trench Safety Act

Attachment "G" – Proof of Insurance

Attachment "H" – Contractor's Qualifications Form

Attachment "I" – Appendix A to the FDEP Supplementary Conditions Certification of Compliance with FDEP Environmental Protection Supplementary Conditions

CONTRACT FORMS AND CONDITIONS

Section C-520 – Agreement Stipulated Price

Attachment A – Public Construction Bond

Section C-700 – Standard General Conditions

Section 00800 – Supplementary Conditions

Exhibit A – Northwest WTP Expansion Geotechnical Report

Section 00801 – FDEP Supplementary Conditions (Construction) including Wage Decision FL135

PROJECT SPECIFICATIONS/DRAWINGS/TECHNICAL DOCUMENTS

Specifications:

Division 01 – General Requirements

Division 02 – Existing Demolition

Division 03 – Concrete

Division 05 – Metals

Division 09 – Finishes

Division 23 – Heating, Ventilating and Air Conditioning (HVAC)

Division 26 – Electrical

Division 31 – Earthwork

Division 32 – Exterior Improvements

Division 33 – Utilities

Division 40 – Process Interconnections

Division 43 – Process Gas and Liquid Handling Purification and Storage Equipment

Division 44 – Pollution and Waste Control Equipment

Division 46 – Water and Wastewater Equipment

Drawings: Pages 1 – 70

END OF TABLE OF CONTENTS

BID NO: 19-83

SECTION 00020 NOTICE TO BIDDERS

Notice is hereby given that sealed bids will be received **until 2:00 P.M. on August 28, 2019** by the St. Johns County Purchasing Department, located at 500 San Sebastian View, St. Augustine, Florida 32084 for **Bid No: 19-83; Northwest WTP Phase 1 (6 to 9 MGD) Expansion**. Bids will be opened promptly after the 2:00 P.M. deadline. **Note:** Bids delivered or received in the Purchasing Department after the 2:00 P.M. deadline shall not be given consideration and shall be returned to the sender unopened.

Scope of Work

The construction of the **Northwest WTP Phase 1 (6 to 9 MGD) Expansion** project requires the contractor to furnish all labor, materials, equipment, and incidentals required to perform the work described in the specifications and as shown on the drawings, including the site improvements, modifications to clear well complex No. 1, the new clear well complex No. 2, the addition of a new Carbon Dioxide storage tank and modifications to the pressure solution feed (PSF) panel, the modifications to the chemical feed systems, the high service pump station improvements, the yard piping addition and improvements, the electrical system and instrumentation system improvements. A detailed scope of work including bid items and allowances can be found in the bid documents. This project is funded through a State Revolving Fund Loan and shall be subject to all Federal-Contract Requirements as provided in the Florida Department of Environmental Protection Supplementary Conditions contained in the bid documents.

Minimum Qualifications

Prime bidder must be fully licensed to do business in the State of Florida and hold a current Certified General Contractor's license at the time the bid is due. Prime or Sub-contractor performing underground utility work shall be fully licensed to do business in the State of Florida and hold a current Certified Underground Utility Contractor's license. Bidders must have successfully completed, as a Prime or Sub-contractor, at least three (3) projects, in the past five (5) years, of similar type, size, and dollar value of the project described herein.

Pre-Bid Conference and Site Visit

A **MANDATORY Pre-Bid Conference** will be held at **10:00 A.M. on August 6, 2019** at the St. Johns County Utility Department, 1205 State Road 16, St. Augustine, FL 32084. Immediately following the Pre-Bid Conference shall be a **MANDATORY Site Visit** at the existing Northwest Water Treatment Plant located at 3390 International Golf Parkway, St. Augustine, Florida 32092. Attendance is required for prime bidders at both the Pre-Bid Conference and the Site Visit in order to be eligible to submit a bid for this project. Failure to sign in at both the Pre-Bid Conference and Site Visit shall result in a bidder being deemed non-responsive and removal from consideration for award. **Please do not park in designated customer service parking spots.**

Bid Documents, Project Specifications and Drawings

Bid Documents may be obtained from Onvia DemandStar, Inc., at their website www.demandstar.com, by requesting Document #19-83. For technical assistance with this website please contact Onvia Supplier Services at 1-800-711-1712. A link to the Onvia DemandStar website is available through the St. Johns County Purchasing website by clicking on the following link: <http://www.sjcfl.us/Purchasing/OpenBids.aspx>. Please check the County's website for download availability and any applicable fees. Bid Documents may also be requested, **in writing**, from David E. Pyle, Procurement Coordinator, St. Johns County Purchasing Department, via email to dpyle@sjcfl.us or fax to (904) 209-0149.

Point of Contact

Any and all questions related to this project shall be directed, **in writing**, to **David E. Pyle, Procurement Coordinator, Purchasing Department**, via email to dpyle@sjcfl.us or fax to (904) 209-0149. In the event the Designated Point of Contact is absent or otherwise unavailable for more than three (3) business days, firms may contact Leigh Daniels, CPPB, Procurement Supervisor at ldaniels@sjcfl.us.

Questions are due no later than **4:00 P.M. on August 14, 2019** so that any necessary addenda may be issued in a timely manner. Any questions received after the deadline will not be answered unless previously approved by the SJC Purchasing Manager or other designated County Representative.

procedure or specification with respect to any bid, invitation, solicitation of proposals, or requests for qualifications, shall file with the Purchasing Department for St. Johns County, a written notice of intent to protest no later than 72 hours (excluding Saturdays, Sundays and legal holidays for employees of St. Johns County) after the posting either electronically or by other means of the notice of intended action, notice of intended award, bid tabulation, publication by posting electronically or by other means of a procedure, specification, term or condition which the person intends to protest, or the right to protest such matter shall be waived. The protest procedures may be obtained from the Purchasing Department and are included in the County's Purchasing Manual. All of the terms and conditions of the County's Purchasing Manual are incorporated by reference and are fully binding.

Vendors shall not contact, lobby, or otherwise communicate with any SJC employee, including any member of the Board of County Commissioners, other than the above referenced individual from the point of advertisement of the Bid until contract(s) are executed by all parties, per SJC Purchasing Code 304.6.5 "Procedures Concerning Lobbying". According to SJC policy, any such communication shall disqualify the vendor, contractor, or Contractor from responding to the subject invitation to bid, request for quote, request for proposal, invitation to negotiate, or request for qualifications. St. Johns County reserves the right to accept or reject any or all bids/proposals, waive minor formalities, and to award the bid/proposal that best serves the interests of St. Johns County. St. Johns County also reserves the right to award the base bid and any alternate bids in any combination that best suits the needs of the County.

BOARD OF COUNTY COMMISSIONERS
OF ST. JOHNS COUNTY, FLORIDA
HUNTER S. CONRAD, CLERK

BY: _____
Deputy Clerk

FRONT END BID DOCUMENTS

SECTION 00100
INSTRUCTION TO BIDDERS

OWNER: The Board of County Commissioners of St. Johns County, Florida (“County”) OR (“Owner”)

PROJECT: BID NO.: 19-83; Northwest WTP Phase 1 (6 to 9 MGD) Expansion

DEFINITIONS

All definitions set forth in the General Conditions of the Contract or in other Contract Documents are applicable to the Bidding Documents.

Addenda are written or graphic instruments issued by the Purchasing Department prior to the time and date for receiving Bids that modify or interpret the Bidding Documents by addition, deletion, clarification, or corrections.

Base Bid is complete and properly signed proposal to do the work, or designated portion thereof, for the sums stipulated therein supported by data called for by the Bidding Documents.

Bid An offer, as a price, whether for payment or acceptance. A quotation, specifically given to a prospective purchaser upon its request, usually in competition with other vendors

Bid (Formal or Sealed) A request for firm prices by Advertised Legal Notice. Prices are submitted in sealed envelopes and in conformance with a prescribed format, all of which are opened in public on an appointed hour and date as advertised.

Bid Bond A good faith monetary commitment which a bidder or surety forfeits to the County of the bidder refuses, or is unable to enter into a contract after submitting a bid, or the bidder cannot furnish the required bonds, usually five percent (5%) of the bid proposal price.

Bidder is a firm or individual who submits a Bid to the Owner for the work described in the proposed Contract Documents.

Bidding Documents include the Advertisement/Notice to Bidders, Front End Bid Documents, Contract Forms and Conditions, Specifications and Plans including any Addenda issued prior to receipt of Bids.

Contract A delivered agreement between two or more parties, legally binding and enforceable, to perform a specific act or acts or exchange goods for consideration. A purchase order becomes a contract when accepted by a vendor. A unilateral contract is one in which only one party promises performance. A bilateral contract is one in which both parties promise performance.

Contractor An individual or firm having a contract to provide goods, service or construction for a specified price

County St. Johns County, a political subdivision of the State of Florida (F.S. 217.73)

Experience Modification Rate (EMR) Number used by insurance companies to gauge both past cost of injuries and future chances of risk.

Responsible Bidder A bidder capable of performing in all respects to fulfill the contract requirements. This includes having the ability to perform, the experience, reliability, capacity, credit, facilities and equipment to meet the contractual obligation.

Responsive Bid, Responsive Proposal, or Responsive Reply A bid, proposal, or reply submitted by a responsive and responsible vendor conforming in all material respects to the solicitation.

Specifications A clear, complete and accurate statement of the physical, functional or technical requirements descriptive of an item and if applicable, the procedure to be followed to determine if the requirements are met.

Subcontractor A party who contracts with a prime contractor to perform all or any part of the prime contractor's obligations.

Unit Price is an amount stated in the Bid as a price per unit of measurement for materials or services as described in the contract documents which shall include all labor, materials, equipment and any other item/s essential to accomplish the scope of work of the Unit Price.

BIDDER'S REPRESENTATION

Each Bidder, by marking his Bid, represents that he has read and understands the Bidding and Contract Documents and his Bid is made in accordance herewith: he has visited the Site and has familiarized himself with the local conditions under which the Work is to be performed; and his Bid is based upon the materials, systems and equipment described in the Bidding Documents without exceptions.

BIDDING DOCUMENTS

Bidding documents may be obtained from www.demandstar.com as stated in the Advertisement or Invitation - Notice to Bidders. Complete sets of Bidding Documents shall be used in preparing the Bid Proposal. St. Johns County shall not assume any responsibility for errors or misinterpretations resulting from the use of complete or incomplete sets of Bidding Documents. The Owner, in making copies of the Bidding Documents available on the above terms, do so only for the purpose of obtaining bids on the Work and do not confer a license or grant for any other use.

INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

Bidders shall promptly notify the Owner of any ambiguity, inconsistency, or error which they may discover upon examination of the Bidding Documents or of the site and local conditions. Bidders requiring clarification of interpretation of the Bidding Documents shall make a written request to the Owner, to reach him at least **fourteen (14) calendar days** prior to the date for receipt of Bids.

An interpretation, correction, or change of the bidding Documents will be made by Addendum. Interpretation, corrections, or changes of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretation, corrections, and change. No change will be made to the Bidding Documents by the Owner or its Representative **seven (7) days** prior to Bid receiving date, however, the Owner reserves the authority to decrease this time depending on the necessity of such change.

SUBSTITUTIONS

The materials, products and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. No substitution will be considered unless written request for approval has been submitted by the Bidder and has been received by the Owner at least **fourteen (14) calendar days** prior to the date for receipt of Bids. Each such request shall meet the requirements of the Supplementary Conditions and include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute, including drawings, cuts, performance and test data any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The project director's approval or disapproval of a proposed substitution shall be final.

If County Staff approves any proposed substitution, such approval will be set forth in an Addendum. Bidders shall **not** rely upon approval made in any other manner.

PRE-BID CONFERENCE AND SITE VISIT

A **MANDATORY Pre-Bid Conference** will be held on **August 6, 2019 at 10:00 A.M.** at the St. Johns County Utility Department, 1205 State Road 16, St. Augustine, FL 32084. Immediately following the Pre-Bid Conference shall be a **MANDATORY Site Visit** at the existing Northwest Water Treatment Plant located at 3390 International Golf Parkway, St. Augustine, Florida 32092. Attendance is required for prime bidders at both the Pre-Bid Conference and the Site Visit in order to be eligible to submit a bid for this project. Failure to sign in at both the Pre-Bid Conference and Site Visit shall result in a bidder being deemed non-responsive and removal from consideration for award. **Please do not park in designated customer service parking spots.**

DESIGNATED POINT OF CONTACT

Any and all questions related to this project shall be directed, **in writing**, to David E. Pyle, CPPB, Procurement Coordinator, Purchasing Department, via email to dpyle@sjcfl.us or fax to (904) 209-0149. In the event the Designated Point of Contact is absent or otherwise unavailable for more than three (3) business days, firms may contact Leigh Daniels, CPPB, Procurement Supervisor at ldaniels@sjcfl.us.

Bidders shall not contact, lobby, or otherwise communicate with any other County Staff, including members of the Board of County Commissioners, other than the designated representative shown above. Failure to comply with this requirement

shall disqualify a bidder from consideration for award, as provided in St. Johns County Purchasing Code 304.6.5 as provided below:

Vendors shall not contact, lobby, or otherwise communicate with any SJC employee, including any member of the Board of County Commissioners, other than the above referenced individual from the point of advertisement of the Bid until contract(s) are executed by all parties, per SJC Purchasing Code 304.6.5 “Procedures Concerning Lobbying”. According to SJC policy, any such communication shall disqualify the vendor, contractor, or Contractor from responding to the subject invitation to bid, request for quote, request for proposal, invitation to negotiate, or request for qualifications. St. Johns County reserves the right to accept or reject any or all bids/proposals, waive minor formalities, and to award the bid/proposal that best serves the interests of St. Johns County. St. Johns County also reserves the right to award the base bid and any alternate bids in any combination that best suits the needs of the County.

QUESTIONS

Any and all questions related to this project shall be directed, **in writing**, to David E. Pyle, Procurement Coordinator, Purchasing Department, via email to dpyle@sjcfl.us or fax to (904) 209-0149. Questions are due no later than **4:00 P.M.** on **August 14, 2019**, so that any necessary addenda may be issued in a timely manner. Any questions received after the deadline will not be answered unless previously approved by the SJC Purchasing Manager or other designated County Representative.

ADDENDA

Addenda will be distributed to all who are known by the entity responsible for distribution of the complete set of Bidding Documents. Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

Each Bidder shall ascertain prior to submitting a bid, that all issued addenda have been received, and each Bidder **shall** acknowledge receipt, of all issued addenda in the space provided in the Official County Bid Form, and a fully acknowledged copy of each issued addendum must be included in the submitted bid proposal. Failure to provide fully acknowledged copies of each addendum may result in a bid proposal being deemed non-responsive.

BID SUBMITTAL REQUIREMENTS

Bids shall be submitted in **TRIPPLICATE (one (1) original and two (2) copies)** on the required forms provided herein. All blanks on the Bid Form shall be filled in by typewriter or manually in blue or black ink. Bidders are not required to submit a copy of this Bid Document with their bid proposals. The bidders are required to submit, at a minimum, the Bid Proposal Attachments listed in this Document.

Bid proposals must be placed in an envelope, sealed and placed in a second envelope or container, plainly marked on the outside addressed to St. Johns County Purchasing Department, with the bidder’s return address in top left hand corner and recite: **“BID NO: 19-83; Northwest WTP Phase 1 (6 to 9 MGD) Expansion”**.

See Example Below:

ABC Company, Inc. 123 Aviles Street St. Augustine, FL 32084	St. Johns County Purchasing Department 500 San Sebastian View St. Augustine, FL 32084 BID NO.: 19-83 – SEALED BID FOR SAMPLE PROJECT
---	--

At the end of this document, a sealed Bid mailing label is provided for convenience. Bidders shall affix the provided label to the outside of the sealed envelope/container to submit their Bid.

Bidder shall assume full responsibility for timely delivery at location designated for receipts of Bids. Bids shall be deposited at the designated location prior to the time and date for receipt of Bids indicated in the Advertisement/Notice to Bidders, or any time extension thereof made by Addendum. Bids received after the time and date for receipt of Bids will be returned to the sender unopened.

Oral, telephonic, telegraphic or electronic Bids are invalid and will not receive consideration.

Where so indicated by the makeup of the Bid Form, sums shall be expressed in both words and figures, and in the case of discrepancy between the two, the amount expressed in words shall govern.

Any interlineations, alteration or erasure must be initialed by the signer of the Bid; failure to do so may cause the Bidder's proposal to be considered non-responsive.

Bidder shall make no stipulation on the Bid Form nor qualify his Bid in any manner, to do so will classify the Bid as being non-responsive, and may result in the Bidder being removed from consideration for award.

Each submitted copy of the Bid Proposal shall include the full legal company name, address, telephone number and legal name of an authorized representative for the Bidder and a statement as to whether the Bidder is a sole proprietor, partnership, corporation, or any other legal entity. Each copy of the submitted Bid shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporation seal affixed.

A Bid submitted by an agent shall have a current Power of Attorney attached certifying agent's authority to bind the Bidder.

BID SECURITY

Each submitted Bid shall be accompanied by a Bid Security, submitted on the Bid Bond Form provided herein, or in the form of a certified or cashier's check, in the amount of **five percent (5%) of the Total Lump Sum Bid Price (Base Bid + Allowances)** amount submitted on the Official County Bid Form, pledging that the Bidder will enter into a contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds as described hereunder covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds to the Owner, if required, the amount of the Bid Security shall be forfeited, not as penalty, but as liquidated damages.

A Bid Security in the form of a certified or cashier's check must be made payable to the Board of County Commissioners of St. Johns County. Bidders submitting a certified or cashier's check as the bid security are not required to submit Attachment "B" – Certificate as to Corporate Principal or the Bid Bond forms provided herein.

A Bid Security in the form of a Bid Bond shall be written on the form provided herein, with an acceptable surety, and the Attorney-in-Fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of his Power of Attorney. Acceptable surety companies are defined herein under "Surety Bond". The Surety Company shall be licensed to do business in the State of Florida and shall be listed by the U.S. Treasury Department. Any Bidder submitting a Bid Security in the form of a Bid Bond must also submit Attachment "B" – Certificate as to Corporate Principal.

The Owner shall have the right to retain the Bid Security of Bidders until either: (a) the Contract is executed and bonds, if required, have been furnished, or (b) the specified time has elapsed so that Bids may be withdrawn, or (c) all Bids have been rejected.

BID BOND INSTRUCTIONS

If a Bidder chooses to submit a Bid Bond on the form provided herein, he must submit the bond as follows:

1. Prepare and submit one (1) original and two (2) copies of the required Bid Bond Forms as shown above
2. Type or print Bidder's and Surety's names in the same language as in the Advertisement, or Invitation to Bid.
3. Affix the Corporate Seal, and type or print the name of the Surety on the line provided and affix its corporate seal.
4. Attach a copy of Surety agent's Power of Attorney, unless the Power of Attorney has been recorded in St. Johns County. If it has been recorded, give the record book and page. If not recorded, the copy of the Power of Attorney must have an original signature of the Secretary or Assistant Secretary of Surety certifying the copy. The Surety's corporate seal must be affixed.

BID POSTPONEMENT/CANCELLATION

The County may, at its sole and absolute discretion, reject any bids that are not submitted in accordance with the terms in this Bid Solicitation. The County may re-advertise this Bid; postpone or cancel, at any time, this Bid process; or waive

any irregularities in this Bid or in the proposals received as a result of this Bid.

MODIFICATION OR WITHDRAWAL OF BID

A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the time and date designated for the receipt of Bids, and Bidder so agrees in submitting his Bid.

Prior to time and date designated for receipt of Bids, a Bid submitted early may be modified or withdrawn only by notice to the party receiving Bids at the place and prior to the time designated for receipt of Bids.

Such notice shall be in writing over the signature of the Bidder. If by telephone, written confirmation over the signature of Bidder must be mailed and postmarked on or before the date and time set for receipt of Bids; it shall be so worded as not to reveal the amount of the original Bid.

Withdrawn Bids may be resubmitted up to the time designated for the receipt of Bids provided that they are then fully in conformance with these Instructions to Bidders.

Bid Security shall be in the amount of five percent (5%) of the Bid as modified or resubmitted.

COSTS INCURRED BY BIDDERS

All expenses involved with the preparation and submission of bids to the County, or any work performed in connection therewith, shall be borne by the Bidder(s). No rights of ownership will be conferred until title of the property is transferred to the successful bidder. All fees for copying and reproduction services for items listed herein are nonrefundable.

CONSIDERATION OF BIDS

Opening of Bids: Unless stated otherwise in an Addenda to the Advertisement/Notice to Bidders, the properly identified Bids received on time will be opened publicly as specified in the Advertisement and a tabulation of the bid amounts of the Base Bids and major Alternates, if any, will be made available to Bidders. The Bid Tabulation will be posted on the Purchasing Department bulletin board for seventy two (72) hours.

Any bidder, proposer or person substantially and adversely affected by an intended decision or by an term, condition, procedure or specification with respect to any bid, invitation, solicitation of proposals or requests for qualifications, shall file with the Purchasing Department for St. Johns County, a written notice of intent to protest no later than seventy two (72) hours (excluding Saturdays, Sundays and legal holidays for employees of St. Johns County) after the posting either electronically or by other means of the notice of intended action, not of intended award, bid tabulation, publication by posting electronically or by other means of a procedure, specification, term or condition which the person intends to protest, or the right to protest such matter shall be waived. The protest procedures may be obtained from the Purchasing Department and are included in the Owner's Purchasing Manual. All of the terms and conditions of the Owner Purchasing Manual are incorporated by reference and are fully binding.

Rejection of Bids: The Owner reserves the right to reject any or all Bids and in particular to reject a Bid not accompanied by any required Bid Security or data required by the Bidding Documents or a Bid in any way incomplete or irregular.

Acceptance of Bid (Award): The Owner shall have the right to reject any or all Bids or waive any minor formality or irregularity in any Bid received.

The Owner shall have the right to accept alternates in any order or combination and to determine the low Bidder on the basis of the sum of the Base Bid and/or the Alternates accepted if alternate bids are requested in the Official County Bid Form.

It is the intent of the Owner to award a contract to the lowest responsible Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents, if judged to reasonable, and does not exceed the funds budgeted for the Project.

If the Contract is awarded, it will be awarded within a minimum of ninety (90) days from the date of the Bid opening, or as designated in the Bid Documents.

MINIMUM QUALIFICATION OF CONTRACTORS

Prime bidder must be fully licensed to do business in the State of Florida and hold a current Certified General Contractor's license at the time the bid is due. Prime or Sub-contractor performing underground utility work shall be fully licensed to do business in the State of Florida and hold a current Certified Underground Utility Contractor's license. Bidders must have successfully completed, as a Prime or Sub-contractor, at least three (3) projects, in the past five (5) years, of similar type, size and dollar value of the project described herein.

Proof of qualifications shall be provided by completing and submitting Attachment "H" – Contractor's Qualifications Form and Attachment "C" along with a copy of each license and certificate listed. All licenses, certifications and pre-qualifications must be valid and current on the date bids are submitted.

Bidders to whom award of a contract is under consideration shall submit to the County, upon his request, a properly executed Contractor's Qualification Statement of AIA Document A305, unless such a statement has been previously required and submitted as a prerequisite to the issuance of Bidding Documents.

SUB-CONTRACTORS

Each Bidder shall submit to the County, a list of Subcontractors and major materials suppliers to be used if awarded the contract. A copy of the form, Attachment "D", is provided in the Bidding Documents.

Upon request by the County, the successful Bidder shall within seven (7) days thereafter, submit all data required to establish to the satisfaction of the County, the reliability and responsibility of the proposed Subcontractors to furnish and perform the work described in the Sections of the Specifications pertaining to such proposed Subcontractor's respective trades.

Prior to the award of the Contract, the County will notify the Bidder in writing if either the County, after due investigation, has reasonable and substantial objection to any person or organization proposed as a Subcontractor. The Bidder then may, at his option, withdraw his Bid without forfeiture of Bid Security or submit an acceptable substitute at no increase in Bid price. If the Bidder fails to submit an acceptable substitute within seven (7) days of the original notification, the County then may, at his option, disqualify the Bidder, at no cost to the County.

The County reserves the right to disqualify any Contractor, Subcontractor, Vendor, or material supplier due to previously documented project problems, either with performance or quality.

Sub-contractors and other persons and organizations proposed by the Bidder and accepted by the County, must be used on the work for which they were proposed and accepted and shall not be changed except with the written approval of the County.

PUBLIC CONSTRUCTION BOND

The Contractor shall be required to obtain and submit a recorded Public Construction Bond covering the faithful performance of the Contract and the payment of all obligations arising thereunder in full amount of the Contract, with such acceptable sureties, secured through the Bidder's usual sources as may be agreeable to the parties. The Contractor shall furnish the required bond, after full execution of the awarded Contract. The Bond shall be released upon satisfactory completion of the project.

SURETY BOND

Acceptable Surety Companies: To be responsible to the Owner as Surety on Bonds, Surety shall comply with the following provisions:

1. Surety must be licensed to do business in the State of Florida;
2. Surety must have been in business and have a record of successful continuous operations for at least three (3) years;
3. Surety shall not have exposed itself to any loss on any one risk in an amount exceeding twenty percent (20%) of its surplus to policyholders;
4. Surety must have fulfilled all of its obligations on all other bonds given to the Owner;
5. Surety must have good underwriting, economic management, adequate reserves for undisclosed liabilities, and net resources for unusual stock and sound investment.

Time of Delivery and Form of Bonds

The Public Construction Bond form will be forwarded to the successful Bidder with his copy of the fully executed

contract. **The Public Construction Bond must be recorded after the contract is signed by all parties.** The bidder will have three (3) days from receipt of fully executed contract to have the Public Construction Bond recorded. The bidder shall have the Public Construction Bond recorded at the St. Johns County Clerk of Courts office, in St. Augustine, Florida. After the book and page number have been assigned to the bond by the recording person, the Bidder is to obtain from the recording person a certified copy of the recorded bond, and deliver the certified copy to the Owner's Contract Administrator. No work can commence until the required bond and Insurance Certificates have been delivered to the Owner. Upon receipt of the certified copy of the recorded bond, the Owner may issue a Notice to Proceed.

Unless otherwise specified in the Bid Documents, the bonds shall be written on the form provided herein. The Bidder shall require the Attorney-in-Fact who executes the required bonds on behalf of the Surety to affix thereto a certified and current copy of his Power of Attorney authorizing his firm to act as agent for the Surety in issuing the bonds.

INDEMNIFICATION

To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, its officials, and employees, from and against liability, claims, damages, losses and expenses including attorney's fees arising out of or resulting from performance of the work, provided that such liability, claims, damages, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the work itself) including loss of use resulting therefrom, but only to the extent caused in whole or in part, by negligent acts or omissions of the Contractor, a Subcontractor, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such liability, claim, damage, loss or expense is caused in part by a party indemnified hereunder.

In claims against any person or entity indemnified under this paragraph by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefits acts or other employee benefits acts.

TERMINATION

Failure on the part of the Contractor to comply with any portion of the duties and obligations under the Contract Agreement shall be cause for termination. If the Contractor fails to perform any aspect of the responsibilities described herein St. Johns County shall provide written notification of any and all items of non-compliance. The Contractor shall then have five (5) consecutive calendar days to correct any and all items of non-compliance. If the items of non-compliance are not corrected, or acceptable corrective action has not been taken within the five (5) consecutive calendar days, the Contract Agreement may be terminated by St. Johns County for cause, upon giving fourteen (14) consecutive calendar days written notice to the Contractor.

The County may terminate the Contract Agreement at any time, without cause, upon thirty (30) days written notice to the Contractor of intention to do so.

If, at any time, the Contract Agreement with the awarded vendor is terminated by the County, whether for cause or for convenience, the County may, at its sole discretion, negotiate with the second lowest, responsible, responsive bidder for the required services in order to enter into a contract with that vendor to prevent a gap in services for the County, if it serves the best interest of the County to do so.

FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

Form to be used: Unless otherwise provided in the Bidding Documents, the Agreement for Work will be written on C-520 Agreement Stipulated Price.

CONTRACT TIME – LIQUIDATED DAMAGES

The Contractor shall have ten (10) days to return Contract originals from the time the Contractor receives a "Notice of Award". St. Johns County will return a "fully executed" Contract to the Contractor no later than seven (7) days after the return of the executed Contract originals (but no later than seventeen (17) days from the Notice of Award).

The Contractor will furnish a recorded original of the Public Construction Bond three (3) business days after receipt of the fully executed Contract (the Public Construction Bond must be recorded after the Contract is fully executed by all parties including the County Clerk). Upon receipt of the recorded Public Construction Bond, the County will issue a Notice to

Proceed. If the Contractor fails to meet any of the dates and timeframes set forth in this section, or fails to execute the Contract, or to provide a Public Construction Bond, the County may elect at its option to consider the Contractor non-responsive and Contract with the next best Bidder.

The work to be performed under this Agreement shall be commenced within **ten (10)** days of the date of the Notice to Proceed, in writing. Construction of the project shall be substantially complete within **five hundred and seventy one (571)** consecutive calendar days from the date stipulated on the Notice to Proceed. Final completion shall be attained within **thirty (30)** consecutive calendar days from the date of substantial completion.

Conditions under which Liquidated Damages are Imposed:

Should the Contractor or, in case of his default, the Surety fail to complete the work within the time stipulated in the contract, or within such extra time as may have been granted by the Owner, the Contractor or, in case of his default, the Surety shall pay to the Owner, not as a penalty but as liquidated damages, the amount so due as determined by the following schedule:

<u>Original Contract Amount</u>	<u>Daily Charge Per Calendar Day</u>
\$50,000 and under.....	\$956 Over
\$50,000 but less than \$250,000.....	\$964
\$250,000 but less than \$500,000.....	\$1,241
\$500,000 but less than \$2,500,000.....	\$1,665
\$2,500,000 but less than \$5,000,000.....	\$2,712
\$5,000,000 but less than \$10,000,000.....	\$3,447
\$10,000,000 but less than \$15,000,000.....	\$4,816
\$15,000,000 but less than \$20,000,000.....	\$5,818
\$20,000,000 and over.....	\$9,198 plus 0.00005 of any amount over \$20 million

(Round to nearest whole dollar)

INSURANCE

The Contractor shall not commence work under this Agreement until he/she has obtained all insurance required under this section and such insurance has been approved by the County. All insurance policies shall be issued by companies authorized to do business under the laws of the State of Florida. The Contractor shall furnish proof of Insurance to the County prior to the commencement of operations. The Certificate(s) shall clearly indicate the Contractor has obtained insurance of the type, amount, and classification as required by contract and that no material change or cancellation of the insurance shall be effective without thirty (30) days prior written notice to the County. **Certificates shall specifically include the County as Additional Insured for all lines of coverage except Workers' Compensation and Professional Liability. A copy of the endorsement must accompany the certificate.** Compliance with the foregoing requirements shall not relieve the Contractor of its liability and obligations under this Agreement.

Certificate Holder Address: St. Johns County, a political subdivision of the State of Florida
500 San Sebastian View
St. Augustine, FL 32084

The Contractor shall maintain during the life of this Agreement, Comprehensive General Liability Insurance with minimum limits of \$1,000,000 per occurrence, \$2,000,000 aggregate, to protect the Contractor from claims for damages for bodily injury, including wrongful death, as well as from claims of property damages which may arise from any operations under this contract, whether such operations be by the Contractor or by anyone directly employed by or contracting with the Contractor.

The Contractor shall maintain during the life of this Agreement, Professional Liability or Errors and Omissions Insurance with minimum limits of \$1,000,000, if applicable.

The Contractor shall maintain during the life of this Contract, Comprehensive Automobile Liability Insurance with minimum limits of \$2,000,000 combined single limit for bodily injury and property damage liability to protect the Contractor from claims for damages for bodily injury, including the ownership, use, or maintenance of owned and non-owned automobiles, including rented/hired automobiles whether such operations be by the Contractor or by anyone directly or indirectly employed by a Contractor.

The Contractor shall maintain Umbrella or Excess Liability Insurance covering workers compensation, commercial general liability and business auto liability with minimum limits of liability of \$1,000,000.

The Contractor shall maintain during the life of this Agreement, adequate Workers' Compensation Insurance in at least such amounts as is required by the law for all of its employees per Florida Statute 440.02.

The CONTRACTOR shall maintain during the life of this Contract, adequate Builder's Risk Insurance in the amount of the initial contract amount plus the values of subsequent modifications, change orders, and loss of materials supplied or installed by others comprising the value of the entire project at the site on a replacement cost basis.

In the event of unusual circumstances, the County Administrator or his designee may adjust these insurance requirements.

GOVERNING LAWS & REGULATIONS

The Contractor shall be responsible for being familiar and complying with any and all federal, state, and local laws, ordinances, rules and regulations that, in any manner, affect the work required under this contract. The agreement shall be governed by the laws of the State of Florida and St. Johns County both as to interpretation and performance.

TAXES

Project is subject to Federal Excise and Florida Sales Taxes, which must be included in Bidder's proposal.

FLORIDA TRENCH SAFETY ACT

Bidders shall complete Certificate of Compliance with Florida Trench Safety Act, in accordance with the requirements of Chapter 553, Florida Statutes. If trenching is not required for this project, state so thereon. Contractor shall be responsible for compliance with all trenching shoring safety requirements.

LIST OF MAJOR EQUIPMENT/MATERIAL SUPPLIERS

No substitution will be considered unless written request for approval has been submitted by the Bidder and has been received by the Engineer at least **fourteen (14) calendar days** prior to the date for receipt of Bids and has been approved by Owner/Engineer via addenda.

The Owner reserves the right to disqualify any Contractor, Subcontractor, Vendor, or material/equipment supplier due to previously documented problems, either with performance or quality.

OWNER DIRECT PURCHASE

St. Johns County reserves the right to Owner Direct Purchase materials or equipment in accordance with County Purchasing Policy 302.21 or implement other means in order to achieve related sales tax or other cost savings.

END OF SECTION

**OFFICIAL COUNTY BID FORM
WITH ATTACHMENTS**

BID NO: 19-83

**SECTION 00300
OFFICIAL COUNTY BID FORM
ST. JOHNS COUNTY, FLORIDA**

PROJECT: Northwest WTP Phase 1 (6 to 9 MGD) Expansion

TO: THE BOARD OF COUNTY COMMISSIONERS OF ST. JOHNS COUNTY, FLORIDA

DATE SUBMITTED: _____

BID PROPOSAL OF

Full Legal Company Name

Mailing Address

Telephone Number

Fax Number

Bidders: Having become familiar with requirements of the project, and having carefully examined the Bidding Documents and Specifications entitled for Bid No: 19-83, Northwest WTP Phase 1 (6 to 9 MGD) Expansion in St. Johns County, Florida, the undersigned proposes to furnish all materials, labor and equipment, supervision and all other requirements necessary to comply with the Contract Documents to submit the following Bid Proposal summarized as follows:

BASE BID

FOR: Northwest WTP Phase 1 (6 to 9 MGD) Expansion as per plans and specifications.

Schedule of Prices

Item No.	Estimated Quantity	Brief Description of Item	Bid Amount in Figures
1.	Lump Sum	All costs for all labor, materials equipment, supplies, taxes, other miscellaneous costs, profit, and overhead, both direct and indirect, for completion of all Work except for those Bid Items hereinafter listed separately	
Lump Sum			\$ _____

Item No.	Estimated Quantity	Brief Description of Item with Unit Price in Words	Bid Amount in Figures
2.		Allowance for Materials Testing <u>Ten thousand dollars</u>	\$ <u>10,000.00</u>
3.		Allowance for Permitting <u>Five thousand dollars</u>	\$ <u>5,000.00</u>
4.		Allowance for FPL <u>Fifteen thousand dollars</u>	\$ <u>15,000.00</u>

TOTAL LUMP SUM BID PRICE: (Summation of Items 1 through 4)

\$ _____

Total Lump Sum Bid Price (Numerical)

_____/100 Dollars

Total Lump Sum Bid Price (Amount written or typed in words)

Bidder shall insert the Total Bid Price in numerals and in words. Any discrepancy between the two submitted amounts shall be determined by the amount written in words.

During the preparation of the Bid, the following addenda, if any, were received:

No.: _____ Date Received:

No.: _____ Date Received:

No.: _____ Date Received:

We, the undersigned, hereby declare that no person or persons, firm or corporation, other than the undersigned are interested, in this proposal, as principals, and that this proposal is made without collusion with any person, firm or corporation, and we have carefully and to our satisfaction examined the Bid Documents and Project Specifications.

We have made a full examination of the location of the proposed work and the sources of supply of materials, and we hereby agree to furnish all necessary labor, equipment and materials, fully understanding that any quantities shown therewith are approximate only, and that we will fully complete all requirements therein as prepared by the Owner, within the same time limit specified in the Bid Documents as indicated above.

If the Undersigned is notified of the acceptance of this Bid Proposal by the Board within ninety (90) calendar days for the time set for the opening of Bids, the Undersigned further agrees, to execute a contract for the above work within ten (10) days after notice that his Bid has been accepted for the above stated compensation in the form of a Contract presented by the Owner.

The Undersigned further agrees that security in the form of a Bid Bond, certified or cashier's check in the amount of not less than five percent (5%) of Total Bid Price, payable to the Owner, accompanies this Bid; that the amount is not to be construed as a penalty, but as liquidated damages which said Owner will sustain by failure of the Undersigned to execute

and deliver the Contract and Bond within ten (10) days of the written notification of the Award of the Contract to him; thereupon, the security shall become the property of the Owner, but if this Bid is not accepted within ninety (90) days of the time set for the submission of Bids, or if the Undersigned delivers the executed Contract upon receipt, the Security shall be returned to the Bidder within seven (7) working days.

CORPORATE/COMPANY

Full Legal Company Name: _____ (Seal)

By: _____
Signature of Authorized Representative (Name & Title typed or printed)

By: _____
Signature of Authorized Representative (Name & Title typed or printed)

Address: _____

Telephone No.: (____) _____ Fax No.: (____) _____

Email Address for Authorized Company Representative: _____

Federal I.D. Tax Number: _____ DUNS #: _____
(If applicable)

INDIVIDUAL

Name: _____
(Signature) (Name typed or printed) (Title)

Address: _____

Telephone No.: (____) _____ Fax No.: _____

Email Address: _____

Federal I.D. Tax Number: _____

- Submittal Requirements:
- Official County Bid Form
 - Attachment "A" – St Johns County Board of County Commissioners Affidavit
 - Attachment "B" – Certificate as to Corporate Principal
 - Attachment "C" – License / Certification List
 - Attachment "D" – List of Proposed Sub-Contractors / Suppliers
 - Attachment "E" – Conflict of Interest Disclosure Form
 - Attachment "F" – Certificate of Compliance with Florida Trench Safety Act
 - Attachment "G" – Proof of Insurance
 - Attachment "H" – Contractor's Qualifications Form
 - Attachment "I" – Appendix A to the FDEP Supplementary Conditions Certification of Compliance with FDEP Environmental Protection Supplementary Conditions
 - Bid Bond Form
 - Fully Acknowledged Addenda Applicable to this bid

Official County Bid Form, Attachments "A", "B", "C", "D", "E", "F", "G", "H", "I" and Bid Bond must be completed, along with a fully acknowledged copy of each Addendum applicable to this Bid and submitted with each copy of the Bid Proposal. One (1) original and two (2) copies of all required forms must be submitted.

BID NO: 19-83

ATTACHMENT "A"

ST. JOHNS COUNTY, BOARD OF COUNTY COMMISSIONERS AFFIDAVIT

TO: ST. JOHNS COUNTY, BOARD OF COUNTY COMMISSIONERS,
ST. JOHNS COUNTY, ST. AUGUSTINE, FLORIDA.

At the time the proposal is submitted, the Bidder shall attach to his Bid a sworn statement.

This sworn statement shall be an affidavit in the following form, executed by an officer of the firm, association, or corporation submitting the proposal, and shall be sworn to before a person who is authorized by law to administer oaths.

STATE OF FLORIDA, COUNTY OF ST. JOHNS

Before me, the Undersigned authority, personally appeared _____ who being duly sworn, deposes and says he is _____ (Title) of the firm of _____ Bidder submitting the attached proposal for the services covered by the bid documents for Bid No: 19-83; Northwest WTP Phase 1 (6 to 9 MGD) Expansion, in St. Johns County, Florida.

The affiant further states that no more than one proposal for the above-referenced project will be submitted from the individual, his firm or corporation under the same or different name, and that such Bidder has no financial interest in the firm of another bidder for the same work. That neither he, his firm, association nor corporation has either directly or indirectly entered into any agreement, participated in any collusion, nor otherwise taken any action in restraint of free competitive bidding in connection with this firm's Bid on the above-described project. Furthermore, neither the firm nor any of its officers are barred from participating in public contract lettings in the State of Florida or any other state.

(Bidder)

Sworn and subscribed to me this _____ day
of _____, 20____.

By: _____

Notary Public:

(Title)

Signature

Printed

My commission Expires: _____

BIDDER ON ALL COUNTY PROJECTS MUST EXECUTE AND ATTACH THIS AFFADAVIT TO EACH BID.

ATTACHMENT "E"

**ST. JOHNS COUNTY BOARD OF COUNTY COMMISSIONERS
CONFLICT OF INTEREST DISCLOSURE FORM**

Project (BID) Number/Description: Bid No 19-83: Northwest WTP Phase 1 (6 to 9 MGD) Expansion

The term "conflict of interest" refers to situations in which financial or other considerations may adversely affect, or have the appearance of adversely affecting a consultant's/contractor's professional judgment in completing work for the benefit of St. Johns County ("County"). The bias such conflicts could conceivably impart may inappropriately affect the goals, processes, methods of analysis or outcomes desired by the County.

Consultants/Contractors are expected to safeguard their ability to make objective, fair, and impartial decisions when performing work for the benefit of the County. Consultants/Contractors, therefore must there avoid situations in which financial or other considerations may adversely affect, or have the appearance of adversely affecting the consultant's/contractor's professional judgement when completing work for the benefit of the County.

The mere appearance of a conflict may be as serious and potentially damaging as an actual distortion of goals, processes, methods of analysis or outcomes. Reports of conflicts based upon appearances can undermine public trust in ways that may not be adequately restored even when the mitigating facts of a situation are brought to light. Apparent conflicts, therefore, should be disclosed and evaluated with the same vigor as actual conflicts.

It is expressly understood that failure to disclose conflicts of interest as described herein may result in immediate disqualification from evaluation or immediate termination from work for the County.

Please check the appropriate statement:

I hereby attest that the undersigned Respondent has no actual or potential conflict of interest due to any other clients, contracts, or property interests for completing work on the above referenced project.

The undersigned Respondent, by attachment to this form, submits information which may be a potential conflict of interest due to other clients, contracts or property interests for completing work on the above referenced project.

Legal Name of Respondent: _____

Authorized Representative(s) : _____

Signature	Print Name/Title
_____ Signature	_____ Print Name/Title

BID NO: 19-83

ATTACHMENT "F"

CERTIFICATE OF COMPLIANCE WITH FLORIDA TRENCH SAFETY ACT

Bidder acknowledges that he is solely responsible for complying with the Florida Trench Safety Act (ACT) and Occupational Safety and Health Administrations excavation safety standard 29 CFR 1926.650 (Subpart P as amended) and the St. Johns County Trenching and Excavation Safety Program. If there is a conflict between the ACT and the St. Johns County Trenching and Excavation Safety Program, the more stringent requirement would apply. Bidder further acknowledges that included in the various items of the proposal and in the Total Bid Price are costs for complying with the Florida Trench Safety Act (90-96, Laws of Florida) effective October 1, 1990 and the Occupational Safety and Health Administrations excavation safety standard.

By: _____

Bidder

Date

Authorized Signature

BID NO: 19-83

ATTACHMENT "G"

CERTIFICATE OF INSURANCE

INSERT CERTIFICATE OF INSURANCE HERE

ATTACHMENT "H"

CONTRACTOR'S QUALIFICATIONS FORM

Bidder acknowledges that he is fully licensed to perform work in the STATE OF FLORIDA.

Any material misrepresentation, as determined by the County, shall result in disqualification.

By: _____
 Bidder _____ Date _____

 Authorized Signature

Contractor's Project Experience

The Bidder shall provide the following information regarding experience within the **past five (5) years** of this solicitation. Bidder must demonstrate the successful completion of **three (3) projects** of similar complexity, nature, size, and dollar amount of project.

Contractor's Project Experience Details Project No. 1	
Name of Project:	
Project Manager Name:	
Superintendent Name:	
Project Description:	
Owner Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Engineer/Architect Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Contract Dates	
Started:	
Original Contractual Completion:	

Contractor's Project Experience Details Project No. 1	
Final Contractual Completion:	
Actual Completion:	
Contract Value	
Original Contract Value:	
Final Contract Value:	
Value of Change Orders to Date:	
Value of Outstanding Claims to Date:	
Bonding Company Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Major Subcontractor Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Name:	
Address:	
Contact Person:	
Telephone Number:	

Contractor's Project Experience Details Project No. 2	
Name of Project:	
Project Manager Name:	
Superintendent Name:	

**Contractor's Project Experience Details
Project No. 2**

Project Description:

Owner Information

Name:

Address:

Contact Person:

Telephone Number:

Engineer/Architect Information

Name:

Address:

Contact Person:

Telephone Number:

Contract Dates

Started:

Original Contractual Completion:

Final Contractual Completion:

Actual Completion:

Contract Value

Original Contract Value:

Final Contract Value:

Value of Change Orders to Date:

Value of Outstanding Claims to Date:

Bonding Company Information

Name:

Address:

Contact Person:

Telephone Number:

Major Subcontractor Information

Name:

Address:

Contact Person:

Contractor's Project Experience Details Project No. 2	
Telephone Number:	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Name:	
Address:	
Contact Person:	
Telephone Number:	

Contractor's Project Experience Details Project No. 3	
Name of Project:	
Project Manager Name:	
Superintendent Name:	
Project Description:	
Owner Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Engineer/Architect Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Contract Dates	
Started:	
Original Contractual Completion:	
Final Contractual Completion:	

Contractor's Project Experience Details Project No. 3	
Actual Completion:	
Contract Value	
Original Contract Value:	
Final Contract Value:	
Value of Change Orders to Date:	
Value of Outstanding Claims to Date:	
Bonding Company Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Major Subcontractor Information	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Name:	
Address:	
Contact Person:	
Telephone Number:	
Name:	
Address:	
Contact Person:	
Telephone Number:	

Additional Questions

Do you have any similar work in progress at this time? _____ Yes _____ No

Length of time in business: _____ Years

Is your company currently involved in any active litigation? Yes or No: _____ If Yes, explain: _____

Has your company ever been sued? Yes or No: _____ If Yes, explain and/or submit court decision or judgment, as applicable: _____

INSERT ATTACHMENT "I" HERE
FDEP Supplementary Conditions
(including Wage Decision FL 135)

BID NO: 19-83

BID BOND

STATE OF FLORIDA
COUNTY OF ST. JOHNS

KNOW ALL MEN BY THESE PRESENTS, that _____ as Principal, and as Surety, are held and firmly bound unto St. Johns County, Florida, in the penal sum of Dollars (\$ _____) lawful money of the United States, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATIONS IS SUCH that whereas the Principal has submitted the accompanying Bid, dated _____, 20__.

For

Northwest WTP Phase 1 (6 to 9 MGD) Expansion, St. Johns County, Florida.

NOW THEREFORE,

- (a) If the Principal shall not withdraw said Bid within ninety (90) days after Bid Award date, and shall within ten (10) days after prescribed forms are presented to him for signature, enter into a written Contract with the County in accordance with the Bid as accepted, and give Bond with good and sufficient Surety or Sureties, as may be required, for the faithful performance and proper fulfillment of such Contract, then the above obligations shall be void and of no effect, otherwise to remain in full force and virtue.
- (b) In the event of the withdrawal of said Bid within the period specified, or the failure to enter into such Contract and give such Bond within the time specified, if the Principal shall pay the County the difference between the amount specified, in said Bid and the amount for which the County may procure the required Work and supplies, if the latter amount be in excess of the former, then the above obligations shall be void and of no effect, otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above bounded parties have executed this instrument under their several seals, this day of _____ A.D., 20__, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

BID NO: 19-83

WITNESSES:

(If Sole Ownership or Partnership two (2) Witnesses required).
(If Corporation, Secretary only will attest and affix seal).

WITNESSES:

PRINCIPAL:

NAME OF FIRM:

SIGNATURE OF AUTHORIZED
OFFICER (AFFIX SEAL)

TITLE

BUSINESS ADDRESS

CITY STATE

WITNESS:

SURETY:

CORPORATE SURETY

ATTORNEY-IN-FACT (AFFIX SEAL)

BUSINESS ADDRESS

CITY STATE


NAME OF LOCAL INSURANCE AGENCY

SEALED BID MAILING LABEL

BID NO: 19-83
Northwest WTP Phase 1 (6 to 9 MGD) Expansion

**Cut along the outer border and affix this label
to your sealed bid envelope to identify it as a
"Sealed BID"**

SEALED BID • DO NOT OPEN	
SEALED BID NO.:	BID NO: 19-83
BID TITLE:	<u>Northwest WTP Phase 1 (6 to 9 MGD) Expansion</u>
DUE DATE/TIME:	By 2:00 P.M. on August 28, 2019
SUBMITTED BY:	_____ Company Name
	_____ Company Address
	_____ Company Address
DELIVER TO:	St. Johns County Purchasing Dept. ATTN: David E. Pyle 500 San Sebastian View St. Augustine FL 32084



END OF DOCUMENT

This page intentionally left blank.

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)**

THIS AGREEMENT is by and between St. Johns County, Florida (“Owner”) and _____ (“Contractor”). Owner and Contractor hereby agree as follows:

Article 1. WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:
- A. The contractor is required to furnish all labor, materials, equipment, and incidentals required to perform the work described in the contract documents and as shown on the drawings, including, the site improvements, modifications to clear well complex No. 1, the new clear well complex No. 2, the addition of a new Carbon Dioxide storage tank and modifications to the pressure solution feed (PSF) panel, the modifications to the chemical feed systems, the high service pump station improvements, the yard piping addition and improvements, the electrical system and instrumentation system improvements. A detailed scope of work including bid items and allowances can be found in the bid documents. This project is funded through a State Revolving Fund Loan and shall be subject to all Federal-Contract Requirements as provided in the Florida Department of Environmental Protection Supplementary Conditions contained in the bid documents.

Article 2. PROJECT

- 2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:
- A. Bid No. 19-83: Northwest WTP Phase 1 (6 to 9 MGD) Expansion

Article 3. ENGINEER

- 3.01 The Project has been designed by CDM Smith, 4651 Salisbury Road, Suite 420, Jacksonville, FL 32256.
- 3.02 The Owner has retained CDM Smith, 4651 Salisbury Road, Suite 420, Jacksonville, FL 32256 (“Engineer”) to act as Owner’s Representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

Article 4. CONTRACT TIMES

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

essence of the Contract.

4.02 Contract Times: Days.

- A. The Work will be substantially completed within five hundred and seventy one (571) consecutive days after the date when the Contract Times commence and will run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within Thirty (30) days after Substantial Completion.

4.03 Liquidated Damages

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
1. Substantial Completion: Contractor shall pay Owner \$.00 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
 2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$.00 for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

4.04 Special Damages

- A. In addition to the amount provided for liquidated damages, Contractor shall reimburse Owner (1) for any fines or penalties imposed on Owner as a direct result of the Contractor's failure to attain Substantial Completion according to the Contract Times, and (2) for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Substantial Completion (as duly adjusted pursuant to the Contract), until the Work is substantially complete
- B. After Contractor achieves Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times, Contractor shall reimburse Owner for the actual costs reasonably incurred by Owner for engineering, construction observation, inspection, and administrative services needed after the time specified in Paragraph 4.02 for Work to be completed and ready for final payment (as duly adjusted pursuant to the Contract), until the Work is completed and ready for final payment.

Article 5. CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:

A. For all Work other than Unit Price Work, a lump sum of:

\$ _____

All specific cash allowances are included in the above price in accordance with Paragraph 13.02 of the General Conditions.

5.02 For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item):

Unit Price Work					
Item No.	Description	Unit	Estimated Quantity	Unit Price	Extended Price
Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities)					\$

5.03 Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment)

\$ _____

5.04 For all Work, at the prices stated in Contractor’s Bid, attached hereto as an exhibit.

Article 6. PAYMENT PROCEDURES

6.01 Submittal and Processing of Payments

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 Progress Payments; Retainage

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor’s Applications for Payment on or about the day of each month during performance of the Work as provided in Paragraph 15.01 of the General Conditions,

provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

6.03 Final Payment

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

Article 7. INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate of Zero (0.00) percent per annum

Article 8. CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations
 - A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
 - E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.

- F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

Article 9. CONTRACT DOCUMENTS

9.01 Contents:

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to [REDACTED], inclusive).
 - 2. Public construction bond (pages 1 to [REDACTED], inclusive).
 - 3. General Conditions (pages 1 to [REDACTED], inclusive).
 - 4. Supplementary Conditions (pages 1 to [REDACTED], inclusive).
 - 5. Florida Department of Environmental Protection State Revolving Fund Program Supplementary Conditions (pages 1 to [REDACTED], inclusive).
 - 6. Specifications as listed in the table of contents of the Project Manual.
 - 7. Drawings (not attached but incorporated by reference) consisting of [REDACTED] sheets with each sheet bearing the following general title: Northwest WTP Phase 1 (6 to 9 MGD) Expansion
 - 8. Addenda (numbers [REDACTED] to [REDACTED], inclusive)
 - 9. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages 1 to [REDACTED], inclusive).
 - 10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.

- d. Field Orders.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

Article 10. MISCELLANEOUS

10.01 Terms

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

10.02 Assignment of Contract

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

10.03 Successors and Assigns

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

10.04 Severability

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

10.05 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 Other Provisions

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

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

OWNER:

CONTRACTOR:

St. Johns County, FL

(Typed Name)

By: _____
Signature of Authorized Representative

By: _____
Signature of Authorized Representative

Print Name

Print Name

Title

Title

Date of Execution:

Date of Execution:

ATTEST:

St. Johns County, FL
Clerk of Courts

Attest: _____

Title: _____

By: _____

Title: _____

Legally Sufficient:

Mailing Address for giving notices:

Deputy County Attorney

Date of Execution:

Mailing Address for giving notices:

License No.: _____

500 San Sebastian View
St. Augustine, FL 32084

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by



Issued and Published Jointly by



Endorsed by



These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

Copyright © 2013:

National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

The copyright for this document is owned jointly by the three sponsoring organizations listed above. The National Society of Professional Engineers is the Copyright Administrator for the EJCDC documents; please direct all inquiries regarding EJCDC copyrights to NSPE.

NOTE: EJCDC publications may be purchased at www.ejcdc.org, or from any of the sponsoring organizations above.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

	Page
Article 1 – Definitions and Terminology	1
1.01 Defined Terms	1
1.02 Terminology	5
Article 2 – Preliminary Matters.....	6
2.01 Delivery of Bonds and Evidence of Insurance	6
2.02 Copies of Documents	6
2.03 Before Starting Construction	6
2.04 Preconstruction Conference; Designation of Authorized Representatives	7
2.05 Initial Acceptance of Schedules	7
2.06 Electronic Transmittals.....	7
Article 3 – Documents: Intent, Requirements, Reuse	8
3.01 Intent.....	8
3.02 Reference Standards.....	8
3.03 Reporting and Resolving Discrepancies	8
3.04 Requirements of the Contract Documents	9
3.05 Reuse of Documents	10
Article 4 – Commencement and Progress of the Work.....	10
4.01 Commencement of Contract Times; Notice to Proceed	10
4.02 Starting the Work.....	10
4.03 Reference Points	10
4.04 Progress Schedule	10
4.05 Delays in Contractor’s Progress	11
Article 5 – Availability of Lands; Subsurface and Physical Conditions; Hazardous Environmental Conditions	12
5.01 Availability of Lands	12
5.02 Use of Site and Other Areas	12
5.03 Subsurface and Physical Conditions.....	13
5.04 Differing Subsurface or Physical Conditions	14
5.05 Underground Facilities	15

5.06	Hazardous Environmental Conditions at Site	17
Article 6 – Bonds and Insurance		19
6.01	Performance, Payment, and Other Bonds	19
6.02	Insurance—General Provisions	19
6.03	Contractor’s Insurance	20
6.04	Owner’s Liability Insurance	23
6.05	Property Insurance.....	23
6.06	Waiver of Rights	25
6.07	Receipt and Application of Property Insurance Proceeds	25
Article 7 – Contractor’s Responsibilities		26
7.01	Supervision and Superintendence	26
7.02	Labor; Working Hours	26
7.03	Services, Materials, and Equipment.....	26
7.04	“Or Equals”	27
7.05	Substitutes	28
7.06	Concerning Subcontractors, Suppliers, and Others	29
7.07	Patent Fees and Royalties	31
7.08	Permits	31
7.09	Taxes	32
7.10	Laws and Regulations.....	32
7.11	Record Documents.....	32
7.12	Safety and Protection.....	32
7.13	Safety Representative	33
7.14	Hazard Communication Programs	33
7.15	Emergencies	34
7.16	Shop Drawings, Samples, and Other Submittals.....	34
7.17	Contractor’s General Warranty and Guarantee.....	36
7.18	Indemnification	37
7.19	Delegation of Professional Design Services	37
Article 8 – Other Work at the Site		38
8.01	Other Work	38
8.02	Coordination	39
8.03	Legal Relationships.....	39

Article 9 – Owner’s Responsibilities.....	40
9.01 Communications to Contractor.....	40
9.02 Replacement of Engineer	40
9.03 Furnish Data	40
9.04 Pay When Due.....	40
9.05 Lands and Easements; Reports, Tests, and Drawings	40
9.06 Insurance	40
9.07 Change Orders.....	40
9.08 Inspections, Tests, and Approvals	41
9.09 Limitations on Owner’s Responsibilities	41
9.10 Undisclosed Hazardous Environmental Condition.....	41
9.11 Evidence of Financial Arrangements.....	41
9.12 Safety Programs	41
Article 10 – Engineer’s Status During Construction.....	41
10.01 Owner’s Representative.....	41
10.02 Visits to Site.....	41
10.03 Project Representative.....	42
10.04 Rejecting Defective Work.....	42
10.05 Shop Drawings, Change Orders and Payments.....	42
10.06 Determinations for Unit Price Work	42
10.07 Decisions on Requirements of Contract Documents and Acceptability of Work	42
10.08 Limitations on Engineer’s Authority and Responsibilities.....	42
10.09 Compliance with Safety Program.....	43
Article 11 – Amending the Contract Documents; Changes in the Work	43
11.01 Amending and Supplementing Contract Documents	43
11.02 Owner-Authorized Changes in the Work	44
11.03 Unauthorized Changes in the Work	44
11.04 Change of Contract Price	44
11.05 Change of Contract Times	45
11.06 Change Proposals	45
11.07 Execution of Change Orders.....	46
11.08 Notification to Surety.....	47
Article 12 – Claims.....	47

12.01	Claims	47
Article 13 –	Cost of the Work; Allowances; Unit Price Work.....	48
13.01	Cost of the Work	48
13.02	Allowances	50
13.03	Unit Price Work	51
Article 14 –	Tests and Inspections; Correction, Removal or Acceptance of Defective Work.....	52
14.01	Access to Work.....	52
14.02	Tests, Inspections, and Approvals.....	52
14.03	Defective Work.....	53
14.04	Acceptance of Defective Work.....	53
14.05	Uncovering Work	53
14.06	Owner May Stop the Work	54
14.07	Owner May Correct Defective Work.....	54
Article 15 –	Payments to Contractor; Set-Offs; Completion; Correction Period	55
15.01	Progress Payments.....	55
15.02	Contractor’s Warranty of Title	58
15.03	Substantial Completion.....	58
15.04	Partial Use or Occupancy	59
15.05	Final Inspection	59
15.06	Final Payment.....	59
15.07	Waiver of Claims	61
15.08	Correction Period	61
Article 16 –	Suspension of Work and Termination	62
16.01	Owner May Suspend Work	62
16.02	Owner May Terminate for Cause	62
16.03	Owner May Terminate For Convenience	63
16.04	Contractor May Stop Work or Terminate	63
Article 17 –	Final Resolution of Disputes	64
17.01	Methods and Procedures.....	64
Article 18 –	Miscellaneous	64
18.01	Giving Notice	64
18.02	Computation of Times.....	64
18.03	Cumulative Remedies	64

18.04	Limitation of Damages	65
18.05	No Waiver	65
18.06	Survival of Obligations	65
18.07	Controlling Law	65
18.08	Headings.....	65

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer

has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and

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

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

- A. *Reporting Discrepancies:*
 - 1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict,

error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

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

4.03 *Reference Points*

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

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 2. abnormal weather conditions;
 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

- 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
- 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings*: The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the

policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

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

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
 - C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
 - D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
 - E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
 - F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

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

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

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

7.12 *Safety and Protection*

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

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

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

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or

exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

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

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. 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;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be 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 and approval of each such variation.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

2. *Samples:*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
 1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval 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 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
 5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
 6. Engineer's review and approval 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.
 7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, 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.
3. If Contractor requests a change of a previously approved 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.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

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

9.04 *Pay When Due*

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

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

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

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

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under

the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 Execution of Change Orders

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

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

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

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

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

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

- B. *Cash Allowances*: Contractor agrees that:
 - 1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 - 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 Access to Work

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

14.02 Tests, Inspections, and Approvals

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

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

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

- e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

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

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

15.06 *Final Payment*

- A. *Application for Payment:*
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

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

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses,

and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

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

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Headings*

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

SECTION 00800
SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions except as amended by Article 1. Additional terms used in these Supplementary Conditions have the meanings stated in Article 1 below, which are applicable to both the singular and plural thereof.

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

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC 1.01 Add the following language at the end of last sentence of Paragraph 1.01.A.8:

The Change Order form to be used on this Project is provided by the Owner. Owner approval is required before Change Orders are effective.

SC 1.01 Delete Paragraph 1.01.A.15 in its entirety and add the following in its place:

Contract Times - The number of days or the dates stated in the Agreement to complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation.

SC 1.01 Add the following new language at the end of the last sentence of Paragraph 1.01.A.28:

The authorized representative of Owner assigned to this project is herein referred to as Project Director.

SC 1.01 Add the following new language at the end of the last sentence of Paragraph 1.01.A.48:

A Work Change directive cannot change Contract Price or Contract Times. Contract Price or Contract time can only be modified with a Change Order.

ARTICLE 2 – PRELIMINARY MATTERS

SC 2.02 Amend the first sentence of Paragraph 2.02.A to read as follows:

A. OWNER shall furnish to the Contractor three (3) copies of the Contract Document (including one fully executed counter part of the Agreement) and one copy in electronic portable document format (PDF).

SC 2.06 Delete Paragraph 2.06.B in its entirety.

SECTION 00800
SUPPLEMENTARY CONDITIONS

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC 4.01 Delete Paragraph 4.01.A in its entirety and add the following in its place:

- A. Notice to Proceed – The OWNER will, after executing the Contract, issue to the Contractor in writing a Notice to Proceed. The beginning of the time allotted for the Contract completion will be 10 days after the date of the Notice to Proceed, or the day on which Work is actually started, whichever occurs first.**

SC. 4.05 Add the following paragraphs immediately after Paragraph 4.05.C.2

- a. Claims for delays due to abnormal weather conditions shall be handled on a monthly basis. The Contractor shall submit a notice of a claim for a weather delay in each particular month on the last day of that month. Failure to submit notice as required shall constitute a waiver of any claim because of abnormal weather conditions for that month. The Contractor shall submit the notice to the Engineer. Within seven (7) calendar days after the submission of the weather claim notice, the Contractor will submit to the Engineer evidence to justify the claim. This evidence will include the following:**
- 1. The days of the month on which the adverse weather occurred. The Contractor will also provide the hours of the day during which the adverse weather occurred at the job site.**
 - 2. A detailed description of the activities that were affected by the adverse weather.**
 - 3. A detailed description of claim for the impact of the adverse weather on the critical path of the schedule.**
- b. The Engineer will review the claim evidence submitted by the Contractor. The Engineer will first compare the adverse weather received during the month against the weather that could have been anticipated for that month, then compare the number of days in the month that exceeded 0.1 inches, then verify that the days requested had greater than 1-inch of precipitation. Anticipated weather for a month will be defined as the average of the weather conditions that have occurred in that month for the years 2014-2016, as documented by the NOAA National Data Center at the St. Augustine Lighthouse.**

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS;
HAZARDOUS ENVIRONMENTAL CONDITIONS

SC 5.03 Add the following paragraphs immediately after Paragraph 5.03.A.3

- A. Report dated May 16, 2019 titled “Report of Geotechnical Exploration Northwest WTP Expansion, St. Johns County, Florida ECS Project No. 35-27930, Client ID 0940” is included in the Bid**

SECTION 00800
SUPPLEMENTARY CONDITIONS

Documents as Exhibit A – Geotechnical Report.

ARTICLE 6 – BONDS AND INSURANCE

SC 6.01 Amend Paragraph A to read as follows:

- A. Contractor shall furnish a public construction bond, in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor’s obligations under the Contract. The bond shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.**

SC 6.01 Amend Paragraph F to read as follows:

- F. Upon request, Owner shall provide a copy of the public construction bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.**

SC 6.02 Add the following paragraphs immediately after Paragraph 6.02.J:

- K. The Contractor shall not commence work under this Contract until he/she has obtained all insurance required under this section and such insurance has been approved by the County. All insurance policies shall be issued by companies authorized to do business under the laws of the State of Florida. The Contractor shall furnish proof of Insurance to the County prior to the commencement of operations. The Certificate(s) shall clearly indicate the Contractor has obtained insurance of the type, amount, and classification as required by contract and that no material change or cancellation of the insurance shall be effective without thirty (30) days prior written notice to the County. Certificates shall specifically include the County as Additional Insured for all lines of coverage except Workers’ Compensation and Professional Liability. A copy of the endorsement must accompany the certificate. Compliance with the foregoing requirements shall not relieve the Contractor of its liability and obligations under this Contract.**

**Certificate Holder Address:
St. Johns County, a political subdivision of the State of Florida
500 San Sebastian View
St. Augustine, FL 32084**

SECTION 00800
SUPPLEMENTARY CONDITIONS

SC 6.03 Delete Paragraph 6.03.A. and replace with the following paragraph:

- A. *Workers' Compensation:* The Contractor shall maintain during the life of this Contract, adequate Workers' Compensation Insurance in at least such amounts as are required by the law for all of its per Florida Statute 440.02.**

SC 6.03 Delete paragraph 6.03 B and replace with the following paragraph:

- B. *Comprehensive General Liability:* The Contractor shall maintain during the life of this Contract, Comprehensive General Liability Insurance with minimum limits of \$1,000,000 per occurrence, \$2,000,000 aggregate to protect the Contractor from claims for damages for bodily injury, including wrongful death, as well as from claims of property damages which may arise from any operations under this Contract, whether such operations be by the Contractor or by anyone directly employed by or contracting with the Contractor.**

SC 6.03 Delete paragraph 6.03 C in its entirety.

SC 6.03 Delete paragraph 6.03 D and replace with the following paragraph:

- D. *Automotive Liability:* The Contractor shall maintain during the life of this Contract, Comprehensive Automobile Liability Insurance with minimum limits of \$2,000,000 combined single limit for bodily injury and property damage liability to protect the Contractor from claims for damages for bodily injury, including the ownership, use, or maintenance of owned and non-owned automobiles, including rented/hired automobiles whether such operations be by the Contractor or by anyone directly or indirectly employed by a Contractor.**

SC 6.03 Delete paragraph 6.03 E and replace with the following paragraph:

- E. *Umbrella or Excess Liability:* The Contractor shall maintain Umbrella or Excess Liability Insurance covering workers compensation, commercial general liability and business auto liability with minimum limits of liability of \$1,000,000.**

SC 6.03 Delete Paragraph 6.03.F in its entirety.

SC 6.03 Delete paragraph 6.03 G in its entirety.

SC 6.03 Delete Paragraph 6.03.H in its entirety and replace with the following paragraph:

- H. *Contractor's professional liability insurance:* The Contractor shall maintain during the life of the contract, Professional Liability or Errors and Omissions Insurance with minimum limits of \$1,000,000, if applicable.**

SECTION 00800
SUPPLEMENTARY CONDITIONS

SC 6.05 Delete Paragraph 6.05 in its entirety.

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

SC 7.02 Amend the first sentence of Paragraph 7.02.B by adding 7:00 AM to 5:00 PM.

SC 7.04 Delete Paragraph 7.04 in its entirety and replace with the following paragraph:

- A. Should the Contractor wish to deviate from the design provided herein, costs for review and approval of these modifications will be borne by the Contractor. The Contractor must submit a request for deviation and acknowledgement that they are responsible for all costs prior to the Engineer reviewing said changes.**
- B. For products, materials, or equipment specified by name and which do not include “Engineer Approved Equal” or “Or Equal”, there is not an option to provide a substitution and one of the product manufacturers or equipment listed shall be provided.**
- C. Any equipment, materials, or products that the Contractor wishes to provide an alternate product, material, or equipment vendor and which are listed in the technical specifications or on the Drawings as “Engineer Approved Equal” or “Or Equal” shall be approved PRIOR to the bid opening. Contractor shall submit all information for approval by the Engineer a minimum of 14-days prior to the bid opening. Substitutions provided after that date will not be accepted or allowed.**
 - 1. Provide the following information with the substitutions package for review during the bid phase:**
 - a. Name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute, including drawings, cut sheets, performance and testing data, and any other information necessary for the evaluation. Standard brochures are not acceptable. Information shall be specific and detailed for this project.**
 - b. Provide a statement comparing the product, material, or equipment with the technical specification or drawings with any deviations, changes, or modifications required clearly outlined.**
 - c. Provide a list of references of similar sized equipment or installation references for review. At least three separate references shall be provided.**
 - 2. Approval of substitutions is strictly at the discretion of the Owner and Engineer.**

SC 7.05 Delete Paragraph 7.05 in its entirety.

SC 7.06 Amend Paragraph 7.06.A by adding the following text to the end of the paragraph:

SECTION 00800
SUPPLEMENTARY CONDITIONS

The Contractor shall not award work valued at more than **50** percent of the Contract Price less cost of direct purchased items and the Sales Tax Exemption Agreement to Subcontractor(s), without prior written approval of the OWNER.

SC 7.16 Delete Paragraph 7.16.B. and replace with the following paragraph:

Submittal Procedures for Shop Drawings, Samples and Other Submittals:
Contractor shall submit as per Section 01300 of the Specifications.

SC 7.16 Delete Paragraph 7.16.C in its entirety.

SC 7.16 Amend Paragraph 7.16.E.2 by striking out the following: “~~three~~” and replace with:
two

SC 7.16 Amend Paragraph 7.16.E.2 by striking out the following: “~~fourth~~” and replace with:
third

ARTICLE 9 – OWNER’S RESPONSIBILITIES

SC 9.13 Add the following new paragraph immediately after Paragraph 9.12.

9.13 **Project Director**

- A. **The Project Director, unless otherwise directed by the Owner shall perform those duties and discharge those responsibilities allocated to the Project Director as set forth in this Agreement. The Project Director shall be the Owner's representative from the effective date of this Agreement until Final Payment has been made. The Project Director shall be authorized to act on behalf of the Owner only to the extent provided in this Agreement.**
- B. **The Owner and the Contractor shall communicate with each other in the first instance through the Engineer and Project Director.**
- C. **The Project Director shall be the initial interpreter of the requirements of the drawings and specifications and the judge of the performance there under by the Contractor. The Project Director shall render written or graphic interpretations necessary for the proper execution or progress of the Work with reasonable promptness on request of the Contractor.**
- D. **The Engineer and Project Director shall review the Contractor's Applications for Payment and shall certify to the Owner for payment to the Contractor, those amounts then due to the Contractor as provided in this Agreement.**
- E. **The Project Director shall have authority to reject Work, which is defective or does not conform to the requirements of this Agreement. If the Project Director deems it necessary or advisable, the Project Director shall**

SECTION 00800
SUPPLEMENTARY CONDITIONS

authority to require additional inspection or testing of the Work for compliance with Contract requirements at Contractor's expense.

- F. The Project Director shall review and approve, or take other appropriate action as necessary, concerning the Contractor's submittals including Product Data and Samples. Such review, approval or other action shall be for the sole purpose of determining conformance with the design concept and information given through the Contract Documents.
- G. The Project Director shall prepare Change Orders and may authorize minor changes in the Work by field order as provided elsewhere herein.
- H. The Project Director shall, upon written request from the Contractor, conduct inspections to determine the date of Substantial Completion and the date of Final Completion, shall receive and forward to the Owner for the Owner's review and records, written warranties and related documents required by this Agreement and shall issue a Final Certificate for Payment upon compliance with the requirements of this Agreement.
- I. The Project Director's decision in matters relating to aesthetic effect shall be final if consistent with the intent of this Agreement.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC 15.01 Add the following language at the end of Paragraph 15.01.B.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC 15.01 Add the following new paragraph immediately after Paragraph 15.01.B.3

4. The Application for Payment form to be used on this Project is supplied by Owner. The OWNER must approve all Applications for Payment before payment is made.

SC 15.01 Delete Paragraph 15.01.D.1 in its entirety and replace with the following:

The Application for Payment with Engineer's recommendations will be presented to the OWNER and Agency for consideration. If the OWNER finds the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 15.01.E will become due twenty (20) days after the Application for Payment is presented to the OWNER, and the OWNER will make payment to the Contractor.

SC 15.02 Amend Paragraph 15.02.A by striking out the following: "~~no later than seven days after the time of payment by Owner~~" and replace with:

no later than the time of payment by OWNER.

SECTION 00800
SUPPLEMENTARY CONDITIONS

- SC 16.02 Add the following new paragraphs immediately after Paragraph 16.02.A.4
- 5. fails to make prompt payment to Subcontractors, or for materials or labor;**
 - 6. persistently disregards laws, ordinances, rules, regulations or orders of any public authority having jurisdiction; or**
 - 7. otherwise substantially violates a material provision of this Agreement,**
- SC 16.02 Replace the words **performance bond** with the words **public construction bond** in Paragraph 16.02.B.2
- SC 16.02 Replace the words **performance bond** with the words **public construction bond** in Paragraph 16.02.C
- SC 16.02 Replace the words **payment bond or performance bond** with the words **public construction bond** in Paragraph 16.02.F.
- SC 16.02 Replace the words **payment bond or performance bond** with the words **public construction bond** in Paragraph 16.02.G.
- SC 16.03 Add the following new paragraph immediately after Paragraph 16.03.B
- C. The Contractor shall incur no further obligations in connection with the Work and the Contractor shall stop Work when such termination becomes effective. The Contractor shall also terminate outstanding orders and subcontracts. The Contractor shall settle liabilities and claims arising out of the termination of subcontracts and orders. The Owner may direct the Contractor to assign the Contractor's right, title and interest under terminated orders or subcontracts to the Owner or its designee.**
 - D. The Contractor shall transfer title and deliver to the Owner such completed or partially completed Work and materials, equipment, parts, fixtures, information and Contract rights as the Contractor has.**
 - E. The Contractor shall submit a termination claim to the Project Director specifying the amounts due because of the termination for convenience together with costs, pricing or other data required by the Project Director. If the Contractor fails to file a termination claim within one (1) year from the effective date of termination, the Owner shall pay the Contractor, an amount derived in accordance with subparagraph (G) below.**
 - F. The Owner and the Contractor may agree to compensation, if any, due to the Contractor hereunder.**
 - G. Absent agreement to the amount due to the Contractor, the Owner shall pay the Contractor the following amounts;**
 - 1. Contract prices for labor, materials, equipment, and other services accepted under this Agreement;**
 - 2. Reasonable costs incurred in preparing to perform and in performing a portion of the Work prior to termination and not**

SECTION 00800
SUPPLEMENTARY CONDITIONS

included in (G.1.) or (G.2), and in terminating the Contractor's performance, plus a fair and reasonable allowance for overhead and profit thereon (such profit shall not include anticipated profit or consequential damages); provided, however, that if it appears that the Contractor would have not profited or would have sustained a loss if the entire Contract had been completed, no profit shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss, if any;

3. Reasonable costs of settling and paying claims arising out of the termination of Subcontracts or orders pursuant to Subparagraph 16.03.C of this Paragraph. These costs shall not include amounts paid in accordance with other provisions hereof.

H. The total sum to be paid the Contractor under this Subparagraph 16.03 shall not exceed the total Contract Price, as properly adjusted, reduced by the amount of payments otherwise made, and shall in no event include duplication of payment.

SC 18.01 Delete from Paragraph A.2 the words "registered or certified."

SC 18.09 Add the following new paragraph immediately after Paragraph 18.08

18.09 Contractor's Employment Opportunity

A. The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin or age.

B. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex, national origin or age. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertisement, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

C. The Contractor and all Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf, state that all qualified applicants shall receive consideration for employment without regard to race, religion, color, sex, national origin or age.

SC 18.10 Add the following new paragraph immediately after Paragraph 18.09

18.10 Apprenticeship Law (Chapter 446, Florida Statutes)

A. The Contractor shall make a diligent effort to hire for Performance of the Contract a number of apprentices in each occupation which bears to the average number of journeyman in that occupation to be employed in the

SECTION 00800
SUPPLEMENTARY CONDITIONS

performance of the Contract, the ratio of at least one (1) apprentice or trainee to every five (5) journeymen.

- B. The Contractor shall, when feasible and except when the number of apprentices or trainees to be hired is fewer than four (4), assure that twenty-five (25) percent of such apprentices or trainees are in their first year of training. Feasibility here involves a consideration of the availability of training opportunities for first year apprentices or trainees, the hazardous nature of the Work for beginning workers, and excessive unemployment of apprentices or trainees in their second or subsequent years of training.
- C. The Contractor, during the performance of the Contract, shall make diligent efforts to employ the number of apprentices or trainees necessary to meet requirements of Subparagraphs a. and b. However, on-the-job training programs shall only be established in non-apprenticable trades or occupations to meet the requirements of this section.
- D. The Contractor agrees to return records of employment, by trade, of the number of apprentices or trainees by first year of training, and the number of journeymen and the wages paid, and hours of work, of such persons on a form as prescribed by the Bureau of Apprenticeship of the Division of Labor at three (3) month intervals. Submission of duplicate copies of forms submitted to the United States Department of Labor shall be sufficient compliance with the provisions of the section.
- E. The Contractor agrees to supply the Bureau of Apprenticeship of the Division of Labor, at three (3) months intervals, a statement describing steps taken toward making diligent effort and containing a breakdown by craft or hours worked and wages paid for first year apprentices or trainees, other apprentices or trainees and journeymen.
- F. The Contractor agrees to insert in any Subcontract under this Agreement the requirements contained in this section. "The term Contractor" as used in such clauses and any Subcontract shall mean the Subcontractor.
- G. Anything herein to the Contrary notwithstanding, Contractor agrees to comply with all of the provisions of Florida Statutes 446 and all regulations prescribed by the Bureau of Apprenticeship of the Division of Labor.

SC 18.11 Add the following new paragraph immediately after Paragraph 18.10.

18.11 Public Records

- A. The cost of reproduction, access to, disclosure, non-disclosure, or exemption of records, data, documents, and/or materials, associated with this Agreement shall be subject to the applicable provisions of the Florida Public Records Law (Chapter 119, Florida Statutes), and other applicable State and Federal provisions. Access to such public records, may not be blocked, thwarted, and/or hindered by placing the public records in the possession of a third party, or an unaffiliated party.

SECTION 00800
SUPPLEMENTARY CONDITIONS

- B. In accordance with Florida law, to the extent that Contractor's performance under this Contract constitutes an act on behalf of the County, Contractor shall comply with all requirements of Florida's public records law. Specifically, if Contractor is expressly authorized, and acts on behalf of the County under this Agreement, Contractor shall:**
- (1) Keep and maintain public records that ordinarily and necessarily would be required by the County in order to perform the Services;**
 - (2) Upon request from the County's custodian of public records, provide the County with a copy of the requested records or allow the records to be inspected or copied within a reasonable time at a cost that does not exceed the cost as provided in Chapter 119, Florida Statutes, or as otherwise provided by law;**
 - (3) Ensure that public records related to this Agreement that are exempt or confidential and exempt from public records disclosure requirements are not disclosed except as authorized by applicable law for the duration of this Agreement and following completion of this Agreement if the Contractor does not transfer the records to the County; and**
 - (4) Upon completion of this Agreement, transfer, at no cost, to the County all public records in possession of the Contractor or keep and maintain public records required by the County to perform the Services.**
- C. If the Contractor transfers all public records to the County upon completion of this Agreement, the Contractor shall destroy any duplicate public records that are exempt or confidential and exempt from public records disclosure requirements. If the Contractor keeps and maintains public records upon completion of this Agreement, the Contractor shall meet all applicable requirements for retaining public records. All records stored electronically must be provided to the County, upon request from the County's custodian of public records, in a format that is compatible with the County's information technology systems.**
- D. Failure by the Contractor to comply with the requirements of this section shall be grounds for immediate, unilateral termination of this Agreement by the County.**

IF THE CONTRACTOR HAS QUESTIONS REGARDING THE APPLICATION OF CHAPTER 119, FLORIDA STATUTES, TO ITS DUTY TO PROVIDE PUBLIC RECORDS RELATING TO THIS AGREEMENT, CONTACT THE CUSTODIAN OF PUBLIC RECORDS AT: OCA, ATTN: Public Records Manager, 500 San Sebastian View, St. Augustine, FL 32084, PH: (904) 209-0805, EMAIL: publicrecords@sjcfl.us.

This page intentionally left blank.



ECS FLORIDA, LLC

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

**REPORT OF
GEOTECHNICAL EXPLORATION
NORTHWEST WTP EXPANSION
ST. JOHNS COUNTY, FLORIDA
ECS PROJECT NO. 35-27930
CLIENT ID: 0940**

Prepared for:

CDM Smith
8381 Dix Ellis Trail, Suite 400
Jacksonville, Florida 32256

Prepared by:

ECS Florida, LLC
7064 Davis Creek Road
Jacksonville, Florida 32256

January 15, 2019
Revised May 16, 2019



January 15, 2019
Revised May 16, 2019

Mr. Yanni Polematidis, P.E., BCEE
CDM Smith
8381 Dix Ellis Trail, Suite 400
Jacksonville, Florida 32256

Reference: Report of Geotechnical Exploration
Northwest WTP Expansion
St. Johns County, Florida
ECS Project No. 35-27930 (**Revised**)
Client ID: 0940

Dear Mr. Polematidis:

ECS Florida, LLC (ECS) has completed the requested geotechnical exploration in general accordance with our proposal dated September 18, 2018. The exploration was performed to evaluate the general subsurface conditions within the proposed future water storage tank, carbon dioxide tank, clearwell/degasifier, odor control scrubbers, stormwater pond, and access roadway. Note Borings B9 and B10 were not performed during our exploration, based on discussions with your office. This report has been revised based on our discussions on May 15, 2019 regarding the clearwell loading information.

We appreciate the opportunity to be your geotechnical consultant on this phase of the project and look forward to providing the materials testing and observation that will be required during the construction phase. If you have any questions, or if we may be of any further service, please contact us.

Very truly yours,
ECS FLORIDA, LLC

Chris M. Egan, P.E.
Project Engineer
Registered, Florida No. 79645

David W. Spangler, P.E.
Geotechnical Department Manager
Registered, Florida No. 58770

Distribution: Mr. Yanni Polematidis, P.E., BCEE – CDM Smith

1 pdf

TABLE OF CONTENTS

Subject	Page No.
1.0 PROJECT INFORMATION	1
1.1 Site Location and Description	1
1.2 Project Description	1
1.3 Review of Soil Survey Map	1
2.0 FIELD EXPLORATION.....	2
2.1 SPT Borings.....	2
2.2 Auger Borings.....	2
3.0 LABORATORY TESTING	2
4.0 GENERAL SUBSURFACE CONDITIONS.....	2
4.1 General Soil Profile.....	2
4.2 Groundwater Level	3
4.3 Normal Seasonal High Groundwater Level	3
5.0 DESIGN RECOMMENDATIONS.....	3
5.1 General.....	3
5.2 Foundation Design Recommendations for Carbon Dioxide Tank and Odor Control Scrubbers..	4
5.3 3 MG Water Storage Tank and Clearwell Foundation Design Recommendations	5
5.4 Pavement Considerations.....	6
5.5 Pond Borrow Suitability.....	7
6.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS.....	7
6.1 Clearing and Stripping	7
6.2 Temporary Groundwater Control.....	8
6.3 Compaction.....	8
6.4 Structural Backfill and Fill Soils.....	8
6.5 Foundation Areas.....	9
6.6 Pavement Areas	9
7.0 QUALITY CONTROL TESTING	9
8.0 REPORT LIMITATIONS.....	9

FIGURES

Figure 1	Site Location Plan
Figure 2	Soil Survey of St. Johns County
Figure 3	Field Exploration Plan
Figures 4-7	Generalized Subsurface Profiles

APPENDICES

Appendix A	Soil Boring Logs Field Exploration Procedures Key to Soil Classification
Appendix B	Laboratory Data Laboratory Test Procedures

1.0 PROJECT INFORMATION

1.1 Site Location and Description

The project site is located at the Northwest Water Treatment Plant, north of the intersection of International Golf Parkway and State Road 16 in St. Johns County, Florida. The site is bordered to the north, northeast, and west by residences, to the east by a park, and to the southwest by an access road. The general site location is shown on Figure 1.

At the time of our exploration, the western portion of the site was developed with tanks and ancillary structures for the water treatment plant. The eastern portion of the project site was undeveloped with surface cover consisting of brush and trees. The site was relatively level with a slight slope downward to the northeast.

1.2 Project Description

Project information was provided by your office via several discussions and an email dated January 14, 2019. We were provided with a copy of a site plan for the subject site, prepared by CDM Smith. This plan indicated the boundary limits for the property, the existing roadways adjacent to the site, the layout of the proposed construction, and the requested boring locations.

We understand the proposed construction includes a future 3 million gallon (MG) water storage tank with a height on the order of 30 feet, a clearwell/degasifier, an odor control scrubber, a new carbon dioxide tank, access roadways, and a stormwater treatment pond. We were not provided detailed grading information. For the purposes of this report, we expect that less than 2 feet of fill (and only nominal cuts) will be required to achieve final grades in structural areas.

Detailed structural loading information was not provided to our office at the time of this report preparation. For the purposes of this report, we have assumed the odor control scrubbers and carbon dioxide storage tank will be founded on either slabs with turndown footings or mats. Based on this assumption, we have assumed that wall or ring footings supporting these structures will be on the order of 3 feet wide or less and isolated point loads will be on the order of 25 kips or less. We have also assumed that the carbon dioxide tank will bear on a mat foundation with a maximum pressure of 250 psf across the mat. We understand that the clearwell will bear on a 36 foot by 46 foot slab with a maximum pressure on the order of 1,400 psf. We also expect that the future 3 MG water storage tank will be supported on an interior mat with an exterior ring foundation.

If actual fill/cut heights vary from these conditions, then the recommendations in this report may need to be re-evaluated. We should be contacted if any of the above project information is incorrect so that we may reevaluate our recommendations.

1.3 Review of Soil Survey Map

Based on the Soil Survey Map of St Johns County, Florida, as prepared by the U.S. Department of Natural Resource Conservation Service, the predominant soil types existing within the site area are described in the following table. The site area is illustrated superimposed on the USDA-NRCS Soil Survey Map included as Figure 2:

Soil ID	Soil Type	Hydrology	Hydrologic Soil Classification	Estimated Seasonal High Groundwater Level ⁽¹⁾
65	Riviera fine sand	Poorly drained	C/D	6 to 18

(1) Inches below ground surface at time of survey.

2.0 FIELD EXPLORATION

We performed a field exploration between January 2, 2019 and January 4, 2019. The approximate boring locations are indicated on the attached Field Exploration Plan (Figure 3). Our personnel determined the boring locations using a handheld Global Positioning System (GPS) unit. The boring locations on the referenced Field Exploration Plan should be considered accurate only to the degree implied by the method of measurement used.

2.1 SPT Borings

We located and performed 11 Standard Penetration Test (SPT) borings, drilled to depths between approximately 20 feet and 85 feet below the existing ground surface, in general accordance with the methodology outlined in ASTM D 1586 to explore the subsurface conditions within the area of the proposed structures. Note Borings B9 and B10 were not performed during our exploration, based on discussions with your office regarding field conditions. Split-spoon soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory for further evaluation. A summary of the field procedures is included in Appendix A.

2.2 Auger Borings

We located and performed six auger borings, drilled to depths of approximately 6 feet or 15 below the existing ground surface in general accordance with the methodology outlined in ASTM D 1452 to explore the subsurface conditions within the proposed pavement and stormwater pond areas. Representative soil samples also were recovered from the auger borings and returned to our laboratory for further evaluation. A summary of the field procedures is included in Appendix A.

3.0 LABORATORY TESTING

A geotechnical engineer classified representative soil samples obtained during our field exploration using the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. A Key to the Soil Classification System is included in Appendix A.

Selected samples of the soils encountered during the field exploration were subjected to quantitative laboratory testing to better define the composition of the soils encountered and to provide data for correlation to their anticipated strength and compressibility characteristics. The laboratory testing determined the percent fines and moisture contents of selected soil samples. The results of the laboratory testing are shown in the Summary of Laboratory Test Data included in Appendix B. Also, these results are shown on the Generalized Subsurface Profiles on Figures 4 through 7 and on the Log of Boring records at the respective depths from which the tested samples were recovered.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General Soil Profile

A graphical presentation of the generalized subsurface conditions is presented on Figures 4 through 7. Detailed boring records are included in Appendix A. It should be understood that the soil conditions will likely vary between the boring locations. The following table summarizes the soil conditions encountered.

GENERAL SOIL PROFILE			
TYPICAL DEPTH (ft)		SOIL DESCRIPTION	USCS ⁽¹⁾
FROM	TO		
0	12	Loose to Medium Dense Fine Sand, Fine Sand with Silt, Fine Sand with Clay, Clayey Fine Sand	SP, SP-SM, SP-SC, SC
12	17	Very Loose Clayey Fine Sand, Silty Fine Sand	SC, SM
17	22	Very Loose Clayey Fine Sand, Silty Fine Sand, or Very Soft Clay	SC, SM, CH
22	52	Medium Dense to Very Dense Fine Sand	SP
52	57	Weathered Limestone	--
57	85	Loose to Dense Very Clayey Fine Sand (Marl)	SC

(1) Unified Soil Classification System

4.2 Groundwater Level

Groundwater was encountered at each boring location and recorded at the time of drilling at depths varying from the ground surface to 3 feet below the existing ground surface. We note that groundwater levels will fluctuate due to seasonal climatic variations, surface water runoff patterns, construction operations, and other interrelated factors. The groundwater depth at each boring location is noted on the Generalized Subsurface Profiles and on the Log of Boring records.

4.3 Normal Seasonal High Groundwater Level

The normal seasonal high groundwater level is affected by a number of factors. The drainage characteristics of the soils, land surface elevation, relief points such as drainage ditches, lakes, rivers, swamp areas, etc., and distance to relief points are some of the more important factors influencing the seasonal high groundwater level.

Based on our interpretation of the site conditions, including the boring logs and Web Soil Survey, we estimate the normal seasonal high groundwater level at the site at the boring locations to be approximately at the depths shown on the Generalized Subsurface Profiles. It is possible that groundwater levels may exceed the estimated normal seasonal high groundwater level as a result of significant or prolonged rains.

5.0 DESIGN RECOMMENDATIONS

5.1 General

Our geotechnical engineering evaluation of the site and subsurface conditions at the property, with respect to the planned construction and our recommendations for site preparation and foundation support, are based on (1) our site observations, (2) the field and laboratory test data obtained, (3) our understanding of the project information and structural conditions as presented in this report, and (4) our experience with similar soil and loading conditions.

If the stated structural or grading conditions are incorrect, or should the location of the structure or pavement areas be changed, please contact us so that we can review our recommendations. Also, the discovery of any site or subsurface conditions during construction that deviate from the data obtained during this geotechnical exploration should also be reported to us for our evaluation.

The recommendations in the subsequent sections of this report present design and construction techniques that are appropriate for the planned construction. We recommend that ECS be provided the opportunity to

review the foundation plans and earthwork specifications to verify that our recommendations have been properly interpreted and implemented.

5.2 Foundation Design Recommendations for Carbon Dioxide Tank and Odor Control Scrubbers

Based on the results of our exploration, we consider the subsurface conditions at the site adaptable for support of the proposed structures when constructed on properly designed conventional shallow foundation systems. Provided the site preparation and earthwork construction recommendations outlined in Section 6.0 of this report are performed, the following parameters may be used for foundation design.

5.2.1 Slab/Mat Design

The floor slab can be constructed as a concrete slab-on-ground with a turned down footing, provided surficial unsuitable materials (topsoil) and clayey sands (SC) are removed to a depth of 2 feet below the slab and replaced with compacted structural fill as outlined in Section 6.0. It is recommended that the floor slab bearing soils be covered with an impervious membrane to reduce moisture entry and floor dampness. A 6-mil-thick plastic membrane is commonly used for this purpose, in accordance with current Florida Building Code specifications. Care should be exercised not to tear the membrane during placement of reinforcing steel and concrete. In addition, we recommend that a minimum separation of 2 feet be maintained between the finished floor levels and the estimated normal seasonal high groundwater level. Provided the slab subgrades are prepared in accordance with Section 6.0, a subgrade reaction modulus of 150 pci may be used for the slab/mat design.

5.2.2 Foundation Design

The carbon dioxide structure and odor control scrubbers slab/mat foundations can be constructed as grade-supported provided that the existing surficial clayey fine sands (SC) are removed and replaced with compacted structural fill as outlined in Section 6.0. To reduce the potential for infiltration of groundwater, we recommend a separation of at least 2 feet between the slab bottom and the seasonal high groundwater level.

5.2.3 Bearing Pressure

The maximum allowable net soil bearing pressure for use in shallow foundation design should not exceed 1,000 pounds per square foot (psf). Net bearing pressure is defined as the soil bearing pressure at the foundation bearing level in excess of the natural overburden pressure at that level. The foundations should be designed based on the maximum load that could be imposed by all loading conditions.

5.2.4 Bearing Depth

The exterior turn down foundations should bear at a depth of at least 12 inches below the exterior final grades, and any interior foundations should bear at a depth of at least 12 inches below the finish floor elevation to provide confinement to the bearing level soils. It is recommended that stormwater be diverted away from the pad area to reduce the possibility of erosion beneath the exterior footings.

As previously mentioned, clayey sands (SC) were encountered within the surficial soils. It is recommended that these clayey soils be removed to a depth of 2 feet below the bottom of the footings and replaced with compacted structural fill, as outlined in Section 6.0.

5.2.5 Bearing Material

The turn down foundations may bear in either the compacted suitable natural soils or compacted structural fill. The bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557), to a depth of at least one foot below the foundation bearing levels.

5.2.6 Settlement Estimates for Carbon Dioxide Tank and Odor Control Scrubbers

Post-construction settlements of the concrete pad will be influenced by several interrelated factors, such as (1) subsurface stratification and strength/compressibility characteristics; (2) footing size, bearing level, applied loads, and resulting bearing pressures beneath the foundations; and (3) site preparation and earthwork construction techniques used by the contractor. Our settlement estimates for the structures are based on the use of site preparation/earthwork construction techniques as recommended in Section 6.0 as well as the assumed loading conditions presented in Section 1.2 of this report. Any deviation from these recommendations could result in an increase in the estimated post-construction settlements of the structures.

Due to the sandy nature of the near-surface soils below the electrical and chemical buildings, we expect the majority of settlement to occur in an elastic manner and fairly rapidly during construction. Using the recommended maximum bearing pressure, the assumed maximum structural loads, and the field and laboratory test data that we have correlated to geotechnical strength and compressibility characteristics of the subsurface soils, we estimate that total settlements of the structures could be on the order of one inch or less.

Differential settlements result from differences in applied bearing pressures and variations in the compressibility characteristics of the subsurface soils. Because of the general uniformity of the subsurface conditions and the recommended site preparation and earthwork construction techniques outlined in Section 6.0, we anticipate that differential settlements of the structure should be within tolerable magnitudes of ½ of the total settlement, or less.

5.3 3 MG Water Storage Tank and Clearwell Foundation Design Recommendations

Based on the results of our exploration, we do not consider the subsurface conditions at the site adaptable for support of the proposed structures on a conventional shallow foundation system. Without soil stabilization, we estimate the settlement of the tanks will exceed the foundation performance criteria (greater than 6 inches for the water storage tank and in excess of 2 ½ inch for the clearwell). Due to the very loose clayey sands encountered between depths of 12 feet and 22 feet in the borings, ground improvement should be used for support of the proposed water storage tank and clearwell. Based on our experience with similar loading and subsurface conditions, it is our opinion that Rigid Inclusions would be a cost effective suitable soil improvement option for this project. Stone columns may be considered as an alternative soil improvement option for this project. It is our opinion due to the very loose clayey sands between approximately 12 feet and 22 feet that the Rigid Inclusions would be more economical and would be the preferred option over stone columns; however, both options may be considered. With soil improvements, settlements of the tank can be designed to be less than maximum allowable total and differential settlements. Provided the slab subgrades are placed over improved soils as discussed in Sections 5.3.1 and 5.3.2, a subgrade reaction modulus of 10 pci may be used for the slab/mat designs at the tank and clearwell. This value assumes soil improvements are designed for a maximum of one inch of settlement of the tank and clearwell slabs.

We recommend that ECS perform additional testing (pressuremeter or dilatometer testing) should be performed in the area of the water storage tank to further evaluate the very loose to loose sandy soils. This additional testing will provide a direct measurement of the in-situ modulus of these sandy soils. Measuring the modulus of these soils will assist in developing a refined settlement estimate. Although we anticipate that the estimated settlements will reduce in magnitude as a result of this additional testing, we do expect that the total settlement of the tank will exceed foundation performance criteria. Therefore, the modulus values and refined settlement estimates could be provided to the specialty contractors to enhance the design criteria used to design the soil improvement system and to provide for a more economical (refined) design.

5.3.1 Rigid Inclusions

Based on the results of the field exploration, rigid inclusions may be considered as a soil improvement alternative to support the proposed storage tank. Rigid inclusions use high modulus, controlled stiffness

columns to transfers loads through poor soils to a suitable underlying soil layer. A bottom-feed mandrel with a top-mounted vibrator is advanced through the weak strata to the underlying firm stratum. Rigid inclusions terminate at an upper strong soil layer or in overlain by an engineered relieving platform. If rigid inclusions are considered, we recommend the system be extended below the very loose clayey sand zone to a depth of at least 35 feet below existing grades. We recommend that a specialty contractor be contacted to provide final design and evaluation of rigid inclusions.

5.3.2 Stone Columns

Based on the results of our field exploration, it is anticipated that vibro-compaction/vibro-replacement may be considered as a soil improvement alternative to support the proposed storage tank and clearwell. Vibro-improvement consists of penetrating the very loose to loose fine sands with a vibrator generating horizontal vibrations. The vibrator penetrates to the design depth under its power accompanied by water jetting. After a certain compaction time at each treatment depth location, the soils become densified. The vibrator is then raised a given distance and the next interval is treated. This procedure is repeated over the entire depth as backfill sand or stone is added. We recommend the soils within the storage tank area be densified to a minimum depth of 30 feet below the ground surface.

Because vibro-improvement utilizes vibratory probes that generate significant vibrations, vibration monitoring of the existing structure should be performed to verify that vibration magnitudes are maintained at an acceptable level for the existing structure.

It is recommended that a specialty contractor be contacted to provide further information pertaining to vibro-compaction for the given subsurface conditions and project information. The proposals prepared by any specialty foundation contractor should be provided to ECS so that we may review the proposed construction techniques to assure compliance with the intention of our geotechnical recommendations.

5.4 Pavement Considerations

Based on the results of our exploration, we consider the subsurface conditions at the site favorable for support of a flexible pavement section when constructed on properly prepared subgrade soils as outlined in Section 6.0 of this report. Typical pavement sections used in northeast Florida are shown on the following table. If requested, we can prepare a project-specific pavement design if specific traffic data is provided.

TYPICAL PAVEMENT SECTION		
Pavement Layer	Auto Parking & Traffic Lanes	Truck Areas
Asphaltic Concrete Wearing Surface	1.5"	2.0"
Limerock Base	6.0"	8.0"
Stabilized Subgrade	12.0"	12.0"

5.4.1 Wearing Surface

The wearing surface should consist of Florida Department of Transportation (FDOT) Type S asphaltic concrete having a minimum Marshall Stability of 1,500 lbs. Specific requirements for Type S asphaltic concrete wearing surface are outlined in the 2000 edition of the *Florida Department of Transportation, Standard Specifications for Road and Bridge Construction*. As an alternative, the wearing surface may consist of a Type SP-9.5 asphaltic concrete as outlined in the current edition of the *Standard Specifications*.

5.4.2 Base and Subgrade

The limerock base course should have a minimum Limerock Bearing Ratio (LBR) of 100 and should be compacted to 100 percent of the modified Proctor maximum dry density (ASTM D 1557) value.

The subgrade material should have a minimum LBR of 40 and be compacted to 98 percent of the modified Proctor maximum dry density (ASTM D 1557) value. Clayey sand (SC) was encountered in Borings A1, A2, and A4 to depths of approximately 1.5 feet below the existing ground surface. We recommend that a minimum of 2 feet of separation be maintained between the bottom of the base material and the top of these clayey soils. If this cannot be achieved through site grading, select undercutting may be required to maintain the required separation.

5.4.3 Underdrains

Satisfactory pavement life is dependent on dry/strong pavement support provided by the base and subgrade courses. Accordingly, a minimum clearance of 2 feet must be maintained between the normal seasonal high groundwater table and the bottom of the base layer. Depending on final pavement grades, underdrains may be required to maintain dry base and subgrade materials.

5.5 Pond Borrow Suitability

Based on the boring results of Boring LA1 and classification of the soil samples, the fine sands with silt (SP-SM) encountered in the borings are considered suitable for use as fill soil. These soils were encountered in the boring from below the topsoil layer to approximately 6 feet below the existing ground surface. The soils containing surficial organic material will require removal and are unsuitable as structural fill. The organic soils could be used in non-structural areas.

We do not recommend the use of clayey fine sand (SC) as fill material. These soils will be more difficult to compact due to their tendency to retain soil moisture and are difficult to dry.

The soils in the proposed pond area that are below the groundwater level will have moisture contents in excess of the modified Proctor optimum moisture content and will require spreading and aeration to bring the moisture content within 2 percentage points of the soil's optimum moisture content corresponding to the required degree of compaction.

6.0 SITE PREPARATION AND EARTHWORK RECOMMENDATIONS

Site preparation as outlined in this section should be performed to provide more uniform foundation bearing conditions, to reduce the potential for post-construction settlements of the planned structures and to maintain the integrity of a flexible pavement section.

6.1 Clearing and Stripping

Prior to construction, the location of existing underground utilities within the construction area should be established. Provisions should then be made to relocate interfering utilities to appropriate locations. Underground pipes that are not properly removed or plugged may serve as conduits for subsurface erosion, which may subsequently lead to excessive settlement of overlying structures.

The "footprint" of the proposed structures plus a minimum additional margin of 5 feet, and of the hardscape areas (parking/driveway) plus a minimum additional margin of 3 feet, should be stripped of all surface vegetation, stumps, debris, organic topsoil, or other deleterious materials. During grubbing operations, roots with a diameter greater than 0.5-inch, stumps, or small roots in a concentrated state, should be grubbed and completely removed.

Based on the results of our field exploration, it should be anticipated that 6 to 12 inches of topsoil and soils containing significant amounts of organic materials may be encountered across the site. The actual depths of unsuitable soils and materials should be determined by ECS using visual observation and judgment during earthwork operations. Any topsoils removed from the building and parking/drive areas can be stockpiled and used subsequently in areas to be grassed.

6.2 Temporary Groundwater Control

Because of the need for densification of the soils within the upper 2 feet below the stripped surface, temporary groundwater control measures may be required if the groundwater level is within 2 feet below the stripped and grubbed surface at the time of construction. Should groundwater control measures become necessary, dewatering methods should be determined by the contractor. We recommend the groundwater control measures, if necessary, remain in place until compaction of the existing soils is completed. The dewatering method should be maintained until backfilling has reached a height of 2 feet above the groundwater level at the time of construction. The site should be graded to direct surface water runoff from the construction area.

Note that discharge of produced groundwater to surface waters of the state from dewatering operations or other site activities is regulated and requires a permit from the State of Florida Department of Environmental Protection (FDEP). This permit is termed a *Generic Permit for the Discharge of Produced Groundwater From Any Non-Contaminated Site Activity*. If discharge of produced groundwater is anticipated, we recommend sampling and testing of the groundwater early in the site design phase to prevent project delays during construction. ECS can provide the sampling, testing, and professional consulting required to evaluate compliance with the regulations.

6.3 Compaction

After completing the clearing and stripping operations and installing the temporary groundwater control measures (if required), the exposed surface should be compacted with a vibratory drum roller having a minimum static, at-drum weight, on the order of 6 tons. Typically, the material should exhibit moisture contents within ± 2 percentage points of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within the upper 2 feet of the compacted natural soils at the site.

Should the bearing level soils experience pumping and soil strength loss during the compaction operations, compaction work should be immediately terminated, and (1) the disturbed soils should be removed and backfilled with compacted structural fill, or (2) the excess moisture content within the disturbed soils should be allowed to dissipate before recompacting.

Care should be exercised to avoid damaging any nearby structures while the compaction operation is underway. Prior to commencing compaction, occupants of adjacent structures should be notified, and the existing conditions of the structures should be documented with photographs and survey (if deemed necessary). Compaction should cease if deemed detrimental to adjacent structures, and ECS should be contacted immediately. We recommend the vibratory roller remain a minimum of 50 feet from existing structures. Within this zone, use of a track-mounted bulldozer, or a vibratory roller operating in the static mode, is recommended.

6.4 Structural Backfill and Fill Soils

Structural backfill or fill required for site development should be placed in loose lifts not exceeding 12 inches in thickness when compacted by the use of the above described vibratory drum roller. The lift thickness should be reduced to 8 inches if the roller operates in the static mode or if track-mounted compaction equipment is used. If hand-held compaction equipment is used, the lift thickness should be further reduced to 6 inches.

Structural fill is defined as a non-plastic, inorganic, granular soil having less than 10 percent material passing the No. 200 mesh sieve and containing less than 4 percent organic material. The fine sand and fine sand with silt or fine sand with clay, without roots, as encountered in the borings, are suitable as fill materials and, with proper moisture control, should densify using conventional compaction methods. Soils with more than 10 to 12 percent passing the No. 200 sieve will be more difficult to compact, due to their nature to retain soil moisture, and may require drying. Typically, the material should exhibit moisture

contents within ± 2 percentage points of the modified Proctor optimum moisture content (ASTM D 1557) during the compaction operations. Compaction should continue until densities of at least 95 percent of the modified Proctor maximum dry density (ASTM D 1557) have been achieved within each lift of the compacted structural fill.

6.5 Foundation Areas

After satisfactory placement and compaction of the required structural fill, the foundation areas may be excavated to the planned bearing levels. The foundation bearing level soils, after compaction, should exhibit densities equivalent to 95 percent of the modified Proctor maximum dry density (ASTM D 1557) to a depth of one foot below the bearing level. For confined areas, such as the footing excavations, any compactive effort should be provided by a lightweight vibratory sled or roller having a total weight on the order of 500 to 2,000 pounds.

6.6 Pavement Areas

After completing the clearing/stripping operations in the pavement areas, any underlying clayey sands and sandy clays that are within 2 feet of the bottom of the pavement base should be over-excavated from within the pavement areas. Structural backfill and fill required to achieve the finish pavement grades then can be placed and compacted as described in Sections 6.3 and 6.4 above. As an exception, densities of at least 98 percent of the modified Proctor maximum dry density (ASTM D1557) should be obtained within the upper one foot of the materials immediately below the proposed base course.

7.0 QUALITY CONTROL TESTING

ECS should be retained to perform the construction material testing and observations required for this project, to verify that our recommendations have been satisfied. We are the most qualified to address problems that may arise during construction, since we are familiar with the intent of our engineering design.

A representative number of field in-place density tests should be made in the upper 2 feet of compacted natural soils, in each lift of compacted backfill and fill, and in the upper 12 inches below the bearing levels in the footing excavations. Density tests are recommended to verify that satisfactory compaction operations have been performed. We recommend density testing be performed (1) at one location for every 5,000 square feet of structure area, (2) at 25 percent of any isolated column footing locations, (3) at one location for every 100 linear feet of continuous wall or ring footings, (4) at one location for every 300 linear feet of underground utilities, and (5) at one location for every 10,000 square feet of pavement area.

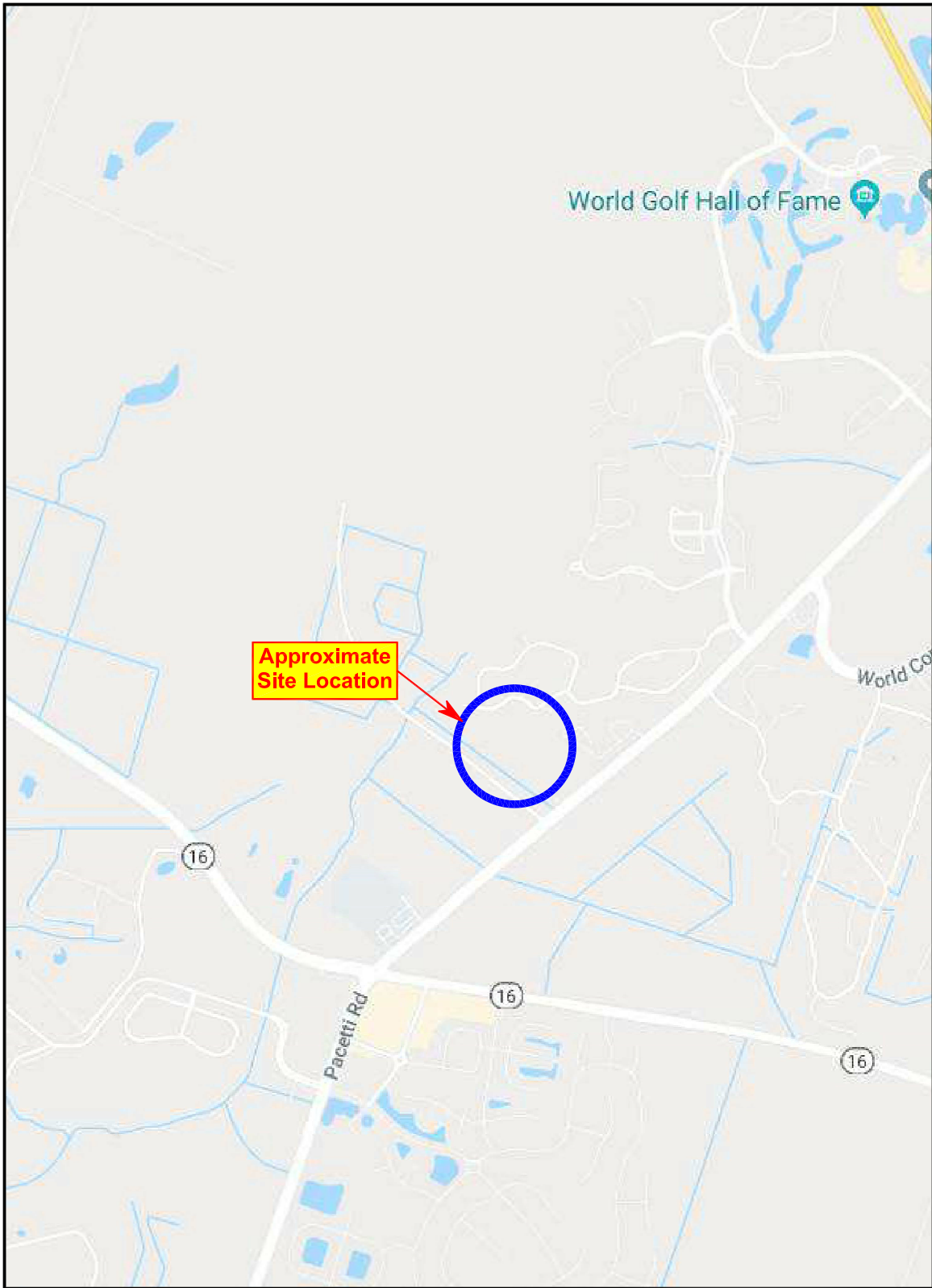
8.0 REPORT LIMITATIONS

Our geotechnical exploration has been performed, our findings obtained, and our recommendations prepared, in accordance with generally accepted geotechnical engineering principles and practices. ECS is not responsible for any independent conclusions, interpretation, opinions, or recommendations made by others based on the data contained in this report.

Our scope of services was intended to evaluate the soil conditions within the zone of soil influenced by the foundation system. Our scope of services does not address geologic conditions, such as sinkholes or soil conditions existing below the depth of the soil borings.

This report does not reflect any variations that may occur adjacent to or between soil borings. The discovery of any site or subsurface condition during construction that deviates from the data obtained during this geotechnical exploration should be reported to us for our evaluation. Also, in the event of any change to the supplied/assumed structural conditions or the locations of the structures, pavement, or pond areas, please contact us so that we can review our recommendations. We recommend that we be provided the opportunity to review the foundation plans and earthwork specifications to verify that our recommendations have been properly interpreted and implemented.

FIGURES



ECS Florida, LLC

Geotechnical ■ Construction Materials ■ Environmental ■ Facilities
 7064 Davis Creek Road, Jacksonville, FL 32256
 T: (904) 880-0960 • F: (904) 880-0970
www.ecslimited.com

Site Location Plan
Northwest WTP Improvements

St. Johns County, Florida



Date: 01/08/19

Project No.: 35-27930

Figure 1

JAS - 35-27930



LEGEND

65 Riviera fine sand



ECS Florida, LLC

Geotechnical ■ Construction Materials ■ Environmental ■ Facilities
 7064 Davis Creek Road, Jacksonville, FL 32256
 T: (904) 880-0960 • F: (904) 880-0970
 www.ecslimited.com

Soil Survey of St. Johns County

Northwest WTP Improvements

St. Johns County, Florida

Issued 1998

Web Soil Survey

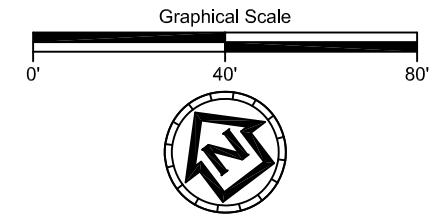
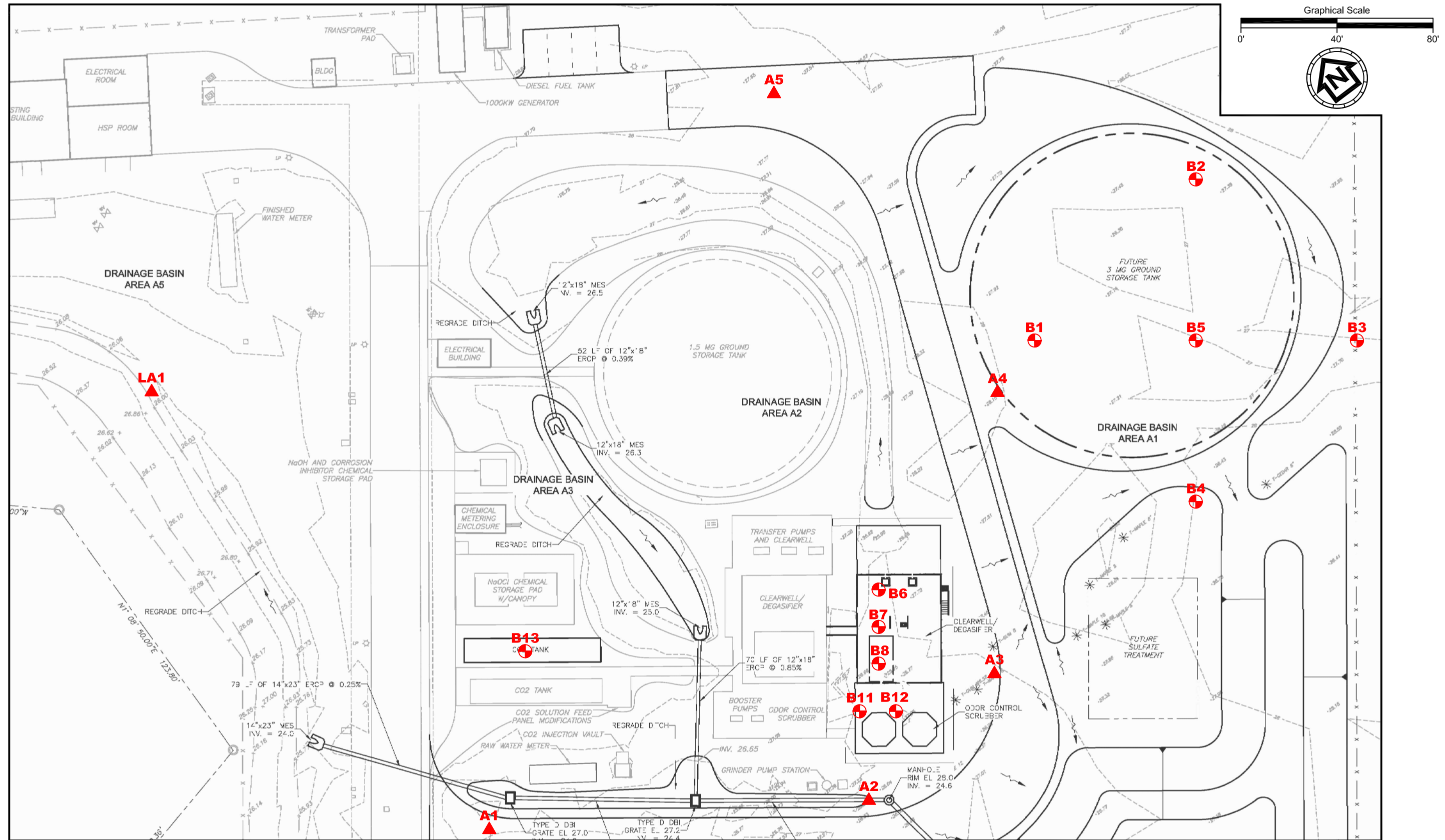


Date: 01/08/19



Project No.: 35-27930

Figure 2

JAS - 35-27930



LEGEND

-  Approximate Location of Standard Penetration Test (SPT) Boring
-  Approximate Location of Auger Boring

ECS Florida, LLC

Geotechnical ■ Construction Materials ■ Environmental ■ Facilities

7064 Davis Creek Road, Jacksonville, FL 32256
 T: (904) 880-0960 • F: (904) 880-0970
 www.ecslimited.com

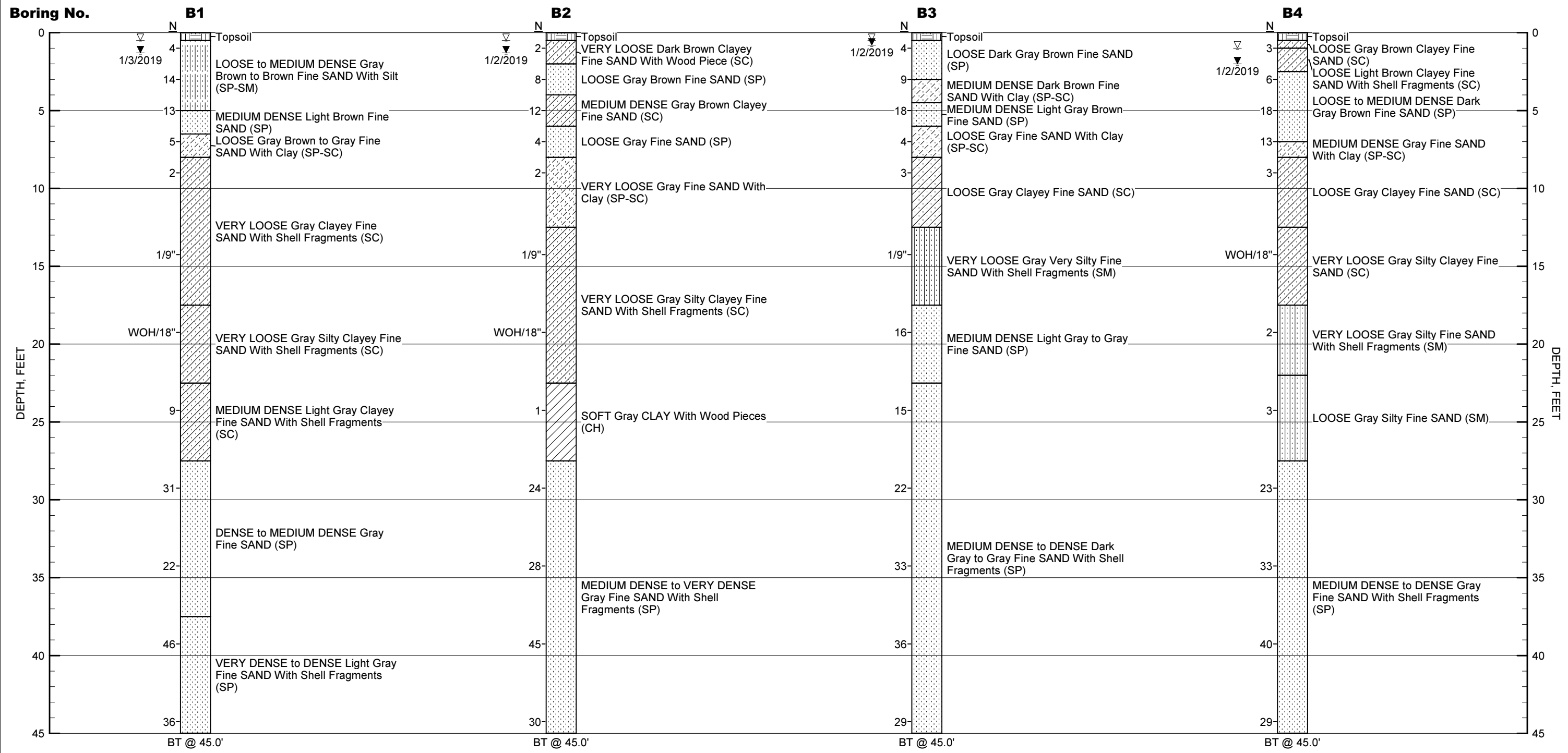
Field Exploration Plan
Northwest WTP Improvements
 St. Johns County, Florida

Date: 01/15/19

Project No.: 35-27930

Figure 3

JAS - 35-27930



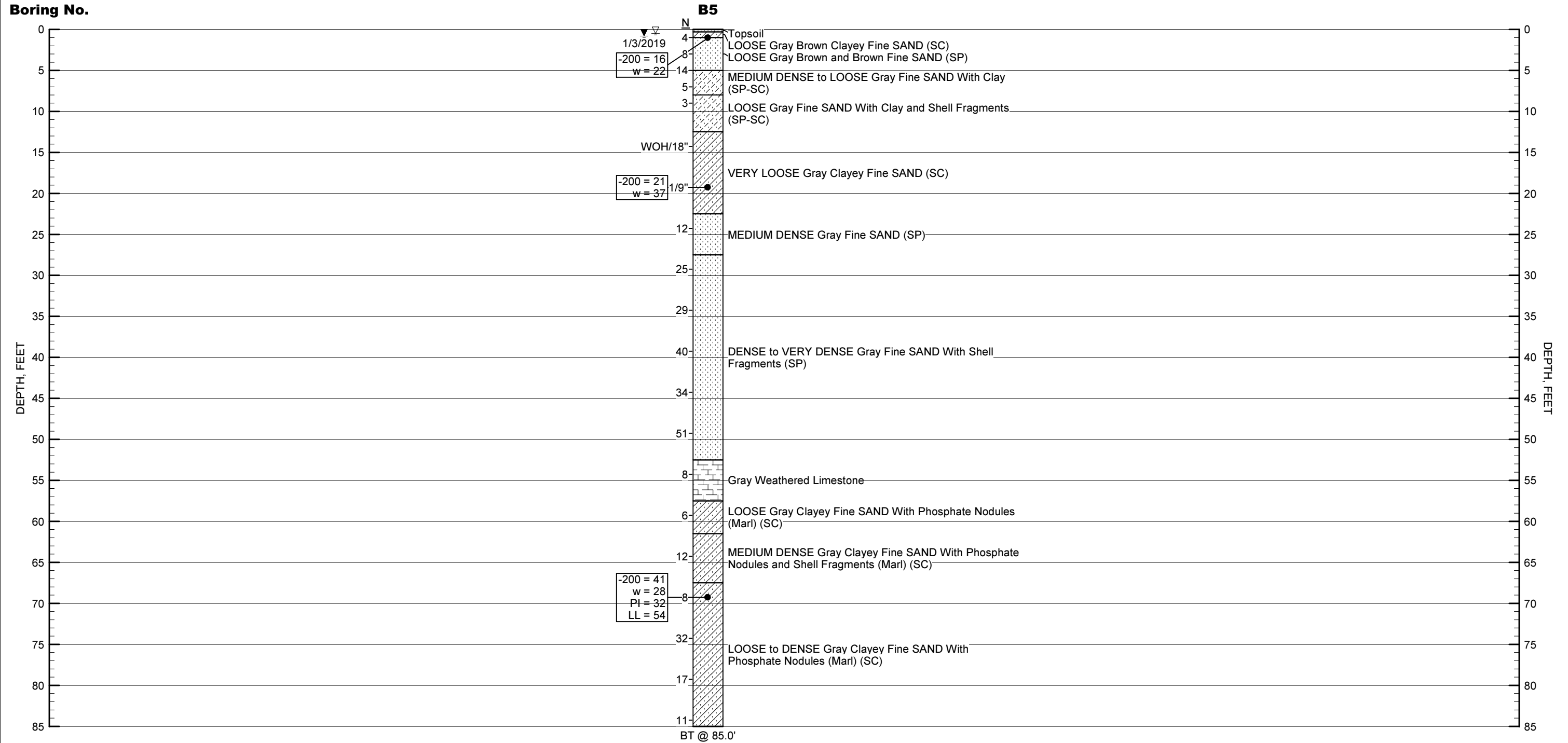
LEGEND

- | | | | | |
|-----------------------------|-----------------------------|--|---|--|
| Topsoil | Fine SAND (SP) | Standard Penetration Resistance, Blows/Foot | WOH Distance Split-Spoon Soil Sampler Dropped Under Weight of Drilling Tools and Hammer | -200 % Passing No. 200 U.S. Standard Sieve |
| Fine SAND With Silt (SP-SM) | Fine SAND With Clay (SP-SC) | Unified Soil Classification System | 1/12" One Blow to Drive Split Spoon Sample Twelve Inches | w Natural Moisture Content (%) |
| Silty Fine SAND (SM) | Clayey Fine SAND (SC) | Groundwater Level at Time of Drilling | BT Boring Terminated at Depth Below Grade | LL Liquid Limit |
| CLAY (CH) | Weathered Limestone | Estimated Normal Seasonal High Groundwater Level | | PI Plasticity Index |

Generalized Subsurface Profiles
Northwest WTP Improvements
 St. Johns County, Florida

DATE: 1/9/19	PROJ. NO.: 35-27930	Figure 4
--------------	---------------------	----------

Boring No.

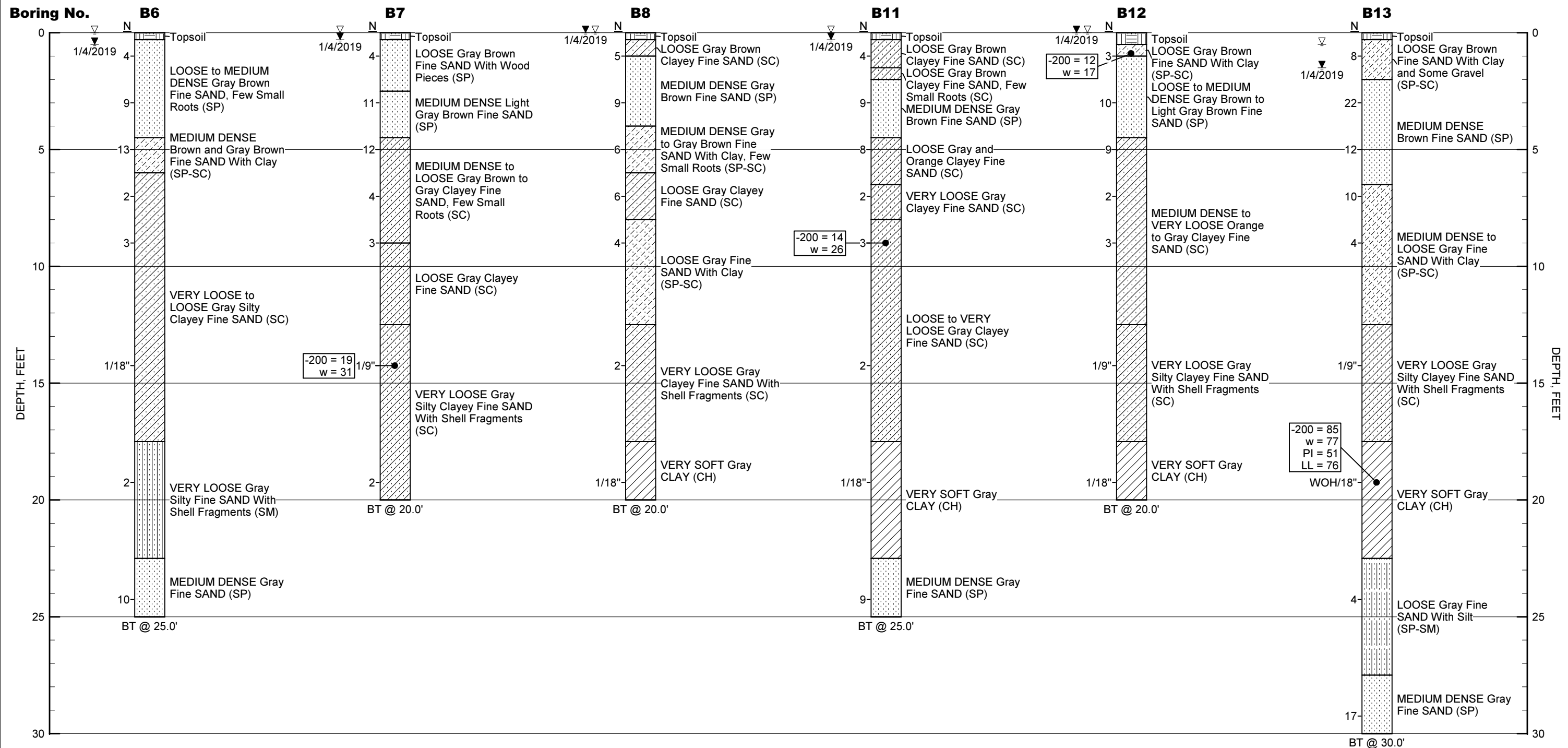


LEGEND

- | | | | | |
|-----------------------------|-----------------------------|--|---|--|
| Topsoil | Fine SAND (SP) | Standard Penetration Resistance, Blows/Foot | WOH Distance Split-Spoon Soil Sampler Dropped Under Weight of Drilling Tools and Hammer | -200 % Passing No. 200 U.S. Standard Sieve |
| Fine SAND With Silt (SP-SM) | Fine SAND With Clay (SP-SC) | Unified Soil Classification System | 1/12" One Blow to Drive Split Spoon Sample Twelve Inches | w Natural Moisture Content (%) |
| Silty Fine SAND (SM) | Clayey Fine SAND (SC) | Groundwater Level at Time of Drilling | BT Boring Terminated at Depth Below Grade | LL Liquid Limit |
| CLAY (CH) | Weathered Limestone | Estimated Normal Seasonal High Groundwater Level | | PI Plasticity Index |

Generalized Subsurface Profiles
Northwest WTP Improvements
 St. Johns County, Florida

DATE: 1/9/19	PROJ. NO.: 35-27930	Figure 5
--------------	---------------------	----------

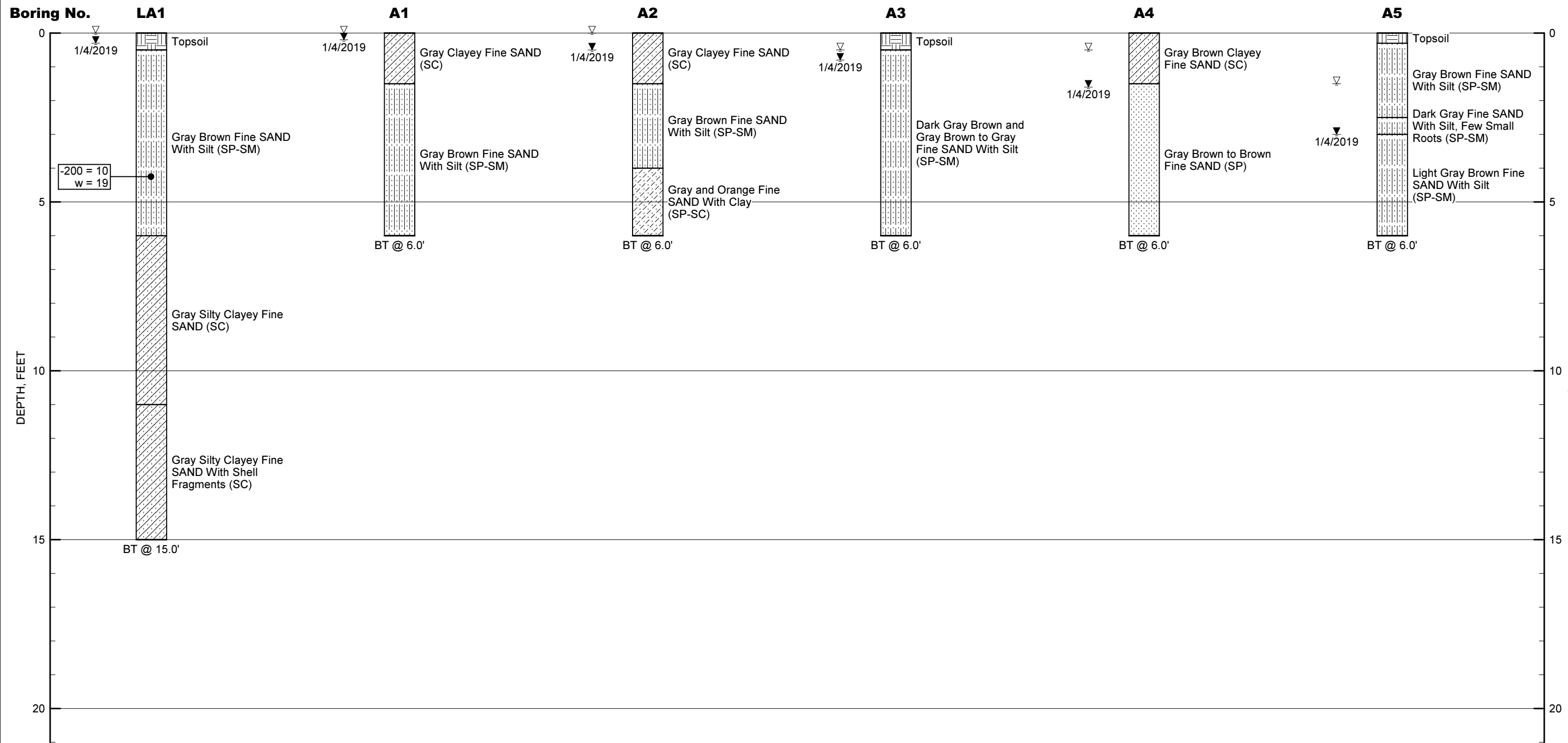


LEGEND












- | | | | | |
|-----------------------------|-----------------------------|--|---|--|
| Topsoil | Fine SAND (SP) | Standard Penetration Resistance, Blows/Foot | WOH Distance Split-Spoon Soil Sampler Dropped Under Weight of Drilling Tools and Hammer | -200 % Passing No. 200 U.S. Standard Sieve |
| Fine SAND With Silt (SP-SM) | Fine SAND With Clay (SP-SC) | Unified Soil Classification System | 1/12" One Blow to Drive Split Spoon Sample Twelve Inches | w Natural Moisture Content (%) |
| Silty Fine SAND (SM) | Clayey Fine SAND (SC) | Groundwater Level at Time of Drilling | BT Boring Terminated at Depth Below Grade | LL Liquid Limit |
| CLAY (CH) | Weathered Limestone | Estimated Normal Seasonal High Groundwater Level | | PI Plasticity Index |

Generalized Subsurface Profiles
Northwest WTP Improvements
 St. Johns County, Florida


DATE: 1/9/19	PROJ. NO.: 35-27930	Figure 6
--------------	---------------------	----------



LEGEND

- | | | | | |
|---|---|--|---|--|
|  Topsoil |  Fine SAND (SP) |  Standard Penetration Resistance, Blows/Foot | WOH Distance Split-Spoon Soil Sampler Dropped Under Weight of Drilling Tools and Hammer | -200 % Passing No. 200 U.S. Standard Sieve |
|  Fine SAND With Silt (SP-SM) |  Fine SAND With Clay (SP-SC) | SP Unified Soil Classification System | 1/12" One Blow to Drive Split Spoon Sample Twelve Inches | w Natural Moisture Content (%) |
|  Silty Fine SAND (SM) |  Clayey Fine SAND (SC) |  Groundwater Level at Time of Drilling | BT Boring Terminated at Depth Below Grade | LL Liquid Limit |
|  CLAY (CH) |  Weathered Limestone |  Estimated Normal Seasonal High Groundwater Level | | PI Plasticity Index |

Generalized Subsurface Profiles
Northwest WTP Improvements
 St. Johns County, Florida



DATE: 1/9/19	PROJ. NO.: 35-27930	Figure 7
--------------	---------------------	----------

APPENDIX A

SOIL BORING LOGS
FIELD EXPLORATION PROCEDURES
KEY TO SOIL CLASSIFICATION



LOG OF BORING

Project No.: 35-27930
 Boring No.: B1
 Sheet 1 of 2

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.3 ft Time: _____ Drilling Date: 1/3/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil	1								
1			LOOSE Gray Brown Fine SAND With Silt (SP-SM)	1	4							
				3								
				5								
				4								
2			MEDIUM DENSE Brown Fine SAND With Silt (SP-SM)	7	14							
				7								
				6								
				5								
3	5		MEDIUM DENSE Light Brown Fine SAND (SP)	7	13							
				7								
				7								
				3								
4			LOOSE Gray Brown to Gray Fine SAND With Clay (SP-SC)	3	5							
				2								
				2								
				1								
5			VERY LOOSE Gray Clayey Fine SAND With Shell Fragments (SC)	1	2							
				1								
				1								
				1								
6	10			1								
7	15		VERY LOOSE Gray Silty Clayey Fine SAND With Shell Fragments (SC)	1/9"	1/9"							
8	20		MEDIUM DENSE Light Gray Clayey Fine SAND With Shell Fragments (SC)	WOH/18"	9							
8	25			4								
				5								
				4								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B1
 Sheet 2 of 2

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.3 ft Time: _____ Drilling Date: 1/3/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	25		MEDIUM DENSE Light Gray Clayey Fine SAND With Shell Fragments (SC) (Continued)									
	9		DENSE to MEDIUM DENSE Gray Fine SAND (SP)	12 15 16	31							
	10			7 10 12	22							
	11		VERY DENSE to DENSE Light Gray Fine SAND With Shell Fragments (SP)	15 23 23	46							
	12			16 16 20	36							
	45		Boring Terminated @ 45 ft.									

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



LOG OF BORING

Project No.: 35-27930
 Boring No.: B2
 Sheet 1 of 2

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.3 ft Time: _____ Drilling Date: 1/2/19 Boring Begun: 1/2/19 Boring Completed: 1/2/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil	1								
1	1		VERY LOOSE Dark Brown Clayey Fine SAND With Wood Piece (SC)	1	2							
				1								
2	2		LOOSE Gray Brown Fine SAND (SP)	2	8							
				2								
				3								
				5								
3	5		MEDIUM DENSE Gray Brown Clayey Fine SAND (SC)	4	12							
				5								
				7								
4	4		LOOSE Gray Fine SAND (SP)	3	4							
				2								
5	5		VERY LOOSE Gray Fine SAND With Clay (SP-SC)	2	2							
				2								
				1								
				1								
				1								
6	15		VERY LOOSE Gray Silty Clayey Fine SAND With Shell Fragments (SC)	1	1/9"	1/9"						
				1/9"								
7	20		SOFT Gray CLAY With Wood Pieces (CH)	1	1							
				1/12"								
8	25			1								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B2
 Sheet 2 of 2

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.3 ft Time: _____ Drilling Date: 1/2/19 Boring Begun: 1/2/19 Boring Completed: 1/2/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	25		SOFT Gray CLAY With Wood Pieces (CH) <i>(Continued)</i>									
	9		MEDIUM DENSE to VERY DENSE Gray Fine SAND With Shell Fragments (SP)	7								
	30			10	24							
	10			12								
	35			14	28							
	11			15								
	40			22	45							
	12			23								
	45		Boring Terminated @ 45 ft.	10								
	16			14	30							
	50			16								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



LOG OF BORING

Project No.: 35-27930
 Boring No.: B3
 Sheet 1 of 2

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.8 ft Time: _____ Drilling Date: 1/2/19 Boring Begun: 1/2/19 Boring Completed: 1/2/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											PLASTICITY INDEX	UNSATURATED SHEAR STRENGTH
	0		Topsoil	1								
1			LOOSE Dark Gray Brown Fine SAND (SP)	2	4							
				2								
				2								
				4								
2			MEDIUM DENSE Dark Brown Fine SAND With Clay (SP-SC)	5	9							
				7								
				5								
3	5		MEDIUM DENSE Light Gray Brown Fine SAND (SP)	8	18							
				10								
4			LOOSE Gray Fine SAND With Clay (SP-SC)	3	4							
				2								
				2								
5			LOOSE Gray Clayey Fine SAND (SC)	2	3							
				1								
				1								
				1								
6	10		VERY LOOSE Gray Very Silty Fine SAND With Shell Fragments (SM)	1	1/9"	1/9"						
				1/9"								
7	15		MEDIUM DENSE Light Gray to Gray Fine SAND (SP)	6	16							
				8								
				8								
8	20		MEDIUM DENSE Dark Gray Fine SAND With Shell Fragments (SP)	1	15							
				4								
				11								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B3
 Sheet 2 of 2

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.8 ft Time: _____ Drilling Date: 1/2/19 Boring Begun: 1/2/19 Boring Completed: 1/2/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	25		MEDIUM DENSE Dark Gray Fine SAND With Shell Fragments (SP) (Continued)									
	9		MEDIUM DENSE to DENSE Gray Fine SAND With Shell Fragments (SP)	5 9 13	22							
	10			12 15 18	33							
	11			10 15 21	36							
	12			10 14 15	29							
	45		Boring Terminated @ 45 ft.									

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B4
 Sheet 1 of 2

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 2 ft Time: _____ Drilling Date: 1/2/19 Boring Begun: 1/2/19 Boring Completed: 1/2/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											PLASTICITY INDEX	UNSATURATED SHEAR STRENGTH
	0		Topsoil	1								
1	1		LOOSE Gray Brown Clayey Fine SAND (SC)	1	3							
			LOOSE Light Brown Clayey Fine SAND With Shell Fragments (SC)	2								
			LOOSE to MEDIUM DENSE Dark Gray Brown Fine SAND (SP)	2								
2	5		MEDIUM DENSE Gray Fine SAND With Clay (SP-SC)	4	6							
				3								
				6								
				12								
				12								
				7								
3	10		LOOSE Gray Clayey Fine SAND (SC)	6	13							
				6								
				1								
4	15		VERY LOOSE Gray Silty Clayey Fine SAND (SC)	2	3							
				2								
				2								
5	20		VERY LOOSE Gray Silty Fine SAND With Shell Fragments (SM)	1	2							
				1								
				1								
6	25		LOOSE Gray Silty Fine SAND (SM)	3	3							
				1								
				2								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B4
 Sheet 2 of 2

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: Length of Casing:
 Groundwater Depth: 2 ft Time: Drilling Date: 1/2/19 Boring Begun: 1/2/19 Boring Completed: 1/2/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	25		LOOSE Gray Silty Fine SAND (SM) (Continued)									
	9		MEDIUM DENSE to DENSE Gray Fine SAND With Shell Fragments (SP)	8 11 12	23							
	10			12 14 19	33							
	11			12 20 20	40							
	12			13 14 15	29							
	45		Boring Terminated @ 45 ft.									

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B5
 Sheet 1 of 4

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: Length of Casing:
 Groundwater Depth: 0.8 ft Time: Drilling Date: 1/3/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											PLASTICITY INDEX	MOISTURE CONTENT (%)
	0		Topsoil	1								
1	0-1		LOOSE Gray Brown Clayey Fine SAND (SC)	1			16		+			
			LOOSE Gray Brown and Brown Fine SAND (SP)	3	4							
				3								
2	1-2			2	8							
				3								
				5								
				8								
				3								
				3								
3	2-3		MEDIUM DENSE to LOOSE Gray Fine SAND With Clay (SP-SC)	8	14							
				2								
				3								
4	3-4			2	5							
				3								
				2								
5	4-5		LOOSE Gray Fine SAND With Clay and Shell Fragments (SP-SC)	1	3							
				2								
				1								
6	5-6		VERY LOOSE Gray Clayey Fine SAND (SC)	1								
				1								
				1								
7	6-7			1	21							
				1								
				1								
8	7-8		MEDIUM DENSE Gray Fine SAND (SP)	4	12							
				5								
				7								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B5
 Sheet 2 of 4

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.8 ft Time: Drilling Date: 1/3/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	25		MEDIUM DENSE Gray Fine SAND (SP) <i>(Continued)</i>									
	9		DENSE to VERY DENSE Gray Fine SAND With Shell Fragments (SP)	10 12 13	25							
	10			13 14 15	29							
	11			12 19 21	40							
	12			10 14 20	34							
	13			20 21 30	51							
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: B5
 Sheet 3 of 4

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.8 ft Time: Drilling Date: 1/3/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	50		DENSE to VERY DENSE Gray Fine SAND With Shell Fragments (SP) (Continued)									
	14		Gray Weathered Limestone	5 5 3	8							
	55		LOOSE Gray Clayey Fine SAND With Phosphate Nodules (Marl) (SC)	1 2 4	6							
	15		MEDIUM DENSE Gray Clayey Fine SAND With Phosphate Nodules and Shell Fragments (Marl) (SC)	2 4 8	12							
	60		LOOSE to DENSE Gray Clayey Fine SAND With Phosphate Nodules (Marl) (SC)	3 3 5	8		41	○+	◇			
	65			14 18 14	32							
	16											
	17											
	18											
	70											
	75											

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B5
 Sheet 4 of 4

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.8 ft Time: _____ Drilling Date: 1/3/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	75		LOOSE to DENSE Gray Clayey Fine SAND With Phosphate Nodules (Marl) (SC) <i>(Continued)</i>									
	19			6								
	80			11	17							
	20			4								
	85		Boring Terminated @ 85 ft.	4								
				4								
				7	11							
	90											
	95											
	100											
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: B7
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.3 ft Time: _____ Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil	1								
1	1		LOOSE Gray Brown Fine SAND With Wood Pieces (SP)	4								
2	2		MEDIUM DENSE Light Gray Brown Fine SAND (SP)	11								
3	3		MEDIUM DENSE to LOOSE Gray Brown to Gray Clayey Fine SAND, Few Small Roots (SC)	12								
4	4			4								
5	5		LOOSE Gray Clayey Fine SAND (SC)	3								
6	6		VERY LOOSE Gray Silty Clayey Fine SAND With Shell Fragments (SC)	19								
7	7		Boring Terminated @ 20 ft.	2								

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B8
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0 ft Time: _____ Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil	1								
1	0-1		LOOSE Gray Brown Clayey Fine SAND (SC)	2								
			MEDIUM DENSE Gray Brown Fine SAND (SP)	3	5							
2	1-2			4								
				4								
3	2-3		MEDIUM DENSE Gray to Gray Brown Fine SAND With Clay, Few Small Roots (SP-SC)	5	9							
				2								
4	3-4			3								
				3	6							
5	4-5		LOOSE Gray Clayey Fine SAND (SC)	3								
				3								
6	5-6		LOOSE Gray Fine SAND With Clay (SP-SC)	3	6							
				3								
7	6-7		VERY LOOSE Gray Clayey Fine SAND With Shell Fragments (SC)	2								
				2	4							
8	7-8			2								
				2								
9	8-9			2								
				2								
10	9-10			2								
				2								
11	10-11			2								
				2								
12	11-12			2								
				2								
13	12-13			2								
				2								
14	13-14			2								
				2								
15	14-15			2								
				2								
16	15-16			2								
				2								
17	16-17			2								
				2								
18	17-18			2								
				2								
19	18-19			2								
				2								
20	19-20			2								
				2								
21	20-21			2								
				2								
22	21-22			2								
				2								
23	22-23			2								
				2								
24	23-24			2								
				2								
25	24-25			2								
				2								
26	25-26			2								
				2								
27	26-27			2								
				2								
28	27-28			2								
				2								
29	28-29			2								
				2								
30	29-30			2								
				2								
31	30-31			2								
				2								
32	31-32			2								
				2								
33	32-33			2								
				2								
34	33-34			2								
				2								
35	34-35			2								
				2								
36	35-36			2								
				2								
37	36-37			2								
				2								
38	37-38			2								
				2								
39	38-39			2								
				2								
40	39-40			2								
				2								
41	40-41			2								
				2								
42	41-42			2								
				2								
43	42-43			2								
				2								
44	43-44			2								
				2								
45	44-45			2								
				2								
46	45-46			2								
				2								
47	46-47			2								
				2								
48	47-48			2								
				2								
49	48-49			2								
				2								
50	49-50			2								
				2								
51	50-51			2								
				2								
52	51-52			2								
				2								
53	52-53			2								
				2								
54	53-54			2								
				2								
55	54-55			2								
				2								
56	55-56			2								
				2								
57	56-57			2								
				2								
58	57-58			2								
				2								
59	58-59			2								
				2								
60	59-60			2								
				2								
61	60-61			2								
				2								
62	61-62			2								
				2								
63	62-63			2								
				2								
64	63-64			2								
				2								
65	64-65			2								
				2								
66	65-66			2								
				2								
67	66-67			2								
				2								
68	67-68			2								
				2								
69	68-69			2								
				2								
70	69-70			2								
				2								
71	70-71			2								
				2								
72	71-72			2								
				2								
73	72-73			2								
				2								
74	73-74			2								
				2								
75	74-75			2								



LOG OF BORING

Project No.: 35-27930
 Boring No.: B11
 Sheet 1 of 1

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.3 ft Time: _____ Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											○	⊗
	0		Topsoil	1								
1	1		LOOSE Gray Brown Clayey Fine SAND (SC)	2	4							
			LOOSE Gray Brown Clayey Fine SAND, Few Small Roots (SC)	3								
2	2		MEDIUM DENSE Gray Brown Fine SAND (SP)	3	9							
				4								
3	5		LOOSE Gray and Orange Clayey Fine SAND (SC)	3	8							
				4								
4			VERY LOOSE Gray Clayey Fine SAND (SC)	2	2							
				1								
5	10		LOOSE to VERY LOOSE Gray Clayey Fine SAND (SC)	1	3		14	+				
				2								
6	15			1	2							
				1								
7	20		VERY SOFT Gray CLAY (CH)	1	1/18"							
				1/18"								
8	25		MEDIUM DENSE Gray Fine SAND (SP)	2	9							
				3								
				6								
Boring Terminated @ 25 ft.												
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: B12
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0 ft Time: _____ Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil	1								
1	1		LOOSE Gray Brown Fine SAND With Clay (SP-SC)	1	3		12		+			
			LOOSE Gray Brown Fine SAND (SP)	2								
			MEDIUM DENSE Light Gray Brown Fine SAND (SP)	2								
2	2		MEDIUM DENSE Orange Clayey Fine SAND (SC)	4	10							
			MEDIUM DENSE Orange Clayey Fine SAND (SC)	3								
3	5		VERY LOOSE to LOOSE Gray Clayey Fine SAND (SC)	4	9							
			VERY LOOSE to LOOSE Gray Clayey Fine SAND (SC)	5								
4				1	2							
				1								
				1								
				1								
5				2	3							
				1								
				1								
6	10			1	1/9"	1/9"						
				1/9"								
7	15			1/9"	1/9"							
				1/9"								
7	20		VERY SOFT Gray CLAY (CH)	1/18"	1/18"							
				1/18"								
	20		Boring Terminated @ 20 ft.									

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



LOG OF BORING

Project No.: 35-27930
 Boring No.: B13
 Sheet 1 of 2

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.5 ft Time: _____ Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											○	◇
	0		Topsoil	2								
1	0 - 1		LOOSE Gray Brown Fine SAND With Clay and Some Gravel (SP-SC)	3	8							
2	1 - 2		MEDIUM DENSE Brown Fine SAND (SP)	6								
3	2 - 3			10								
4	3 - 4			12								
5	4 - 5		MEDIUM DENSE to LOOSE Gray Fine SAND With Clay (SP-SC)	10								
6	5 - 6			5								
7	6 - 7		VERY LOOSE Gray Silty Clayey Fine SAND With Shell Fragments (SC)	6								
	7 - 8			1/9"								
	8 - 9			1/9"	1/9"							
	9 - 10											
	10 - 11											
	11 - 12											
	12 - 13											
	13 - 14											
	14 - 15											
	15 - 16											
	16 - 17											
	17 - 18											
	18 - 19											
	19 - 20		VERY SOFT Gray CLAY (CH)	WOH/18"								
	20 - 21			WOH/18"			85	○	◇			
	21 - 22											
	22 - 23											
	23 - 24											
	24 - 25		LOOSE Gray Fine SAND With Silt (SP-SM)	1								
				2								
				2	4							

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: B13
 Sheet 2 of 2

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: AWJ Drill Mud: Super Gel-X
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.5 ft Time: Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
9	25		LOOSE Gray Fine SAND With Silt (SP-SM) <i>(Continued)</i>	5 7 10	17							
			MEDIUM DENSE Gray Fine SAND (SP)									
	30		Boring Terminated @ 30 ft.									
	35											
	40											
	45											
	50											

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: LA1
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Automatic Hammer Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: Flight Auger Drill Mud: _____
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.3 ft Time: +24 Hours Date: 1/4/19 Boring Begun: 1/3/19 Boring Completed: 1/3/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											<ul style="list-style-type: none"> ○ Pocket Penetrometer Undisturbed Sample ● Pocket Penetrometer Disturbed Sample ▼ Torvane ● Unconfined Compression ⊠ Triaxial Compression 	
	0		Topsoil									
	0 - 1		Gray Brown Fine SAND With Silt (SP-SM)									
1	1											
	1 - 2						10		+			
2	2											
	2 - 3		Gray Silty Clayey Fine SAND (SC)									
3	3											
	3 - 4											
4	4											
	4 - 5		Gray Silty Clayey Fine SAND With Shell Fragments (SC)									
5	5											
	5 - 15		Boring Terminated @ 15 ft.									
	15 - 20											
	20 - 25											
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: A1
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Hand Auger Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: _____
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.2 ft Time: Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
1	0	▲	Gray Clayey Fine SAND (SC)									
			Gray Brown Fine SAND With Silt (SP-SM)									
2		▲										
3	5	▲										
			Boring Terminated @ 6 ft.									
	10											
	15											
	20											
	25											
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: A2
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Hand Auger Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: _____ Drill Mud: _____
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.5 ft Time: Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
1	0	▼	Gray Clayey Fine SAND (SC)								○	●
			Gray Brown Fine SAND With Silt (SP-SM)								○	●
			Gray and Orange Fine SAND With Clay (SP-SC)								○	●
	5	▼	Boring Terminated @ 6 ft.									
	10											
	15											
	20											
	25											

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19

Remarks



Project No.: 35-27930
 Boring No.: A3
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Hand Auger Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: _____ Drill Mud: _____
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 0.8 ft Time: Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil									
1	0.5		Dark Gray Brown Fine SAND With Silt (SP-SM)									
	1.5		Gray Brown Fine SAND With Silt (SP-SM)									
2	2.5		Gray Fine SAND With Silt (SP-SM)									
	5.5		Boring Terminated @ 6 ft.									
	10											
	15											
	20											
	25											
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: A4
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Hand Auger Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: _____
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 1.6 ft Time: Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
1	0	▲	Gray Brown Clayey Fine SAND (SC)									
			Gray Brown Fine SAND (SP)									
2		▲	Brown Fine SAND (SP)									
3	5	▲	Boring Terminated @ 6 ft.									
	10											
	15											
	20											
	25											
Remarks												

LOG OF BORING 35-27930.GPJ ELLIS ASSOCIATES.GDT 1/9/19



Project No.: 35-27930
 Boring No.: A5
 Sheet 1 of 1

LOG OF BORING

Project: Northwest WTP Improvements Client: CDM Smith
 Drill Rig: Hand Auger Driller: M. Foster
 Boring Location: See Field Exploration Plan Drill Rod: _____ Drill Mud: _____
 Casing Size: _____ Length of Casing: _____
 Groundwater Depth: 3 ft Time: _____ Drilling Date: 1/4/19 Boring Begun: 1/4/19 Boring Completed: 1/4/19

SAMPLE NO.	DEPTH, FEET	SAMPLE TYPE	DESCRIPTION	BLOWS PER 6 IN.	N Value	PERCENT ORGANIC MATERIAL	PERCENT PASSING NO. 200 SIEVE	PLASTIC LIMIT	MOISTURE CONTENT (%)	LIQUID LIMIT	SHEAR STRENGTH (ksf)	
											Unconfined Compression	Triaxial Compression
	0		Topsoil									
1	1		Gray Brown Fine SAND With Silt (SP-SM)									
2	2		Dark Gray Fine SAND With Silt, Few Small Roots (SP-SM)									
			Light Gray Brown Fine SAND With Silt (SP-SM)									
3	5											
			Boring Terminated @ 6 ft.									
	10											
	15											
	20											
	25											

Remarks



FIELD EXPLORATION PROCEDURES

Standard Penetration Test (SPT) Borings

The Standard Penetration Test (SPT) borings were made in general accordance with the latest revision of ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils". The borings were advanced by rotary (or "wash-n-chop") drilling techniques. At 2 ½ to 5 foot intervals, a split-barrel sampler inserted to the borehole bottom and driven 18 inches into the soil using a 140 pound hammer falling on the average 30 inches per hammer blow. The number of hammer blows for the final 12 inches of penetration is termed the "penetration resistance, blow count, or N-value". This value is an index to several in-place geotechnical properties of the material tested, such as relative density and Young's Modulus.

After driving the sampler 18 inches (or less if in hard rock-like material), the sampler was retrieved from the borehole and representative samples of the material within the split-barrel were containerized and sealed. After completing the drilling operations, the samples for each boring were transported to our laboratory where they were examined by our engineer in order to verify the driller's field classification. The retrieved samples will be kept in our facility for a period of six (6) months unless directed otherwise.

Hand Auger Boring

The auger borings were performed manually by the use of a hand auger and in general accordance with the latest revision of ASTM D 1452, "Soil Investigation and Sampling by Auger Borings". Representative samples of the soils brought to the ground surface by the augering process were placed in sealed containers and transported to our laboratory where they were examined by our engineer to verify the driller's field classification.



KEY TO SOIL CLASSIFICATION

Description of Compactness or Consistency in Relation To Standard Penetration Resistance

Granular Materials		
Relative Density	Safety Hammer SPT N-Value (Blow/Foot)	Automatic Hammer SPT N-Value (Blow/Foot)
Very Loose	Less than 4	Less than 3
Loose	4 – 10	3 – 8
Medium Dense	10 – 30	8 – 24
Dense	30 – 50	24 – 40
Very Dense	Greater than 50	Greater than 40

Silts and Clays		
Consistency	Safety Hammer SPT N-Value (Blow/Foot)	Automatic Hammer SPT N-Value (Blow/Foot)
Very Soft	Less than 2	Less than 1
Soft	2 – 4	1 – 3
Firm	4 – 8	3 – 6
Stiff	8 – 15	6 – 12
Very Stiff	15 – 30	12 – 24
Hard	Greater than 30	Greater than 24

DESCRIPTION OF SOIL COMPOSITION**

(Unified Soil Classification System)

MAJOR DIVISION	Group Symbol	LABORATORY CLASSIFICATION CRITERIA		SOIL DESCRIPTION	
		FINER THAN 200 SIEVE %	SUPPLEMENTARY REQUIREMENTS		
Coarse grained (over 50% by weight coarser than No. 200 sieve)	Gravelly soils (over half of coarse fraction larger than No. 4)	GW	<5*	D_{60}/D_{10} greater than 4, $D_{30}^2 / (D_{60} \times D_{10})$ between 1 & 3	Well graded gravels, sandy gravels
		GP	<5*	Not meeting above gradation for GW	Gap graded or uniform gravels, sandy gravels
		GM	>12*	PI less than 4 or below A-line	Silty gravels, silty sandy gravels
		GC	>12*	PI over 7 above A-line	Clayey gravels, clayey sandy gravels
	Sandy soils (over half of coarse fraction finer than No. 4)	SW	<5*	D_{60}/D_{10} greater than 6, $D_{30}^2 / (D_{60} \times D_{10})$ between 1 & 3	Well graded sands, gravelly sands
		SP	<5*	Not meeting above gradation requirements	
		SM	>12*	PI less than 4 or below A-line	Silty sands, silty gravelly sands
		SC	>12*	PI over 7 and above A-line	Clayey sands, clayey gravelly sands
Fine grained (over 50% by weight finer than No. 200 sieve)	Low compressibility (liquid limit less than 50)	ML	Plasticity chart		Silts, very fine sands, silty or clayey fine sands, micaceous silts
		CL	Plasticity chart		Low plasticity clays, sandy or silty clays
		OL	Plasticity chart, organic odor or color		Organic silts and clays of low plasticity
	High compressibility (liquid limit more than 50)	MH	Plasticity chart		Micaceous silts, diatomaceous silts, volcanic ash
		CH	Plasticity chart		Highly plastic clays and sandy clays
		OH	Plasticity chart, organic odor or color		Organic silts and clays of high plasticity
Soils with fibrous organic matter	PT	Fibrous organic matter; will char, burn or glow		Peat, sandy peats, and clayey peat	

* For soils having 5 to 12 percent passing the No. 200 sieve, use a dual symbol such as SP-SM.

** Standard Classification of Soils for Engineering Purposes (ASTM D 2487)

SAND/GRAVEL DESCRIPTION MODIFIERS	
Modifier	Sand/Gravel Content
Trace	<15%
With	15% to 29%
Sandy/Gravelly	>29%

ORGANIC MATERIAL MODIFIERS	
Modifier	Organic Content
Trace	1% to 2%
Few	2% to 4%
Some	4% to 8%
Many	>8%

SILT/CLAY DESCRIPTION MODIFIERS	
Modifier	Silt/Clay Content
Trace	<5%
With	5% to 12%
Silty/Clayey	13% to 35%
Very	>35%

APPENDIX B

LABORATORY DATA
LABORATORY TEST PROCEDURES



LABORATORY TEST PROCEDURES

Percent Fines Content

The percent fines or material passing the No. 200 mesh sieve of the sample tested was determined in general accordance with the latest revision of ASTM D 1140. The percent fines are the soil particles in the silt and clay size range.

Natural Moisture Content

The water content of the sample tests was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ratio of “pore” or “free” water in a given mass of material to the mass of solid material particles.

Atterberg Limits

The Atterberg Limits consist of the Liquid Limit (LL) and the Plastic Limit (PL). The LL and PL were determined in general accordance with the latest revision of ASTM D 4318. The LL is the water content of the material denoting the boundary between the liquid and plastic states. The PL is the water content denoting the boundary between the plastic and semi-solid states. The Plasticity Index (PI) is the range of water content over which a soil behaves plastically and is denoted numerically by the difference between the LL and the PL. The water content of the sample tested was determined in general accordance with the latest revision of ASTM D 2216. The water content is defined as the ration of “pore” or “free” water in a given mass of material to the mass of solid material particles.

SUPPLEMENTARY CONDITIONS (CONSTRUCTION)

Florida Department of Environmental Protection
State Revolving Fund Program
Supplementary Conditions
for

Formally Advertised
Construction Procurement

Revised October 2017

**TABLE OF CONTENTS FOR THE FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION
SUPPLEMENTARY CONDITIONS**

Article Number	Article Title	Page
1	DEFINITIONS	FDEP-1
2	PRIVITY OF AGREEMENT/CONTRACT	FDEP-2
3	PROCUREMENT REQUIREMENTS	FDEP-2
4	RESOLUTION OF PROTESTS AND CLAIMS/DISPUTES	FDEP-2
5	CHANGES TO THE BIDDING AND CONTRACT DOCUMENTS	FDEP-3
6	BONDS AND INSURANCE	FDEP-3
7	AWARD OF AGREEMENT/CONTRACT	FDEP-4
8	ITEMIZED CONSTRUCTION COST BREAKDOWN; CONSTRUCTION AND PAYMENT SCHEDULES	FDEP-4
9	FDEP/USEPA ACCESS TO RECORDS AND PROJECT SITE	FDEP-4
10	DISADVANTAGED BUSINESS ENTERPRISES	FDEP-4
11	DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 12549)	FDEP-5
12	EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)	FDEP-6
13	IMMIGRATION REFORM AND CONTROL ACT OF 1986 STATE OF FLORIDA EXECUTIVE ORDER 11-116)	FDEP-12
14	ENVIRONMENTAL COMPLIANCE	FDEP-12
15	FEDERAL LABOR STANDARDS PROVISION	FDEP-12
16	AMERICAN IRON AND STEEL PROVISION	FDEP-12
17	PROHIBITED LOCAL GOVERNMENT CONSTRUCTION PREFERENCES	FDEP-12

Appendix	Title	Page
A	CERTIFICATION OF COMPLIANCE WITH THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS	FDEP-13
B	GOALS AND TIMETABLES FOR MINORITIES AND FEMALES	FDEP-14
C	FEDERAL LABOR STANDARDS PROVISION	FDEP-15
D	AMERICAN IRON AND STEEL PROVISION	FDEP-23

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS

The intent of the Florida Department of Environmental Protection (FDEP) Supplementary Conditions is to complement and supplement other provisions of the Bidding Documents. However, if there is any conflict between the FDEP Supplementary Conditions and other provisions of the Bidding Documents, the FDEP Supplementary Conditions shall take precedence over the other provisions except when the other provisions are similar to, but more stringent than, the FDEP Supplementary Conditions. When other provisions of the Bidding Documents are similar to, but more stringent than, the FDEP Supplementary Conditions, the more stringent provisions shall apply.

ARTICLE 1 - DEFINITIONS

Wherever used in these Supplementary Conditions (except in the appendices to these Supplementary Conditions), the following terms have the meanings indicated, which are applicable to both the singular and plural thereof.

- 1.1 Addendum - A written or graphic instrument that is issued prior to the opening of bids and that clarifies, corrects, or changes the Bidding Documents.
- 1.2 Agreement or Contract - The written agreement between the Owner and the Contractor covering the Work to be performed and furnished; these Supplementary Conditions and other Contract Documents are attached to the Agreement/Contract and made a part thereof as provided therein.
- 1.3 Bid - The offer or proposal of a bidder submitted on the prescribed form and setting forth the price(s) for the Work to be performed and furnished.
- 1.4 Bidder - Any person, firm, or corporation that submits a bid directly to the Owner.
- 1.5 Bidding Documents - The Advertisement for Bids or the Invitation to Bid, the Instructions to Bidders or the Information for Bidders, the Bid Form, the proposed Contract Documents, and all addenda.
- 1.6 Bond - An instrument of security.
- 1.7 Change Order - A document that is recommended by the Engineer and signed by the Contractor and the Owner; that authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Time; and that is issued on or after the Effective Date of the Agreement/Contract.
- 1.8 Contract Documents - The Agreement/Contract; the Contractor's Bid when attached as an exhibit to the Agreement/Contract; the Performance and Payment Bond(s); the General Conditions; the Supplementary Conditions (including these Supplementary Conditions); the Specifications (written technical descriptions of material, equipment, construction systems, standards, and workmanship as applied to the Work and certain administrative details applicable thereto); the Drawings (drawings that show the character and scope of the Work to be performed and furnished); all addenda that pertain to the Contract Documents; and all change orders.
- 1.9 Contract Time - The number of days or the date stated in the Contract Documents for completion of the Work.
- 1.10 Contractor - The person, firm, or corporation with whom or which the Owner enters into the Agreement/Contract.
- 1.11 Effective Date of the Agreement/Contract - The date indicated in the Agreement/Contract on which the Agreement/Contract becomes effective, or if no such date is indicated in the Agreement/Contract, the date on which the Agreement/Contract is signed and delivered by the last of the two parties to sign and deliver the Agreement/Contract.
- 1.12 Engineer - The person, firm, or corporation named as such in the Contract Documents.
- 1.13 Minority Business Enterprise (MBE) - A historically Black college or university or a business that is (a) certified as socially and economically disadvantaged by the Small Business Administration, (b) certified as an MBE by a state or federal agency, or (c) an independent business concern which is at least 51-percent owned and controlled by minority group members. (A minority group member is an individual who is a citizen of the United States and one of the following: [i] Black American; [ii] Hispanic American [with origins from Puerto Rico, Mexico, Cuba, or South or Central America]; [iii] Native American [American Indian, Eskimo, Aleut, or native Hawaiian]; or [iv] Asian-Pacific American

[with origins from Japan, China, the Philippines, Vietnam, Korea, Samoa, Guam, the U.S. Trust Territories of the Pacific, Northern Marianas, Laos, Cambodia, Taiwan, or the Indian Subcontinent].)

1.14 Notice to Proceed -The written notice given by the Owner to the Contractor fixing the date on which the Contract Time will commence to run and on which the Contractor shall start to perform its obligations under the Contract Documents.

1.15 Owner - The local government (municipality, county, district, or authority; or any agency thereof; or a combination of two or more of the foregoing acting jointly) with which the Florida Department of Environmental Protection (FDEP) may execute, or has executed, a State Revolving Fund loan agreement and for which the Work is to be provided.

1.16 Project - The total construction or facilities described in a State Revolving Fund loan agreement between the FDEP and the Owner, of which the Work to be provided under the Contract Documents may be the whole or a part.

1.17 Sponsor – The recipient of the State Revolving Fund loan agreement that provides funds for the project.

1.18 Subcontract - A direct contract between a subcontractor and the Contractor, or any other subcontractor at any tier, for the furnishing of goods (material and equipment) or the performance of services (including construction) necessary to complete the Work.

1.19 Subcontractor - A person, firm, or corporation having a direct contract with the Contractor, or any other subcontractor at any tier, for the furnishing of goods (material and equipment) or the performance of services (including construction) necessary to complete the Work.

1.20 Successful Bidder - The lowest responsive, responsible bidder to whom or which the Owner intends to award the Agreement/Contract.

1.21 Women's Business Enterprise (WBE) - A business that is (a) certified as a WBE by a state or federal agency or (b) an independent business concern which is at least 51-percent owned and controlled/operated by women. (Determination of whether a business is at least 51-percent owned by women shall be made without regard to community property laws [e.g., an otherwise qualified WBE that is 51-percent owned by a married woman in a community property state will not be disqualified because the married woman's husband has a 50-percent interest in the married woman's share of the business; similarly, a business that is 51-percent owned by a married man and 49-percent owned by women will not become a qualified WBE by virtue of the married man's wife having a 50-percent interest in the married man's share of the business].)

1.22 Work - The entire completed construction or the various separately identifiable parts thereof required to be performed and furnished under the Contract Documents; Work is the result of performing services, furnishing labor, furnishing material and equipment, and incorporating material and equipment into the construction as required by the Contract Documents.

ARTICLE 2 - PRIVITY OF AGREEMENT/CONTRACT

2.1. The Owner expects to finance this Agreement/Contract with assistance from the FDEP, which administers a State Revolving Fund loan program supported in part with funds directly made available by grants from the United States Environmental Protection Agency (USEPA). Neither the State of Florida nor the United States (nor any of their departments, agencies, or employees) will be a party to this Agreement/Contract or any lower-tier subcontract.

ARTICLE 3 - PROCUREMENT REQUIREMENTS

3.1. This Agreement/Contract and the Owner's solicitation and award of this Agreement/Contract are subject to requirements contained in Chapter 62-503 (Revolving Loan Program) and/or Chapter 62-552, Florida Administrative Code as applicable.

ARTICLE 4 - RESOLUTION OF PROTESTS AND CLAIMS/DISPUTES

Resolution of Protests Concerning the Owner's Solicitation and/or Award of this Agreement/Contract:

4.1. Protests concerning the Owner's solicitation and/or award of this Agreement/Contract must be filed in writing with the Owner to be considered.

4.2. All timely written protests concerning the Owner's solicitation and/or award of this Agreement/Contract are to be resolved in accordance with the Owner's dispute resolution process. A copy of the ordinance(s), resolution(s), or written policy (policies) that set forth the Owner's dispute resolution process is included elsewhere in the Bidding Documents or is to be made available by the Owner upon request.

4.3. Neither the (FDEP) nor the USEPA will become a party to, or have any role in resolving, protests concerning the Owner's solicitation and/or award of this Agreement/Contract. Protest decisions made by the Owner cannot be appealed to the FDEP or the USEPA.

Resolution of Claims and Disputes Between the Owner and the Contractor:

4.4. Unless otherwise provided in the Contract Documents, all claims and disputes between the Owner and the Contractor arising out of, or relating to, the Contract Documents or the breach thereof are to be decided by arbitration (if the Owner and the Contractor mutually agree) or in a court of competent jurisdiction within the State of Florida.

4.5. Neither the FDEP nor the USEPA will become a party to, or have any role in resolving, claims and disputes between the Owner and the Contractor.

ARTICLE 5 - CHANGES TO THE BIDDING AND CONTRACT DOCUMENTS

5.1. All changes to the Bidding Documents made subsequent to the FDEP's acceptance of the Bidding Documents and prior to the opening of bids are to be documented via addendum (addenda) to the Bidding Documents; all changes to the Contract Documents made after the opening of bids are to be documented by change order(s) to the Contract Documents. The Owner shall submit all addenda and change orders to the FDEP.

ARTICLE 6 - BONDS AND INSURANCE

Bid Guarantees:

6.1. Each bidder's bid is to be accompanied by a bid guarantee made payable to the Owner in an amount at least equal to five percent of the bidder's maximum bid price and in the form of a certified check or bid bond.

Performance and Payment Bond(s):

6.2. The Contractor shall furnish a combined performance and payment bond in an amount at least equal to 100 percent of the Contract Price (or, if required elsewhere in the Contract Documents, the Contractor shall furnish separate performance and payment bonds, each in an amount at least equal to 100 percent of the Contract Price) as security for the faithful performance and payment of all the Contractor's obligations under the Contract Documents. This(these) bond(s) are to be delivered to the Owner by the Contractor along with the executed Agreement/Contract. The Owner shall forward a copy of this (these) bond(s) to the FDEP.

Insurance:

6.3. The Owner and/or the Contractor (as required elsewhere in the Contract Documents) shall purchase and maintain, during the period of construction, such liability insurance as is appropriate for the Work being performed and furnished and as will provide protection from claims that may arise out of, or result from, the Contractor's performance and furnishing of the Work (whether the Work is to be performed or furnished by the Contractor or any subcontractor at the Work site) and the Contractor's other obligations under the Contract Documents. This insurance is to include workers' compensation insurance, comprehensive general liability insurance, comprehensive automobile liability insurance, and contractual liability insurance applicable to the Contractor's indemnification obligations and is to be written for not less than the limits of liability and coverages determined by the Owner or required by law, whichever is greater.

6.4. The Owner and/or the Contractor (as required elsewhere in the Contract Documents) shall purchase and maintain, during the period of construction, property insurance upon the Work at the Work site in an amount equal to the full replacement cost of the Work or the full insurable value of the Work. This insurance is to include the interests of the Owner, the Contractor, and all subcontractors at the Work site (all of whom are to be listed as insured or additional insured parties); is to insure against the perils of fire and extended coverage; and is to include "all-risk" insurance for physical loss or damage due to theft, vandalism and malicious mischief, collapse, water damage, and/or all other risks against which coverage is obtainable.

6.5. Before any Work at the Work site is started, the Contractor shall deliver to the Owner certificates of insurance that the Contractor is required to purchase and maintain in accordance with Paragraphs 6.3 and 6.4 of this Article and other provisions of the Contract Documents, and the Owner shall deliver to the Contractor certificates of insurance that the Owner is required to purchase and maintain in accordance with Paragraphs 6.3 and 6.4 of this Article and other provisions of the Contract Documents.

ARTICLE 7 - AWARD OF AGREEMENT/CONTRACT

7.1. If this Agreement/Contract is awarded, it is to be awarded to the lowest responsive, responsible bidder. A fixed price (lump sum or unit price or both) agreement/contract is to be used. A clear explanation of the method of evaluating bids and the basis for awarding this Agreement/Contract are included elsewhere in the Bidding Documents. All bids may be rejected when in the best interest of the Owner. After the contract has been awarded, the Owner shall give the Contractor a notice to proceed fixing the date on which the Contract Time will commence to run. The Owner shall forward a copy of this notice to proceed to the FDEP.

ARTICLE 8 - ITEMIZED CONSTRUCTION COST BREAKDOWN; CONSTRUCTION AND PAYMENT SCHEDULES

8.1. The Contractor shall submit to the Owner, within ten calendar days after the Effective Date of this Agreement/Contract, an itemized construction cost breakdown and construction and payment schedules.

8.1.1. The itemized construction cost breakdown, or schedule of values, is to include quantities and prices of items aggregating the Contract Price and is to subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices are to include an appropriate amount of overhead and profit applicable to each item of Work.

8.1.2. The construction, or progress, schedule is to indicate the Contractor's estimated starting and completion dates for the various stages of the Work and is to show both the projected cost of Work completed and the projected percentage of Work completed versus Contract Time.

8.1.3. The payment schedule is to show the Contractor's projected payments cumulatively by month.

ARTICLE 9 – FDEP/USEPA ACCESS TO RECORDS AND PROJECT SITE

9.1. Authorized representatives of the Owner, the FDEP, and the USEPA shall have access to, for the purpose of inspection, the Work site(s), any books, documents, papers, and records of the Contractor that are pertinent to this Agreement/Contract at any reasonable time. The Contractor shall retain all books, documents, papers, and records pertinent to this Agreement/Contract for a period of five years after receiving and accepting final payment under this Agreement/Contract.

NOTE: ARTICLE 10 ONLY APPLIES TO FEDERAL CAP GRANT PROJECTS

ARTICLE 10 - DISADVANTAGED BUSINESS ENTERPRISES

10.1 A goal of five percent of the Contract Price is established for Minority Business Enterprise (MBE) participation in the Work, and a goal of five percent of the Contract Price is established for Women's Business Enterprise (WBE) participation in the Work. If bidders or prospective contractors (including the Contractor) intend to let any lower-tier goods

or services (including construction) subcontracts for any portion of the Work, they shall physically include these percentage goals for MBE and WBE participation in all solicitations for subcontracts and shall take good faith efforts to assure that MBEs and WBEs are utilized, when possible, as sources of goods and services. Good faith efforts are to include the following:

- 10.1.1. Require Disadvantaged Business Enterprises (DBEs) are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.
- 10.1.2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
- 10.1.3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.
- 10.1.4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.
- 10.1.5. Use the services and assistance of the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.
- 10.1.6. If the prime contractor awards subcontracts, require the prime contractor to take the steps in paragraphs 10.1.1 through 10.1.5 of this section.

10.2. Within ten calendar days after being notified of being the apparent Successful Bidder, the apparent Successful Bidder shall submit to the Owner documentation of the affirmative steps it has taken to utilize Minority and Women's Business Enterprises (MBEs and WBEs) in the Work and documentation of its intended use of MBEs and WBEs in the Work. The Owner shall keep this documentation on file and shall forward to the FDEP a copy of the apparent Successful Bidder's documentation concerning its intended use of MBEs and WBEs in the Work.

ARTICLE 11 - DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 12549)

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions

11.1. The bidder certifies, by submission of this proposal, that neither the bidder nor its principals, nor the bidder's subcontractors nor their principals, are presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

11.2. Where the bidder is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

11.3. The bidder also certifies that it and its principals and the bidder's subcontractors and their principals:

11.3.1. Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or contract under a public transaction; violation of federal or state anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

11.3.2. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses enumerated in paragraph 11.3.1 of this certification; and

11.3.3. Have not within a three-year period preceding this proposal had one or more public transactions (federal, state or local) terminated for cause or default. Where the bidder is unable to certify to any of the above, such owner shall attach an explanation to this proposal.

11.3.4. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the federal government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

11.3.5. The bidder shall incorporate the foregoing requirements 11.1 through 11.3 in all subcontracts.

ARTICLE 12 - EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

12.1. Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246). (Applicable to contracts/subcontracts exceeding \$10,000)

12.1.1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

12.1.2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in Florida, are as follows:

Goal for female participation: 6.9 percent statewide

Goal for minority participation: (See Appendix B at FDEP-20 for goals for each county)

These goals are applicable to all the Contractor's construction work (whether or not it is federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

12.1.3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

12.1.4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is the State of Florida.

12.1.5. Contractors shall incorporate the foregoing requirements in all subcontracts.

12.2. Equal Opportunity Clause (Applicable to contracts/subcontracts exceeding \$10,000)

During the performance of this contract, the contractor agrees as follows:

12.2.1. The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Contractor shall take affirmative action to ensure that applicants for employment are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

12.2.2. The Contractor shall post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause. The notice can be obtained online at http://www.eeoc.gov/employers/upload/eeoc_self_print_poster.pdf. The Contractor shall state that all qualified applicants be considered without regard to race, color, religion, sex or national origin.

12.2.3. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.

12.2.4. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

12.2.5. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

12.2.6. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

12.2.7. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

12.2.8. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs 12.2.1 through 12.2.8 in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

12.3. The Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

12.3.1. As used in these specifications:

- a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
- b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
- c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
- d. "Minority" includes:
 - (i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - (ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - (iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

12.3.2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

12.3.3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

12.3.4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction Contractors performing construction work in geographical areas where they do not have a federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the FEDERAL REGISTER in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

12.3.5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

12.3.6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

12.3.7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

- a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
- b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

- c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the Contractor may have taken.
- d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 12.3.7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

- n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
- o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
- p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

12.3.8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (12.3.7a through 12.3.7p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

12.3.9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

12.3.10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

12.3.11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12.3.12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

12.3.13. The Contractor, in fulfilling its obligation under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

12.3.14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

12.3.15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

12.4. Pursuant to 41 CFR 60-1.7, if the price of this bid exceeds \$10,000, the bidder, by signing and submitting this proposal, certifies the following:

12.4.1. Affirmative action programs pursuant to 41 CFR 60-2 have been developed and are on file;

12.4.2. Documentation of a previous contract or subcontract subject to the equal opportunity clause is available;

12.4.3. All reports due under the applicable filing requirements have been filed with the Joint Reporting Committee, the Deputy Assistant Secretary or the Equal Employment Opportunity Commission; and

12.4.4. Each prospective construction subcontractor that may be awarded a lower-tier construction subcontract with a price exceeding \$10,000 shall meet the above requirements 12.4.1 through 12.4.3.

12.5. Pursuant to 41 CFR 60-1.8, if the price of this bid exceeds \$10,000, the bidder, by signing and submitting this proposal, certifies the following:

12.5.1. That he/she does not maintain or provide for his/her employees any segregated facility at any of his/her establishments;

12.5.2. That he/she does not permit employees to perform their services at any location, under his/her control, where segregated facilities are maintained;

12.5.3. That he/she will not maintain or provide for employees any segregated facilities at any of his/her establishments;

12.5.4. That he/she will not permit employees to perform their services at any location under his/her control where segregated facilities are maintained;

12.5.5. That a breach of this certification is violation of the Equal Opportunity Clause of this contract; and

12.5.6. That he/she will obtain identical certifications from proposed Subcontractors prior to the award of Subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such certifications in his/her files.

As used in this certification, the term "segregated facilities" means any waiting rooms, work eating areas, time clocks, locker rooms, and other storage or dressing areas, transportation and housing facilities provided for employees which are in fact segregated on the basis of race, color, religion, or otherwise.

12.6. If the price of this Agreement/Contract exceeds \$10,000, the Owner shall give written notice to the Director of the Office of Federal Contract Compliance Programs within ten working days of award of this Agreement/Contract. The notice is to include the name, address, and telephone number of the Contractor; the employer identification number of the Contractor; the dollar amount of this Agreement/Contract; the estimated starting and completion dates of this Agreement/Contract; the number of this Agreement/Contract; and the geographical area in which the Work is to be performed.

12.7. If the price of this Agreement/Contract equals or exceeds \$50,000 and if the Contractor has 50 or more employees, the Contractor shall electronically file Standard Form 100 (EEO-1) online at <https://egov.eeoc.gov/eeo1/eeo1.jsp> within 30 calendar days after the award of this Agreement/Contract, unless the Contractor has submitted such a report within 12 months preceding the date of award of this Agreement/Contract. In addition, the Contractor shall ensure that each construction subcontractor having 50 or more employees and a lower-tier construction subcontract with a price equaling or exceeding \$50,000 also electronically files this form within 30 calendar days after the award to it of the lower-tier construction subcontract, unless the construction subcontractor has submitted such a report within 12 months preceding the date of award of the lower-tier construction subcontract.

ARTICLE 13 - IMMIGRATION REFORM AND CONTROL ACT OF 1986 (STATE OF FLORIDA EXECUTIVE ORDER 11-116)

The Immigration Reform and Control Act of 1986 prohibits employers from knowingly hiring illegal workers. The Contractor shall only employ individuals who may legally work in the United States – either U.S. citizens or foreign citizens who are authorized to work in the U.S. The Contractor shall use the U.S. Department of Homeland Security’s E-Verify Employment Eligibility Verification system (<http://www.uscis.gov/portal/site/uscis>) to verify the employment eligibility of:

- all new employees, during the term of this Agreement, to perform employment duties within Florida; and,
- all new employees (including subcontractors and subrecipients) assigned by the Contractor to perform work pursuant to this Agreement.

The Contractor shall include this provision in all subcontracts/subgrants it enters into for the performance of work under this Agreement.

ARTICLE 14 – ENVIRONMENTAL COMPLIANCE

The Contractor, and all subcontractors at any tier, shall comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act (42 U.S.C. 1857[h]), Section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738 (Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans).

ARTICLE 15 – FEDERAL LABOR STANDARDS PROVISION

Contracts being constructed with assistance from the State Revolving Fund Program are currently required to comply with the Federal Labor Standards Provisions as provided in Appendix C. Signing Appendix A certifies compliance with these provisions.

ARTICLE 16 – AMERICAN IRON AND STEEL PROVISION

Contracts being constructed with assistance from the State Revolving Fund Program are currently required to comply with The American Iron and Steel Provision as provided in Appendix D. Signing Appendix A certifies compliance with these provisions.

ARTICLE 17 - PROHIBITED LOCAL GOVERNMENT CONSTRUCTION PREFERENCES

- A. Pursuant to Section 255.0991, F.S., for a competitive solicitation for construction services in which 50 percent or more of the cost will be paid from state-appropriated funds which have been appropriated at the time of the competitive solicitation, a state, college, county, municipality, school district, or other political subdivision of the state may not use a local ordinance or regulation that provides a preference based upon:
1. The contractor’s maintaining an office or place of business within a particular local jurisdiction;
 2. The contractor’s hiring employees or subcontractors from within a particular local jurisdiction; or
 3. The contractor’s prior payment of local taxes, assessments, or duties within a particular local jurisdiction.
- B. For any competitive solicitation that meets the criteria in Paragraph A., a state college, county, municipality, school district, or other political subdivision of the state shall disclose in the solicitation document that any applicable local ordinance or regulation does not include any preference that is prohibited by Paragraph A.

**APPENDIX A TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SUPPLEMENTARY CONDITIONS**

**CERTIFICATION OF COMPLIANCE WITH THE FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS**

This certification relates to a construction contract proposed by _____,
(insert the name of the Owner)

which expects to finance the proposed construction contract with assistance from the Florida Department of Environmental Protection (which administers a State Revolving Fund loan program supported in part with funds directly made available by grants from the United States Environmental Protection Agency). I am the undersigned prospective construction contractor or subcontractor.

I certify that I have read the Florida Department of Environmental Supplementary Conditions and agree to incorporate the following articles into the bid and/or contract:

- ARTICLE 11 DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 12549)
- ARTICLE 12 EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)
- ARTICLE 13 IMMIGRATION REFORM AND CONTROL ACT OF (STATE OF FLORIDA EXECUTIVE ORDER 11-116)
- ARTICLE 14 ENVIRONMENTAL COMPLIANCE
- ARTICLE 15 FEDERAL LABOR STANDARDS PROVISION
- ARTICLE 16 AMERICAN IRON AND STEEL PROVISION

I agree that I will obtain identical certifications from prospective lower-tier construction subcontractors prior to the award of any lower-tier construction subcontracts with a price exceeding \$2,000. I also agree that I will retain such certifications in my files.

(Signature of Authorized Official) (Date)

(Name and Title of Authorized Official [Print or Type])

(Name of Prospective Construction Contractor or Subcontractor [Print or Type])

(Address and Telephone Number of Prospective Construction Contractor or Subcontractor [Print or Type])

(Employer Identification Number of Prospective Construction Contractor or Subcontractor)

**APPENDIX B TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SUPPLEMENTARY CONDITIONS**

GOALS AND TIMETABLES FOR MINORITIES AND FEMALES

[Note: These goals and timetables are the goals and timetables referred to in Paragraph 2 of the "Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246)"; these goals and timetables are to be included in all FDEP assisted construction contracts and subcontracts with a price exceeding \$10,000 and in all solicitations for such contracts and subcontracts.]

The following goals and timetables for female utilization shall be included in all federal and federally assisted construction contracts and subcontracts in excess of \$10,000. The goals are applicable to the contractor's aggregate on-site construction workforce whether or not part of that workforce is performing work on a federal or federally assisted construction contract or subcontract.

Area covered: Goals for Women apply nationwide.

Goals and Timetables

Timetable	Goals (percent)
Indefinite	6.9

Goals for minority utilization can be found in the Department of Labor's Technical Assistance Guide for Federal Construction Contractors (May 2009), available on the internet at <http://www.civilrightsusa.gov/pdf/TAG%20-%20Constuction.pdf> . These goals shall be included for each craft and trade in all federal or federally assisted construction contracts and subcontracts in excess of \$10,000 to be performed in the respective geographical areas. The goals are applicable to each nonexempt contractor's total onsite construction workforce, regardless of whether or not part of that workforce is performing work on a federal, federally assisted or non-federally related project, contract or subcontract.

Construction contractors which are participating in an approved Hometown Plan (see 41 CFR 60-4.5) are required to comply with the goals of the Hometown Plan with regard to construction work they perform in the area covered by the Hometown Plan. With regard to all their other covered construction work, such contractors are required to comply with the applicable SMSA or EA goal contained in this Appendix.

APPENDIX C
TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
SUPPLEMENTARY CONDITIONS

Davis-Bacon Requirements

FEDERAL LABOR STANDARDS PROVISIONS

(Davis-Bacon Act, Copeland Act, and Contract Works Hours & Safety Standards Act)

The Project to which the construction work covered by this contract pertains is being assisted by the United States of America and the following Federal Labor Standards Provisions are included in this Contract pursuant to the provisions applicable to such federal assistance.

1 Minimum Wages.

(i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act, 29 CFR Part 3, the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of 29 CFR 5.5(a)(1)(iv); also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period.

Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR Part 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under 29 CFR Part 5.5(a)(1)(ii) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii) (a) The sponsor, on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The FDEP shall approve a request for an additional classification and wage rate and fringe benefits; therefore, only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(b) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the sponsor(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the sponsor to the FDEP. The FDEP will transmit the request to the Administrator of the Wage and Hour Division, employment Standards Administration, U. S. Department of Labor. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional

classification action within 30 days of receipt and so advise the FDEP or will notify FEDP within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB control number 1215-0140.)

(c) In the event that the Contractor, the laborers or mechanics to be employed in the Classification or their representatives, and the sponsor do not agree on the proposed classification and wage rate (including the amount designed for fringe benefits, where appropriate), the FDEP shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of FDEP, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

(d) The wage rate (including fringe benefits where appropriate) determined pursuant to subparagraphs (1)(b) or (c) of this paragraph, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program. Provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account, assets for the meeting of obligations under the plan or program. (Approved by the Office of Management and Budget under OMB Control Number 1215-0140.)

2. Withholding.

The sponsor shall, upon written request of the EPA or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees and helpers employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee or helper, employed or working on the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), all or part of the wages required by the contract, EPA may, after written notice to the contractor, sponsor, applicant, or owners, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and Basic Records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in Section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs. (Approved by the Office of Management and Budget under OMB Control Numbers 1215-0140 and 1215-0017).

(ii) (a) The contractor shall submit weekly for each week in which any contract work is performed, a copy of all payrolls to the sponsor. Such documentation shall be available upon request by FDEP. As to each payroll copy received, the sponsor shall provide a certification that the project is in compliance with the requirements of 29 CFR 5.5(a)(1) with each disbursement request. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR Part 5.5(a)(3)(I), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead, the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site <http://www.dol.gov/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current addresses of each covered worker, and shall provide them upon request to the sponsor for transmission to the FDEP or EPA if requested by EPA, the FDEP, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsor. (Approved by the Office of Management and Budget under OMB Control Number 1215-0149).

(b) Each payroll submitted shall be accompanied by a Statement of Compliance, signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under 29 CFR Part 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR Part 5.5 (a)(3)(I), and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(c) The weekly submission of a properly executed certification set forth on the reverse side of Option Form WH-347 shall satisfy the requirement for submission of the Statement of Compliance required by paragraph A. 3(ii)(b) of this section.

(d) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 231 of Title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph A.3(I) of this section available for inspection, copying, or transcription by authorized representatives of the FDEP or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FDEP may, after written notice to the contractor, or sponsor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request to make such records available may be grounds for debarment action pursuant to 29 CFR Part 5.12.

4. Apprentices and Trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U. S. Department of Labor, the Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio

of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program, shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with the determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U. S. Department of Labor, the Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program the contract will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal Employment Opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

5. Compliance with Copeland Act Requirements.

The contractor shall comply with the requirements of 29 CFR Part 3 which are incorporated by reference in this contract.

6. Subcontracts.

The contractor or subcontractor will insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR Part 5.5.

7. Contract Termination, Debarment.

A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act Requirements.

All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR Parts 1, 3 and 5 are herein incorporated by referenced in this contract.

9. Disputes Concerning Labor Standards.

Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR Parts 5, 6 and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the sponsor, FDEP, EPA, the U. S. Department of Labor, or the employees or their representatives.

10. Certification of Eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded government contracts by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded EPA contracts or participate in EPA programs pursuant to Executive Order 12549.

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a government contract by virtue of Section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1) or to be awarded EPA contracts or participate in EPA programs pursuant to Executive Order 12549.

(iii) The penalty for making false statements is prescribed in the U. S. Criminal Code, 18 U. S. C. 1001. Additionally, U. S. Criminal Code, Section 1010, Title 18, U. S. C., Federal Housing Administration transactions, provides in part "Whoever, for the purpose of . . . influencing in any way the action of such Administration . . . makes, utters or publishes any statement, knowing the same to be false . . . shall be fined not more than \$5,000 or imprisoned not more than two years, or both".

11. Complaints, Proceedings, or Testimony by Employees.

A. No laborer or mechanic to whom the wage, salary, or other labor standards provisions of this contract are applicable shall be discharged or in any other manner discriminated against by the contractor or any subcontractor because such employee has filed any complaint or instituted or caused to be instituted any proceeding or has testified or is about to testify in any proceeding under or relating to the labor standards applicable under this contract to his employer.

B. Contract Work Hours and Safety Standards Act. The sponsor shall insert the following clauses set forth in paragraphs B.(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by item 3 above or 29 CFR 4.6. As used in the paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in subparagraph (1) of this paragraph, the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in subparagraph (1) of this paragraph, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in subparagraph (1) of this paragraph.

(3) Withholding for unpaid wages and liquidated damages. The sponsor, upon written request of the FDEP or an authorized representative of the Department of Labor, may withhold or cause to be withheld, from any moneys payable on

account of work performed by the contractor or subcontractor under any such contract or any other federal contract with the same prime contract, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in subparagraph (2) of this paragraph.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in subparagraph (1) through (4) of this paragraph and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in subparagraphs (1) through (4) of this paragraph.

C. Health and Safety

(1) No laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor by regulation.

(2) The contractor shall comply with all regulations issued by the Secretary of Labor pursuant to Title 29 Part 1926 (formerly part 1518) and failure to comply may result in imposition of sanctions pursuant to the Contract Work Hours and Safety Standards Act (Public Law 91-54.83 State 96).

(3) The contractor shall include the provisions of this Article in every subcontract so that such provisions will be binding on each subcontractor. The contractor shall take such action with respect to any subcontract as the Secretary of Housing and Urban Development or the Secretary of Labor shall direct as a means of enforcing such provisions.

12. Guidance to Contractor for Compliance with Labor Standards Provisions

a) Contracts with Two Wage Decisions

If the contract includes two wage decisions, the contractor, and each subcontractor who works on the site, must submit either two separate payrolls (one for each wage decision) or one payroll which identifies each worker twice and the hours worked under each wage decision. One single payroll, reflecting each worker once, may be submitted provided the Contractor uses the higher rate in the wage decisions for each identical job classification. However, where a job classification is not listed in a wage decision and is needed for that portion of the work, the classification **must** be added to the wage decision. A worker may not be paid at the rate for a classification using the hourly rate for that same classification in another wage decision. After the additional classification is approved, the contractor may pay the higher of the two rates and submit one payroll, if desired.

b) Complying with Minimum Hourly Amounts

- 1) The minimum hourly amount due to a worker in each classification is the total of the amounts in the Rates and Fringe Benefits (if any) columns of the applicable wage decision.
- 2) The contractor may satisfy this minimum hourly amount by any combination of cash and bona fide fringe benefits, regardless of the individual amounts reflected in the Rates and Fringe Benefits columns.
- 3) A contractor payment for a worker which is required by law is not a fringe benefit in meeting the minimum hourly amount due under the applicable wage decision. For example, contractor payments for FICA or unemployment insurance are not a fringe benefit; however, contractor payments for health insurance or retirement are a fringe benefit. Generally, a fringe benefit is bona fide if (a) it is available to most workers and (b) involves payments to a third party.
- 4) The hourly value of the fringe benefit is calculated by dividing the contractor's annual cost (excluding any amount contributed by the worker) for the fringe benefit by 2080. Therefore, for workers with overtime, an additional payment may be required to meet the minimum hourly wages since generally fringe benefits have no value for any time worked over 40 hours weekly. (If a worker is paid more than the minimum rates required by the wage decision, this should not be a problem. As long as the total wages received by a worker for straight time equals the hours worked times the minimum hourly rate in the wage decision, the requirement of the Davis-Bacon and Related Acts has been satisfied.)

c) Overtime

For any project work over 40 hours weekly, a worker generally must be paid 150% of the actual hourly cash rate received, not the minimum required by the wage decision. (The Davis-Bacon and Related Acts only establishes minimum rates and does not address overtime. The Contract Work Hours Act contains the overtime requirement and uses basic rate of pay as the base for calculation, not the minimum rates established by the Davis-Bacon and Related Acts.)

d) Deductions

Workers who have deductions, not required by law, from their pay must authorize these deductions in writing. The authorization must identify the purpose of each deduction and the amount, which may be a specific dollar amount or a percentage. A copy of the authorization must be submitted with the first payroll containing the deduction. If deducted amounts increase, another authorization must be submitted. If deducted amounts decrease, no revision to the original authorization is needed. Court-ordered deductions, such as child support, may be identified by the responsible payroll person in a separate document. This document should identify the worker, the amount deducted and the purpose. A copy of the court order should be submitted.

e) Classifications Not Included in the Wage Decision

If a classification not in the wage decision is required, please advise the owner's representative in writing and identify the job classification(s) required. In some instances, the state agency may allow the use of a similar classification in the wage decision.

Otherwise, the contractor and affected workers must agree on a minimum rate, which cannot be lower than the lowest rate for any trade in the wage decision. Laborers (including any subcategory of the laborer classification) and truck drivers are not considered a trade for this purpose. If the classification involves a power equipment operator, the minimum cannot be lower than the lowest rate for any power equipment operator in the wage decision. The owner will provide forms to document agreement on the minimum rate by the affected workers and contractor.

The U.S. Department of Labor (USDOL) must approve the proposed classification and rate. The contractor may pay the proposed rate until the USDOL makes a determination. Should the USDOL require a higher rate, the contractor must make wage restitution to the affected worker(s) for all hours worked under the proposed rate.

f) Supervisory Personnel

Foremen and other supervisory personnel who spend at least 80% of their time supervising workers are not covered by the Davis-Bacon and Related Acts. Therefore, a wage decision will not include such supervisory classifications and their wages are not subject to any minimums under the Davis-Bacon and Related Act or overtime payments under the Contract Work Hours and Safety Standards Act. However, foremen and other supervisory personnel who spend less than 80% of their time engaged in supervisory activities are considered workers/mechanics for the time spent engaged in manual labor and must be paid at least the minimum in the wage decision for the appropriate classification(s) based on the work performed.

g) Sole Proprietorships / Independent Contractors / Leased Workers

The nature of the relationship between a prime contractor and a worker does not affect the requirement to comply with the labor standards provisions of this contract. The applicability of the labor standards provisions is based on the nature of the work performed.

If the work performed is primarily manual in nature, the worker is subject to the labor standards provisions in this contract. For example, if John Smith is the owner of ABC Plumbing and performs all plumbing work himself, then Mr. Smith is subject to the labor standards provisions, including minimum wages and overtime. His status as owner is irrelevant for labor standards purposes.

If a worker meets the IRS standards for being an independent contractor, and is employed as such, this means that the worker must submit a separate payroll as a subcontractor rather than be included on some other payroll. The worker is still subject to the labor standards provisions in this contract, including minimum wages and overtime.

If a contractor or subcontractor leases its workers, they are subject to the labor standards provisions in this contract, including minimum wages and overtime. The leasing firm must submit payrolls and these payrolls must reflect information required to determine compliance with the labor standards provisions of this contract, including a classification for each worker based on the nature of the work performed, number of regular hours worked, and number of overtime hours worked.

h) Apprentices / Helpers

A worker may be classified as an apprentice **only if participating in a federal or state program**. Documentation of participation must be submitted. Generally, the apprentice program specifies that the apprentice will be compensated at a percentage of journeyman rate. For Davis-Bacon Act purposes, the hourly rate cannot be lower than the percentage of the hourly rate for the classification in the applicable wage decision.

If the worker does not participate in a federal or state apprentice program, then the worker must be classified according to duties performed. This procedure may require classification in the trade depending on tools used, or as a laborer if specialized tools of the trade are not used. The contractor may want to consult with the Wage and Hour Division of the U.S. Department of Labor located in most large cities regarding the appropriate classification.

Presently, no worker may be classified as a helper. As with apprentices not participating in a formal apprentice program, the worker must be classified according to duties performed and tools used.

APPENDIX D TO THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION SUPPLEMENTARY CONDITIONS

American Iron and Steel Requirement

The Contractor acknowledges to and for the benefit of the _____ (“Owner”) and the State of Florida (the “State”) that it understands that iron and steel products to be installed as a part of this contract must be in compliance with the requirements in H.R. 3547, “Consolidated Appropriations Act, 2014,” (Appropriations Act). H.R. 3547 includes the following language in Division G, Title IV, Sec. 436, under the heading, "Use of American Iron and Steel,":

(a) (1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j-12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term "iron and steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the "Administrator") finds that--

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney’s fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

For waivers to these requirements based on (2)(b) above, contact Sheryl Parsons at USEPA Region IV. She can be reached by phone at (404) 562-9337.

This page intentionally left blank.

"General Decision Number: FL20190135 03/15/2019

Superseded General Decision Number: FL20180178

State: Florida

Construction Type: Heavy

County: St Johns County in Florida.

HEAVY CONSTRUCTION PROJECTS (Including Sewer and Water Lines)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.60 for calendar year 2019 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.60 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2019. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR

5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/04/2019
1	03/15/2019

* ELEC0177-002 12/03/2018

	Rates	Fringes
ELECTRICIAN.....	\$ 28.21	12.44

ENGI0673-014 05/01/2013

	Rates	Fringes
OPERATOR: Oiler.....	\$ 19.52	9.05

IRON0597-004 04/01/2018

	Rates	Fringes
IRONWORKER, STRUCTURAL AND REINFORCING.....	\$ 25.50	10.23

LABO0517-002 05/01/2017

	Rates	Fringes
LABORER: Grade Checker.....	\$ 19.20	7.85

PAIN0164-007 08/01/2018

	Rates	Fringes
--	-------	---------

PAINTER: Brush Only.....\$ 20.21 10.73

 SUFL2009-174 06/24/2009

	Rates	Fringes
CARPENTER.....	\$ 15.80	0.00
CEMENT MASON/CONCRETE FINISHER...	\$ 13.23	2.15
LABORER: Common or General.....	\$ 9.89	1.58
LABORER: Landscape.....	\$ 7.25	0.00
LABORER: Pipelayer.....	\$ 12.85	1.21
LABORER: Power Tool Operator (Hand Held Drills/Saws, Jackhammer and Power Saws Only).....	\$ 10.63	2.20
OPERATOR: Asphalt Paver.....	\$ 11.59	0.00
OPERATOR: Backhoe Loader Combo.....	\$ 16.10	2.44
OPERATOR: Backhoe/Excavator.....	\$ 13.91	1.39
OPERATOR: Bulldozer.....	\$ 13.40	1.19
OPERATOR: Crane.....	\$ 22.38	0.00
OPERATOR: Grader/Blade.....	\$ 16.00	2.84
OPERATOR: Loader.....	\$ 11.31	2.02

OPERATOR: Mechanic.....	\$ 14.32	0.00
OPERATOR: Roller.....	\$ 10.93	0.00
OPERATOR: Scraper.....	\$ 11.00	1.74
OPERATOR: Trackhoe.....	\$ 20.92	5.50
OPERATOR: Tractor.....	\$ 10.54	0.00
TRUCK DRIVER, Includes Dump		
Truck.....	\$ 14.63	0.00
TRUCK DRIVER: Lowboy Truck.....	\$ 13.06	2.18
TRUCK DRIVER: Off the Road		
Truck.....	\$ 12.21	1.97

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

=====

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is

like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1,

2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.

Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

=====

END OF GENERAL DECISION"



SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Future work.
6. Purchase contracts.
7. Owner-furnished products.
8. Contractor-furnished, Owner-installed products.
9. Access to site.
10. Coordination with occupants.
11. Work restrictions.
12. Specification and Drawing conventions.
13. Miscellaneous provisions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Northwest Water Treatment Plant – Phase 1 Expansion.

1. Project Location: 3390 International Golf Parkway, St. Augustine, Florida 32084.

- B. Owner: St. Johns County Utility Department, 1205 SR 16, St. Augustine, FL 32084.

1. Owner's Representative: James Overton, 904-209-2614, joverton@sjcfl.us.

- C. Engineer: David J. Prah, 407-660-6379 prahdj@cdmsmith.com or Yanni Polematidis, 904-527-6722, PolematidisIM@cdmsmith.com.

- D. Engineer's Consultants: Engineer has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Electrical: David Lassetter, 904-743-1585, wlass@bellsouth.net.
- E. Contractor: To Be Determined, has been engaged as Contractor for this Project.
- F. Web-Based Project Interaction: Engineer shall utilize a web-based platform (On-line Workroom) for administering general project communications, submittals, schedules and other project-related information during the construction phase of this project. Owner, Engineer and Contractor shall have access to construction administration during the duration of this project.
 1. See Section 013100 "Project Management and Coordination." for requirements for administering and using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 1. The Phase 1 (6 to 9 mgd) expansion, the Project, is part of a two-phased expansion plan. The next phase, not included in the current work described herein, is Phase 2 which will expand the plant from 9 to 12 mgd.
 2. The Phase 1 expansion (this project) includes the addition of the following items and as shown on the Contract Documents:
 - a. Modifications to the existing Carbon Dioxide (CO₂) Pressure Solution Feed (PSF) panel, located next to the existing 91-ton carbon dioxide storage and feed system.
 - b. One new 91-ton carbon dioxide storage tank.
 - c. One New Clearwell Complex, (Clearwell Complex No.2) to include a new 3.0 MGD degasification tower, two (2) new biotrickling filters, each with a rated capacity of 13,500 scfm, one new 9,000 scfm centrifugal blower, three new 2,100 gpm variable frequency drive (VFD) vertical turbine transfer pumps, chemical piping additions for sodium hypochlorite and sodium hydroxide to clearwell complex no. 2, sample pumps and piping and all structural, electrical and instrumentation improvements as described herein and as shown on the drawings.
 - d. Modifications to Clearwell Complex No. 1, to include, the demolition and removal of the existing chemical odor control scrubber, replacement of the existing centrifugal blowers with two new 9,000 scfm centrifugal blowers, modification to the FRP ductwork allowing the degasification tower offgas to be routed to the new biotrickling filter system at clearwell complex no. 2, removal of three (3) existing horizontal split case transfer pumps and the addition of two (2) a new 2100 gpm VFD driven vertical turbine transfer pumps and all structural, electrical and instrumentation improvements as described herein and as shown on the drawings.
 - e. Modifications to the High Service Pump Station to increase the capacity from 13.6 mgd to 18.1 mgd peak hourly flow (PHF). Modifications include the removal of high service pumps (HSPs) 1, 2, 3 and 4 and replacement with three new VFD driven 3,150 gpm HSPs for pump slots 2,3 and 4 in the revised location and orientation as shown on sheets M-10 and M-11.
 - f. The addition of two (2) new sodium hypochlorite (NaOCl) metering pumps and modifications to the chemical feed application points for the sodium hypochlorite and sodium hydroxide (NaOH) that serve the existing chemical odor control

scrubber as shown on the drawings, redirecting the feed application points to feed chemicals to clearwell complex no. 2.

- g. Site work for the expansion, including a loop access driveway, clearing and grading, site fencing, site lighting, a new motorized facility access gate and a new manual access gate, and associated required landscaping, for the proposed Phase 2 footprint and facility layout. All disturbed areas and areas of new work, shall be sodded with Bahia sod. Sod is to be installed within 10 feet perimeter of any new or existing structure, asphalt pavement, sidewalks or other impervious areas disturbed by the work. All new or regraded swales are to be completely sodded, including a 10 foot perimeter beyond the sloped areas. The stormwater pond is to be sodded, from elevation 23.0 to elevation 27.5, including an area 10 ft beyond the top of bank of the pond. The remaining areas are to be hydro seeded with Bahia.
- h. In-plant yard piping modifications, including replacement of three existing yard pipe valves, that are non-operational at three locations denoted on the drawings.
- i. Site stormwater drainage and grading improvements, for the Phase 2 site improvements and modifications.
- j. Site demolition work including the removal of the existing hydropneumatic tank.
- k. All instrumentation and electrical improvements as shown on the drawings and as described herein.
- l. Install two new 4 inch schedule 40 PVC conduits by directional bore from the existing FPL pole, as shown on sheet E-9 and C-7, to the existing handhole to be used by FPL to replace a segment of the existing underground electrical primary and shall be installed in accordance with FPL requirements.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 FUTURE WORK

A. The Contract Documents include requirements that will allow Owner to carry out future work following completion of this Project; provide for the following future work:

1. Addition of a new 3-MG prestressed concrete finished water storage tank.
2. Addition of one new 3.0-mgd forced draft degasification tower and associated blower at Clearwell Complex No. 2.
3. Addition of one new biotrickling filter
4. Replacement of the existing booster pumps for the carbon dioxide injection system

1.6 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section. Final general producers as it relates to the site access shall be addressed by Owner and Engineer during the Pre-Construction Meeting prior to the commencement of activities.
- B. Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations to the areas as indicated on the Contract Documents. A Contractor staging, storage and stockpile area is shown on sheet C-2.
2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing High Service Pump Station Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage of any portion of the facility. Perform the Work so as not to interfere with Owner's day-to-day operations. The existing plant's 6.0 mgd potable water production capacity is to be maintained during the entire construction project. Maintain existing exits unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 2. Notify Owner not less than 48 hours in advance of activities that will affect Owner's operations.

1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated and approved by the Owner.
 1. Hours for Utility Shutdowns: As noted by Owner during the preconstruction meeting.

- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions and anticipated duration.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations as scheduled on Drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

This page intentionally left blank.

SECTION 011011 – SPECIAL PROCEDURES FOR MAINTENANCE OF PLANT OPERATION AND SEQUENCE OF CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Northwest Water Treatment Plant is operated 24 hours a day, seven days a week. The existing facility will be maintained in continuous operation by the Owner at all times during the entire construction period, except for periods specifically delineated within this Section. The Contractor shall schedule and conduct his work such that it will not impede any part of the treatment process, create potential hazards to operating equipment and/or personnel, reduce the quality of the plants finished potable water. It shall be the Contractor's responsibility to ensure complete compatibility with the facility operations in his working schedules and sequenced construction activities.
- B. Detailed startup and testing activities for maintenance of plant operations (MOPO) affected equipment and facilities are provided in this Section. Where shutdowns are required, they shall be performed in the months of November through March except where otherwise approved.

1.3 SEQUENCE OF CONSTRUCTION - GENERAL

- A. In order to maintain continuous plant operations during construction, a phased construction sequence shall be required. Specific constraints and steps are outlined and are intended to suggest a sequence for specific activities. This sequence shall be coordinated with the Owner and the Engineer and submitted for approval. Work will not commence unless the sequence has been approved.
- B. The detailed sequence of construction shall be based upon the construction schedule submitted by the Contractor and approved by the Engineer. However, a suggested sequence of construction is described below for specific portions of the work. The Contractor may alter the sequence as approved by the Engineer, providing plant operations are maintained.
- C. The order of construction shall be subject to the approval of the Engineer and Owner; such approval or direction, however, shall in no way relieve the Contractor's responsibility to perform the work in accordance with the Contract Documents. The construction plans and specifications have been developed to minimize the construction impacts on the operation of the Northwest Water Treatment Plant. The Contractor shall note the requirements of this Section with regard to the operation of the facility and the phasing of construction when developing his work sequence. The Contractor's work sequence must be specifically detailed in the required schedule.

- D. The following work sequence provides for completing the construction of the project within the requirements of the Owner's plant operation and schedule limitations. It does not purport to cover any sequences necessitated by the actual construction methods. This is a partial outline only. Portions of the work not specifically itemized must be scheduled by the Construction Manager in accordance with the requirements of the approved construction sequence. The Contractor is required to account for all details in formulating his own complete plan for implementation of the project.
- E. Some of the tasks below may overlap one another in performance of the work. Numerical and alphabetical identification of the tasks does not necessarily conform with actual order of construction.
- F. All new and existing equipment, piping, and water retaining structures, that are modified with this work and that come in contact with raw water, process water or finished potable water, shall be disinfected and bacteriologically tested per the requirements of the Florida Department of Environmental Protection (FDEP) public water supply permit and the applicable AWWA guideline.
- G. The sequence outline included herein provides a required general order of the work. When listed, work described herein, will require certain activities to occur before additions, activities or outages are allowed. Some of the work, listed herein, can occur independent of a preceding activity. Some of the work listed in the following sequence may also be listed by Phase and Stage. The Phase description provides a general sequence of the work. The Work described as Phase 1 or a preceding phase, is to be conducted and completed before the work in the subsequent phases can be started. Additionally, some of the work in a specific phase is also listed by Stage. The work described as Stage 1 or a preceding stage is to be conducted and completed, before the work in a subsequent stage can be started.

1.4 SEQUENCE OF CONSTRUCTION

- A. High Service Pump Station (Sheets M-11 and E-12)
 - 1. Work performed on the high service pump station as described below can be performed independent of the Clearwell No. 1 and 2 Modifications described herein.
 - a. The high service pump station shall remain in operation at all times. High Service Pump Nos. 5 and 6 shall remain fully operational and in service during removal and replacement of existing high service pumps No. 1 to 4.
 - b. Replacement of each pump shall require prior conversion of program logic from hardwired to Modbus TCP. All high service pump logic shall be moved from RTU100 to RTU200.
 - c. The existing VFDs for HSPs No. 5 and 6 shall be modified as indicated on E-2 to enable Modbus TCP communications with RTU200. VFD modifications shall be performed on only one pump at a time, during a period of low demand as approved in advance by SJCUD. The low demand period may be outside normal working hours.
 - d. The initial work shall require the isolation of the high service pump suction header to HSPs 1 through 4, by closing the 20 inch Butterfly valve (BFV) on suction header upstream of pumps No. 1 to 4 prior to demolition/removal of existing pumps, valves and piping and installing a temporary 12 inch blind flange on the

- suction pipe to pumps no. 1 through 4. The individual 12-inch BFV on each pump can be used to isolate HSPs 1 through 4, if the 20 BFV needs to be opened.
- e. The pump discharge header pipe for HSPs No. 1 through 4, can be isolated from the distribution piping by closing the downstream BFV for pumps No. 1 to 4 prior to demolition/removal of existing pumps, valves and piping.
 - f. Replace pump No. 1 to 4 and associated electrical equipment and variable frequency drives (VFDs) in the following order:
 - 1) Replacement of HSP pump No. 4 shall be required to be the first pump to be removed from service and replaced. Prior to placing the new replacement HSP No. 4 into service the contractor shall provide all required disinfection, Bacteriological testing, training and startup services, required to demonstrate the full operational capabilities of the new VFD driven HSP No. 4. Ethernet Module shall be installed in RTU 200 and CAT6 Shielded Ethernet Cabling shall be installed between the new Pump No. 4 VFD and RTU200 in order to set up the new programming for control of the pump. CAT6 cable shall be terminated and landed on the communications module in VFD No. 4 (VFD-240) and on the new Ethernet Switch module in RTU200.
 - 2) Existing pump No. 1, 2 and 3 can then be removed from service and replaced with new VFD driven pumps No. 2 and 3. There will no longer be a high service pump no. 1, after the replacement. Prior to placing each new replacement HSP into service, the contractor shall provide all required disinfection, bacteriological testing, training and startup services required to demonstrate the full operational capabilities of each of the new VFD driven high service pump. Similar to Pump No. 4, CAT6 Ethernet Cabling shall be installed between each new pump VFD and RTU200. CAT6 cable shall be terminated and landed on the communications module in the VFD and on the new Ethernet Switch module in RTU200.
 - 3) After replacement of pump No. 1 through No. 4, all signal wiring between the VFDs and ICP100 (Instrumentation Control Panel 100 which contains RTU100) shall be disconnected from both ends and removed as indicated on E-3 and I-3.

B. Carbon Dioxide System Upgrades (Sheets M-2 and M-3)

1. Work performed on the carbon dioxide system as described below can be performed independently of the Clearwell No. 1 and 2 Modifications described below.
2. During the modifications of the pressure solution feed (PSF) panel there will be periods where the system will require operation in manual mode.
3. Contractor shall coordinate with the Owner to operate the Carbon Dioxide System in manual while the new Raw Water pH Panel is being installed. All new programming logic shall be in place as part of this task to allow selection of pH Analyzer No. 1, pH Analyzer No. 2 or the Average pH as the process variable for the automatic Carbon Dioxide feed control.
4. The maximum allowable shutdown time to perform this work is 6 hours per day. Coordination shall be required with the Owner to ensure that adequate water supply in the existing ground storage tanks is always available.
5. The carbon dioxide system installer shall sequence the installation such that the carbon dioxide feed system can operate the remaining 18 hours of the day.

C. Clearwell No. 1 and 2 Modifications – Phase 1 (Sheets M-4 and M-5)

1. Phase 1 consists of the installation of piping and interconnection valves upstream, between and downstream of Clearwell No. 1 and Clearwell No. 2.
 - a. Coordinate Shutdown of all raw water supply wells during this work activity with the Owner during a time of low flow. The maximum allowable shutdown time to perform this work is 6 hours.
 - b. During the shutdown the following activities shall occur:
 - 1) On the 24-inch supply piping to existing Clearwell No. 1, remove the existing plug on the 24-inch tee for the piping connection to Clearwell No. 2 and install a 24-inch pipe spool piece and a new 24-inch BFV as shown on the Drawings. The 24-inch BFV shall be closed immediately after installation and normal operation can be resumed.
 - 2) On the 24-inch transfer pump discharge piping to the ground storage tanks downstream of existing Clearwell No. 1, remove the existing plug on the 24-inch tee for the piping connection to Clearwell No. 2 for the discharge header piping of the transfer pumps and install a 24-inch pipe spool piece and a new 24-inch BFV as shown on the Drawings. The 24-inch BFV shall be closed immediately after installation and normal operation can be resumed.
 - 3) Drain the transfer pump clearwell and remove the 24-inch blind flange for the interconnect piping that will connect the existing Clearwell No. 1 and Clearwell No. 2 transfer pump clearwells. Install 24-inch BFV and close immediately after installation.
 - c. After successful completion of the above activities, the raw water supply wells and existing Clearwell No. 1 can be put back into operation

D. Clearwell No.1 and 2 Modification – Phase 2 (Stage 1)

1. Phase 2 (Stage 1) consists of the construction of the new Clearwell No. 2 as shown on Sheets M-7 and M-8. During Phase 2 (Stage 1) Clearwell No. 1 will remain in operation with its full production capacity.
2. The following activities shall occur during Phase 2 (Stage 1):
 - a. Clearwell No. 2, shall be constructed and outfitted with all new mechanical, electrical and instrumentation equipment, as described herein and as shown on the drawings.
 - b. Clearwell No. 2 shall be fully operational, inspected, disinfected, bacteriological tested, and all training and testing of the new equipment shall be complete and accepted by the Owner.
 - c. The biotrickling filter system shall be constructed and the FRP piping shall be installed to the north of the future biotrickling filter including a temporary 36-inch blind flange. No connection to the existing chemical odor control system shall occur during Phase 2.
 - d. Install temporary NaOCl and NaOH piping from one of the metering pumps of NaOCl Pump Skid (Clearwell Complex No. 2 Disinfection) and NaOH Pump Skid (Clearwell Complex No. 2 pH Adj), respectfully, to the existing chemical scrubber. The pump skids are shown on Sheet M-9. The existing NaOCl and NaOH piping at

the chemical scrubber can be demolished (see Sheet M-4) and replaced with the temporary piping.

- e. Install permanent NaOCl and NaOH piping to the Clearwell Complex No. 2 as shown on Sheet M-5.
- f. Replace one metering pump in the existing NaOCl Pump Skid (Clearwell Complex No. 2 Disinfection). The Chemical scrubber shall remain in operation utilizing the existing larger sodium hypochlorite metering pump and temporary piping.
- g. Complete hardware and programming modifications to RTU300 required for operation of Clearwell No. 2.
- h. Complete the expansion of MCC-3 as indicated on E-4 and E-13.

E. Clearwell No. 1 and 2 Modifications – Phase 2 (Stage 2)

1. Phase 2 (Stage 2) consists of the startup of the transfer pumps associated with Clearwell No. 2, demolition of the existing transfer pumps and installation of electrical work associated with the new degasifier No. 3. During Phase 2 (Stage 2) the existing degasifier No. 1 and 2 will be in operation and the new transfer pumps associated with Clearwell No. 2 will be in operation while the existing transfer pumps are being demolished and replaced.
2. The following activities shall occur during Phase 2 (Stage 2):
 - a. Ethernet Module shall be installed in RTU 300 and CAT6 Ethernet Cabling shall be installed between each of the three new transfer pump VFDs and RTU300 in order to set up the new programming for control of the pumps. CAT6 cable shall be terminated and landed on the communications module in each VFD (VFD-333, VFD-334 and VFD-335) and on the new Ethernet Switch module in RTU300.
 - b. The 24-inch BFV shall be opened on the 24-inch interconnect piping between the Clearwell No. 1 and No. 2 transfer pump clearwells, refer to Sheet M-5 and M-7.
 - c. Startup and test the three new transfer pumps on Clearwell No. 2.
 - d. Upon successful startup and Owner acceptance of the three new transfer pumps, the existing transfer pumps can be taken offline.
 - e. Remove/demolish the existing transfer pumps associated with Clearwell No. 1, refer to Sheet M-4.
 - f. One of the motor starters for the existing transfer pumps shall be utilized for the blower motor of the new degasifier No. 3 as shown on E-5, E-6 and E-13.

F. Clearwell No. 1 and 2 Modifications – Phase 2 (Stage 3)

1. Phase 2 (Stage 3) consists of the startup of the new degasifier No. 3 and biotrickling filter system. During Phase 2 (Stage 3) raw water will be treated by degasifier No. 1, 2 and 3 while the new transfer pump station associated with Clearwell No. 2 is in operation. The transfer pumps associated with Clearwell No. 1 will not be in operation during this phase. The exhaust air from degasifier No. 1 and 2 will continue to be conveyed to the existing chemical scrubber while the exhaust air from the new degasifier No. 3 will be conveyed to the new biotrickling filter system.
2. The following activities shall occur during Phase 2 (Stage 3):
 - a. The new degasifier No. 3 shall be started, tested and put into operation upon successful startup and Owner acceptance.

- b. The exhaust from degasifier No. 3 shall be utilized to startup the new biotrickling filter system. The new biotrickling filter system shall be started up, tested and put into operation upon successful startup and Owner acceptance.

G. Clearwell No. 1 and 2 Modifications – Phase 2 (Stage 4)

1. Phase 2 (Stage 4) consists of the replacement of the existing blowers associated with degasifier No. 1 and 2. During Phase 2 (Stage 4) raw water will be treated by either degasifier No. 1 and 3 or degasifier No. 2 and 3. The transfer pumps associated with Clearwell No. 1 will not be in operation during this phase. The exhaust air from degasifier No. 1 or 2 will continue to be conveyed to the existing chemical scrubber while the exhaust air from the new degasifier No. 3 will be conveyed to the new biotrickling filter system.
2. The following activities shall occur during Phase 2 (Stage 4):
 - a. Modify the programming in RTU300 to add automatic logic to start the Degasifier No. 3 blower and to adjust the calculated flow to each degasifier to take into account that there are three degasifiers now instead of two.
 - b. Degasifier No. 1 shall be taken offline and one of the motors starters associated with the existing transfer pumps shall be modified and utilized for the replacement of the existing blower. During this time raw water shall be treated through degasifier No. 2 and 3.
 - c. Upon successful installation and startup of the degasifier No. 1 blower, degasifier No. 1 shall be put back into operation. The damper on the discharge of the blower may require adjustment to reduce the flow from the new blower.
 - d. Degasifier No. 2 shall be taken offline and one of the motors starters associated with the existing transfer pumps shall be utilized for the replacement of the existing blower. During this time raw water shall be treated through degasifier No. 1 and 3.
 - e. Upon successful installation and startup of the degasifier No. 2 blower, degasifier No. 2 shall be put back into operation. The damper on the discharge of the blower may require adjustment to reduce the flow from the new blower.

H. Clearwell No. 1 and 2 Modifications – Phase 2 (Stage 5)

1. Phase 2 (Stage 5) consists of the demolition of the existing chemical scrubber system and conveyance of the exhaust air from degasifier No. 1 and 2 to the new biotrickling filter system. During Phase 2 (Stage 5) raw water will be treated by all three degasifiers. The transfer pumps associated with Clearwell No. 1 will not be in operation during this phase. The exhaust from all degasifiers will be connected to and conveyed to the new biotrickling filter system.
2. The following activities shall occur during Phase 2 (Stage 5):
 - a. The existing chemical scrubber shall be demolished as shown on Sheet M-4. The temporary chemical piping to the chemical scrubber can be removed at this time.
 - b. Installation of the remaining ductwork to convey exhaust from degasifier No. 1 and 2 to the new biotrickling filters system shall be installed as shown on Sheet M-7. During the installation of the ductwork, the exhaust shall be conveyed through the existing bypass.
 - c. The demolition and installation of the new ductwork shall be completed within a maximum 10-day period (calendar days).

- d. Install the second NaOCl metering pump in the existing NaOCl Pump Skid (Clearwell Complex No. 2 Disinfection).
- e. Reconnect permanent piping for the NaOH and NaOCl piping going to Clearwell No. 2 that were previously used for temporary piping.

I. Clearwell No. 1 and 2 Modifications – Phase 3

1. Phase 3 consists of the demolition of the existing transfer pump piping inside of Clearwell No. 1. During Phase 3, Clearwell No. 1 will need to be taken off-line and all raw water flow will be conveyed through Clearwell No. 2.
2. The following activities shall occur during Phase 3.
 - a. Close the 24-inch BFV on the interconnect piping between the transfer pump clearwells of Clearwell No. 1 and Clearwell No. 2.
 - b. Close the 16-inch valves on the influent of degasifier No. 1 and 2 such that all raw water flow is conveyed to Clearwell No. 2.
 - c. Close the 36-inch damper at degasifier No. 1 and 2 at Clearwell No. 1.
 - d. Drain the water from the Clearwell No. 1 transfer pump station clearwell.
 - e. Remove all piping inside of the Clearwell No. 1 transfer pump station clearwell as shown on Sheet M-4.
 - f. Disinfect and perform 48-hour bacteriological testing of Clearwell No. 1 transfer pump station clearwell as required by the Florida Department of Environmental Protection Agency (FDEP).
 - g. The Contractor shall be allowed three days to remove all three 16-inch transfer pump suction pipes from the transfer pump station clearwell and install a blind flange as shown on Sheets M-4 and M-5.
 - h. Upon receiving approval from the FDEP, Clearwell No. 1 can be put back into service. All valves shall be put back into their normal operating position.
 - i. CAT6 Ethernet Cabling shall be installed between each of the two new transfer pump VFDs and RTU300 in order to set up the new programming for control of the pumps. CAT6 cable shall be terminated and landed on the communications module in each VFD (VFD-331 and VFD-332) and on the new Ethernet Switch module in RTU300.
 - j. The new vertical turbine pumps and associated piping for Clearwell No. 1 can be installed, started up and put into operation (refer to Sheet M-5 and M-6).

END OF SECTION – 011011

This page intentionally left blank.

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than 14 days following the Notice to Proceed date.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - f. Contract designation

2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - f. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
6. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application Preparation: Complete every entry on form. Execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.

3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- D. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- E. Transmittal: Submit two signed original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- G. Maintain an updated set of drawings to be used as record drawings in accordance with Section 017839. As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by Owner and Engineer for completeness and accuracy.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule.
 4. Products list (preliminary if not final).
 5. Submittal schedule.
 6. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
- I. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. Include initial submittal of closeout record drawings in accordance with Section 017839.
 3. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Final submittal of closeout record drawings in accordance with Section 017839.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. Evidence that claims have been settled.
 6. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Project meetings.

- B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 013300 "Submittal Procedures" for preparing and submitting informational submittals.
3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, and in web-based Project software directory. Keep list current at all times.

1.5 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Engineer
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.
 - 9. Drawing number and detail references, as appropriate.
 - 10. Field dimensions and conditions, as appropriate.
 - 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 - 12. Contractor's signature.
 - 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated (Microsoft Word) form with substantially the same content as indicated above, acceptable to Engineer.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to the Owner's Front End Documents."
 4. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer and Owner in writing within 7 days of receipt of the RFI response.
- E. On receipt of Engineer's and Owner's action, immediately distribute the RFI response to affected parties. Review response and notify Engineer within five days if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Engineer's Digital Data Files: Digital data files of Engineer's CAD drawings will be provided by Engineer for Contractor's use during construction. These will be provided at the Pre-Construction Meeting.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD 2017 or earlier versions.
 4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.
 - a. Subcontractors, and other parties granted access by Contractor to Engineer's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Engineer.
- B. Web-Based Project Software: Contractor shall use Engineer's web-based Project software site (SharePoint Work Room) for purposes of hosting and managing Project communication and documentation until Final Completion.

1. At completion of Project, Contractor shall provide digital archive in format (CD or USB flash drive) that is readable by common desktop software applications in format acceptable to Engineer.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

- A. General: Engineer will schedule and conduct meetings at Project site unless otherwise indicated.
- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Critical work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Use of web-based Project software.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of the Contract Documents.
 - l. Submittal procedures.
 - m. Preparation of Record Documents.
 - n. Use of the premises.
 - o. Work restrictions.
 - p. Working hours.
 - q. Procedures for disruptions and shutdowns.
 - r. Construction waste management and recycling.
 - s. Parking availability.
 - t. Office, work, and storage areas.
 - u. Equipment deliveries and priorities.
 - v. Safety.

- w. Security.
 - x. Progress cleaning.
 - y. List of major subcontractors and suppliers.
3. Minutes: Engineer shall be responsible for conducting meeting will record and distribute meeting minutes to Owner and Contractor.
- C. Progress Meetings: Engineer will schedule and conduct progress meetings in regular intervals.
- 1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: Contractor shall provide Engineer agenda items for items complete the last 30-days of construction, upcoming 30-days of construction and progress on action items. Contractor shall also review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of Proposal Requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
 - 3. Minutes: Engineer shall be responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Site condition reports.
 - 6. Unusual event reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF file.

B. Startup construction schedule.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, latest allowable start date, latest allowable finish date, status (where critical) and total float and free float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at monthly intervals.

H. Unusual Event Reports: Submit at time of unusual event.

I. Qualification Data: For scheduling consultant.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Program Description

1. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.
2. The construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.

B. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

1. Unless otherwise approved by Engineer use Oracle Primavera Contractor or P6 Professional Project Management software for current Windows operating system.

C. Qualifications

1. The Contractor shall have the capability of preparing and utilizing the specified CPM schedule, or engage the services of a specialized scheduling professional to do so. Within seven days of the award of contract, provide a résumé or qualifications statement for the individual within the Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of the CPM schedule. The résumé or qualifications statement shall demonstrate that the proposed responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. The proposed responsible party for the CPM schedule is subject to approval by the Engineer and Owner. If the proposed responsible party for the CPM schedule is not approved by the Engineer and/or Owner, Contractor shall resubmit a more-appropriate candidate for approval.

D. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

E. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than one month unless specifically allowed by Engineer or for off-site activities such as procurement and delivery of materials.
 2. Procurement Activities: Include procurement process activities for the long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- F. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Retain first six subparagraphs below if applicable; coordinate with requirements in Section 011000 "Summary."
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordinate list below with work restrictions listed in Section 011000 "Summary."
 - b. Uninterruptible services.
 - c. Use-of-premises restrictions.
 - d. Provisions for future construction.
 - e. Seasonal variations.
 - f. Environmental control.
 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Critical Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.

- h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Retain first subparagraph below when required under IAQ provisions of applicable Division 01 sustainable design requirements Section.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
- 7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Completion of mechanical installation.
 - c. Completion of electrical installation.
 - d. Substantial Completion.
- G. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- H. Acceptability
 - 1. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.
 - 2. The Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.
 - 3. Engineer's review of the Contractor's construction schedule submittals shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called Engineer's attention to such deviations at the time of submission and Engineer has given written concurrence to the specific deviations, nor shall any concurrence by the Engineer relieve Contractor from responsibility for errors and omissions in the submittals. Concurrence of the CPM Activity Network by the Engineer is advisory only and shall not relieve the Contractor of responsibility for accomplishing the Work within the Contract completion date(s).
 - 4. Concurrence, acceptance, or approval of the Contractor's CPM schedule by the Engineer in no way makes the Engineer an insurer of the CPM schedule's success, nor liable for time or cost overruns resulting therefrom.
 - 5. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Engineer.
 - 6. CPM schedules that contain activities with negative float, or which extend beyond the contract completion date, will not be acceptable.

7. Except where earlier completions are specified, CPM schedules which show completion of all work prior to the contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by the Contractor.
- I. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule two days before each regularly scheduled progress meeting.
 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. As the Work progresses, indicate final completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.
 3. Submit a narrative report based on the CPM schedule evaluation, in a format agreed upon by the Contractor and the Engineer. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of each activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed.
 - J. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule or it is apparent the contract completion date will not be met due to delays to the critical path, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
 - K. The contract completion time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, the Contractor shall furnish such justification and supporting evidence as the Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to any extension of any contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network will not be the basis for a change therein.
 - L. Distribution: Distribute 11" x 17" copies of approved schedule to Engineer and Owner testing and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 15 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 45 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 - m. Maintenance of existing facilities.
 - n. Contract milestones.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

1.8 REPORTS

- A. Monthly Construction Reports: Prepare a monthly construction status report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. Approximate count of personnel at Project site.
 3. Equipment at Project site.
 4. Material deliveries.
 5. Testing and inspection.
 6. Accidents.
 7. Unusual events.
 8. Stoppages, delays, shortages, and losses.
 9. Meter readings and similar recordings.
 10. Emergency procedures.

11. Orders and requests of authorities having jurisdiction.
 12. Change Orders received and implemented.
 13. Work Change Directives received and implemented.
 14. Services connected and disconnected.
 15. Equipment or system tests and startups.
 16. Partial completions and occupancies.
 17. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

This page intentionally left blank.

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 4. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit digital photographs to Engineer.
 - 1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in web-based project software site:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.

- g. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.
- D. File Names: Name media files with date and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of demolition or starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take a minimum of 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take a minimum of 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.
- F. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.

3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Substantial Completion of a major phase or component of the Work.
 - d. Extra record photographs at time of final acceptance.
 - e. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

This page intentionally left blank.

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
- 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
- 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
- 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
- 4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and final completion construction photographs.
- 5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
- 6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
- 7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- 8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
- 9. Section 017900 "Demonstration and Training" for submitting video recordings of

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- 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. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.

1.5 SUBMITTAL FORMATS

- A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:
1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
 2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
 3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
 4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.
 5. EXAMPLE: D-033000.13-008-B.
 - a. D = Shop Drawing.
 - b. 03 30 00.13 = Section; use only 6 digits for sections that do not include 8 digits.
 - c. 008 = the eighth different submittal under this Section.
 - d. B = the second submission (first resubmission) of that particular shop drawing.
- B. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Engineer.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.

7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- C. Options: Identify options requiring selection by Engineer.
- D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
 - a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. Web-Based Project Software: Prepare submittals in PDF form, and upload submittals over 20-MB, or as to be determined, to web-based Project software website (SharePoint WorkRoom). Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow 21 days for initial review of each submittal (and 30 days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
 4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:

- a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
- a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.

4. Web-Based Project Software: Prepare submittals in PDF form, and upload submittals over 20-MB, or as to be determined, to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit one set of Samples. Engineer will retain Sample sets
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least two sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of

assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

F. Certificates:

1. Certificates and Certifications Submittals: Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
2. Contractor's Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:
 - a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "
3. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
7. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

G. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.10 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Contractor Responsible for:
 1. Determination and verification of materials including manufacturer's catalog numbers.
 2. Determination and verification of field measurements and field construction criteria.

3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 4. Determination of accuracy and completeness of dimensions and quantities.
 5. Confirmation and coordination of dimensions and field conditions at Site.
 6. Construction means, techniques, sequences, and procedures.
 7. Safety precautions.
 8. Coordination and performance of Work of all trades.
 9. Other requirements enumerated in Contract Documents.
- C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ENGINEER'S REVIEW

- A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return it.
1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Engineer will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Engineer without action.
- G. Shop drawings will be returned to the Contractor with one of the following codes.
1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
 2. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
 3. "APPROVED AS NOTED/CONFIRM" – This combination of codes is assigned when a confirmation of the notations and comments is required by the Contractor. The

Contractor may release the equipment or material for manufacture; however, all notation and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Engineer within 15 calendar days of the date of the engineer's transmittal requiring confirmation.

4. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
5. "REJECTED" or "NOT APPROVED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
6. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's approval. This code is generally used with submittals involving the Contractor's means and methods of construction work plans, and health and safety plans.

1.12 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
 1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
 3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.

4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer/Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

This page intentionally left blank.

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- B. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

- D. **Product Tests:** Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. **Source Quality-Control Tests:** Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- F. **Testing Agency:** An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- G. **Quality-Assurance Services:** Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- H. **Quality-Control Services:** Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.4 DELEGATED-DESIGN SERVICES

- A. **Performance and Design Criteria:** Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.5 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for direction before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 DELEGATED DESIGN

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
1. Delegated-Designer: Professionals currently registered in State in which project work occurs.

1.7 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
1. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.

8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens and test assemblies, ; do not reuse products on Project.

2. **Testing Agency Responsibilities:** Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.11 QUALITY CONTROL

- A. **Owner Responsibilities:** Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspection allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. **Contractor Responsibilities:** Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. **Testing Agency Responsibilities:** Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. **Associated Contractor Services:** Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.
1. **Distribution:** Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.
- B. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 312000 "Earthwork" for disposal of ground water at Project site.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.5 QUALITY ASSURANCE

- A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.
- C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by Engineer from manufacturer's standard colors.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Contractor shall provide an air-conditioned interior space for field offices for duration of Project.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where shown on the Drawings or where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.
 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

3.3 CONTRACTOR'S FIELD OFFICE

- A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.
- B. Locate field office(s) in accordance with approved shop drawings and as directed by the Owner.
- C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.

3.4 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service, if approved by Owner.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

- G. The Contractor shall furnish temporary light and power, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.5 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Maintain support facilities until Engineer schedules Final Completion inspection. Remove just before Final Completion.
- B. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earthwork."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Provide temporary parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 311000 "Site Clearing."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As indicated on Drawings.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.
- C. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

This page intentionally left blank.

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs.

PART 2 - EXECUTION

2.1 PROTECTION OF LAND RESOURCES

- A. Restore land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.
- B. Outside of areas requiring earthwork for the construction of the new facilities, the Contractor shall not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.
- C. Protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.
- D. Protect all trees as indicated on the Drawings and as shown on the Drawings.
- E. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Owner will

decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.

1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
 2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Owner, shall be immediately removed and replaced.
- F. The locations of the Contractor's storage and other construction activities, required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as by the Owner and Engineer and shall not be within wetlands or floodplains. The Contractor shall submit a layout of the proposed storage areas to the Owner and Engineer for approval at least 10 days prior to scheduled start. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.
- G. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he shall submit the following for approval at least ten days prior to scheduled start of such temporary work.
1. A layout of all temporary roads, excavations, embankments and drainage to be constructed within the work area.
 2. Details of temporary road construction.
 3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.
 4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The Drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.
- H. Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as approved by the Engineer or Owner.

- I. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

END OF SECTION 015639

This page intentionally left blank.

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Engineer through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that

does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Engineer will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Engineer's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. **Manufacturer's Warranty:** Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. **Special Warranty:** Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. **Special Warranties:** Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. **Manufacturer's Standard Form:** Modified to include Project-specific information and properly executed.
 - 2. **Specified Form:** When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.

3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Engineer will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

- a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- C. Visual Matching Specification: Where Specifications require "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
 4. Samples, if requested.
- B. Submittal Requirements: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.

- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Certified Surveys: Submit two copies signed by land surveyor.
- D. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in State of Florida and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - a. Primary operational systems and equipment.
 - b. Plumbing piping systems.
 - c. Mechanical systems piping and ducts.
 - d. Control systems.
 - e. Communication systems.
 - f. Conveying systems.
 - g. Electrical wiring systems.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - a. Water, moisture, or vapor barriers.
 - b. Exterior curtain-wall construction.
 - c. Equipment supports.
 - d. Piping, ductwork, vessels, and equipment.
 - e. Noise- and vibration-control elements and systems.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of storm sewer and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls and floors for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Engineer according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Engineer promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and

duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of major site improvements and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors: Remove in-place floor coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Structure and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Structure and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report using Owner's designated form. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons.
 - 4. Quantity of waste salvaged, both estimated and actual in tons.
 - 5. Quantity of waste recycled, both estimated and actual in tons.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Qualification Data: For waste management coordinator.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Use Owner's designated form. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Owner's designated form. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 024119 "Selective Demolition."
 - 2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 - 1. Demolition Waste:
 - a. Concrete.
 - b. Metals
 - c. Equipment.
 - d. Piping.
 - e. Supports and hangers.
 - f. Valves.
 - g. Mechanical equipment.
 - h. Electrical conduit.
 - i. Copper wiring.

2. Construction Waste:
 - a. Lumber.
 - b. Metals.
 - c. Piping.
 - d. Electrical conduit.
 - e. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
 - f. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 1. Pulverize concrete to maximum 4-inch size.
- B. Metals: Separate metals by type.
 1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- C. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, and other components by material and size.
- D. Conduit: Reduce conduit to straight lengths and store by material and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 2. Polystyrene Packaging: Separate and bag materials.
 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

- B. Burning: Do not burn waste materials.

END OF SECTION 017419

This page intentionally left blank.

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 4. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.

7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit final completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first.
2. Organize items applying to each space by major element, including categories for individual walls, floors, and equipment.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Page number.
4. Submit list of incomplete items in the following format:
 - a. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit by uploading to web-based project software site.
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including trenches, equipment vaults, and similar spaces.
 - g. Sweep concrete floors broom clean in unoccupied spaces.
 - h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - i. Remove labels that are not permanent.
 - j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - k. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - l. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - m. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs and bulbs noticeably dimmed by hours of use to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit on digital media acceptable to Engineer or by email to Engineer for review.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 60 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual with comments incorporated from "Initial Manual Submittal" at least 15 days before commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit initial and final manual in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit final manuals in the form of hard-copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 CONTENTS OF OPERATION AND MAINTENANCE MANUALS

- A. Provide operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.
- B. Contents:
 - 1. A table of contents/Index.
 - 2. Specific description of each system and components.
 - 3. Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s).
 - 4. Contractor and/or equipment supplier/manufacturer shall clearly strike out portions of manual that do not apply to the project. Manual will be rejected until inapplicable information is deleted and only applicable information is clearly indicated.
 - 5. Specific on-site operating instructions (including starting and stopping procedures).
 - 6. Safety considerations.
 - 7. Project specific operational procedures.
 - 8. Project specific maintenance procedures.
 - 9. Manufacturer's operating and maintenance instructions – specific to the project.
 - 10. Copy of each wiring diagram.
 - 11. Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s).
 - 12. List of spare parts and recommended quantities.
 - 13. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.
 - 14. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - 15. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.
 - 16. Warranties and Bonds, as specified in Section 017700.
 - 17. Electronic copy of manual.
- C. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:
 - 1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.
 - 2. Panelboard circuit directories including electrical service characteristics, controls and communications and color coded wiring diagrams as installed.
 - 3. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
 - 4. Maintenance Requirements
 - a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions.
 - b. Alignment, adjusting, balancing and checking instructions.
 - c. Servicing and lubrication schedule and list of recommended lubricants.
 - d. Manufacturer's printed operation and maintenance instructions.
 - e. Sequence of operation by instrumentation and controls manufacturer.

- f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.
5. Control diagrams by controls manufacturer as installed (As-Built)
6. Contractor's coordination drawings, with color coded piping diagrams, as installed (As-Built)
7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.
8. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.
9. Test and balancing reports, as required.
10. Additional Requirements as specified in individual product specification.
11. Design data for systems engineered by the Contractor or its Suppliers.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for maintaining and exhibiting project record documents as a prerequisite for progress payments.
 - 2. Section 017300 "Execution" for final property survey.
 - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit one pdf set of marked-up record prints.
 - 2) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit one pdf set of marked-up record prints.
 - 2) Include each drawing, whether or not changes and additional information were recorded.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Work Change Directive.
 - k. Changes made following Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

1.5 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for

Engineer's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

This page intentionally left blank.

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Submit training outline for each piece of equipment as required by the equipment's respective Section
- B. Qualification Data: For instructor.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit digital copy within seven days of end of each training session.

1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative with adequate knowledge of the equipment to provide training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction.
- B. Set up instructional equipment at instruction location as required.

1.8 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Names: Utilize file names based on name of equipment, as identified in Project specifications.
- B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
- C. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 018819 - TIGHTNESS TESTING PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Tightness testing of cast-in-place reinforced concrete liquid retaining structures.

- B. Related Requirements:

- 1. Section 031500 "Concrete Joints and Accessories" for joints in concrete structures.
 - 2. Section 033000 "Cast-In-Place Concrete" for concrete related construction.
 - 3. Section 331300 "Disinfecting of Water Utility Distribution" for disinfection of water containing building components.
 - 4. Section 400551 "Common Requirements for Process Valves" for valves and valve actuators.

1.3 INFORMATIONAL SUBMITTALS

- A. Submit in accordance with Section 013300:

- 1. Action Plan: Submit a detailed plan and schedule for each structure, which shows method of filling, testing and disposal of water.
 - 2. Repair Procedures: Submit for acceptance the proposed repair methods, materials, and modifications needed, if structure does not meet tightness testing.
 - 3. Retain "Test Reports" Paragraph below for test reports that are Contractor's responsibility.
 - 4. Test Reports: Submit a completed Tightness Test Report, Figure A, appended at the end of this Section of each test for each structure.

1.4 FIELD CONDITIONS

- A. Coordinate timing and procedures for obtaining water for testing, structure testing, and water disposal with the Engineer and Owner a minimum of 30 days in advance of actual testing.

- B. Water Source:

1. Contractor may use water for testing from Owner's plant water system. Make arrangements with Owner through the Engineer. Obtain water at a time, flow rate, and location approved by Owner.
 2. Provide labor, materials, equipment, incidentals, and power required to convey water to the structure.
- C. Water Disposal:
1. Dispose of test water in an approved manner. Do not dispose by discharging onto the ground surface of public or private land.
 2. Provide labor, materials, equipment, incidentals, and power required to convey water from the structure.
- D. Environmental Conditions: Do not schedule test measurements for a period when the weather forecast indicates a substantial change in weather patterns.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Perform tightness testing of cast-in-place reinforced concrete liquid retaining structures conforming to ACI 350.1 and as specified in this Section.
- B. Perform tightness tests prior to waterproofing and dampproofing and prior to placing backfill around structures in order to permit observation and detection of leakage points.
- C. Individually test each cell of multi-cell tanks.
- D. Multi-cell tanks may be tested as a single unit where indicated.

3.2 PREPARATION

- A. Remove dirt, mud, and debris from structures prior to initiating tightness tests. Flush floor and sumps with water to provide a clean surface that is ready for testing.
- B. Prior to testing, temporarily seal or bulkhead inlet and outlet pipes not required to be operational for testing procedures.
- C. Confirm that valves are completely closed. Repair and reset seals if necessary. Test valves for leakage in accordance with requirements of respective Sections as part of the preparation for final tightness testing under this Section.
- D. Estimates of valve leakage will not be allowed as adjustments to the measured structure leakage.

3.3 EXAMINATION

- A. Examine structures to be tested for potential leakage paths including cracks, voids, honeycombs, and unsealed joints. Repair such paths as directed by the Engineer, without additional compensation.
- B. Proceed with testing only after unsatisfactory conditions have been corrected.

3.4 TESTING PROCEDURES

A. Testing Conditions:

- 1. Do not begin filling of reinforced concrete structure until concrete elements of the structure have attained specified design strength, but not less than 14 days after placement of all concrete elements.
- 2. Fill reinforced concrete structure not exceeding a rate of 4 feet in 1 hour.
- 3. To minimize water absorption by concrete during testing, fill reinforced concrete structure to maximum operating water surface level and maintain water at that level for at least 3 days, prior to beginning tightness tests. Observe the exterior surfaces of the structure in both the early mornings and late afternoons during 3 days prior to tightness testing. Note any water observed on the structure exterior surfaces.
- 4. Test only a single structure at a time. Concurrent testing of contiguous or adjacent structures will not be allowed.

B. Testing Procedures:

- 1. Test Duration: Test period shall be at least the time required to lower the water surface 3/8 inch, assuming a loss of water at the maximum allowable rate. The test period need not be longer than 5 days.
- 2. Measure water surface elevations at 24-hour intervals. The vertical distance to the water surface shall be measured to within 1/16 inch from a fixed point on the structure above the water surface. Measure water surface elevations at the same four locations, 90 degrees apart. Record water temperature 18 inches below water surface when taking the first and last sets of measurements.
 - a. Use methods to determine amount of precipitation or evaporation as approved by the Engineer.
- 3. Compute percentage of water volume loss based on measured change in water surface elevation, area of the horizontal water surface, initial water volume, and correction for precipitation or evaporation where applicable.

C. Reports: Prepare and submit as referenced in this Section.

3.5 ACCEPTANCE

- A. Following conditions shall be considered as NOT meeting the criteria for acceptance, regardless of actual loss of water volume from the structure:

1. Groundwater seeping or flowing into the structure through floors, walls, or wall-floor joints.
 2. Structures which exhibit seeping or flowing water from joints, cracks, voids, honeycombs, or from beneath the foundation.
 3. Damp spots on concrete surfaces.
 4. Moisture can be deposited on a dry hand held against the exterior surface of the structure.
- B. Tightness of concrete tanks and structures will be considered acceptable when the conditions of previous Paragraph A are not present and when loss of water volume does not exceed 0.05 percent of the starting volume per day.

3.6 REPAIRS AND RETESTING

- A. Structures failing the tightness test and not exhibiting visible leakage may be retested after an additional stabilization period of 7 days. Structures failing this second test shall be repaired at no additional cost to the Owner prior to further testing.
- B. Restart test when test measurements become unreliable due to unusual precipitation or other external factors.
- C. Repaired structures shall be retested. Repairs and retesting shall be conducted without additional compensation and shall be continued and repeated until the structure meets all requirements specified herein.

3.7 SCHEDULE

- A. Test following structures for tightness:
1. Tank types include:
 - a. Clearwell No. 2.

END OF SECTION 018819

**FIGURE A
TIGHTNESS TEST REPORT**

PROJECT _____ SUBMITTED BY _____

STRUCTURE * _____ TEST DATES _____

Allowable loss of water volume _____ percent in 24 hours

Measured loss of water volume _____ percent in 24 hours

TEST READINGS

Water Temperature at Start _____ degrees F

Water Temperature at End _____ degrees F

Operating Water Surface Level _____

Entry	Date**	Time	Water Surface Elevation				Initials**
			Location 1	Location 2	Location 3	Location 4	
0							
1							
2							
3							
4							
5							
Change in level (difference between entry 5 and entry 0)							
Average change in level (sum of change in level / 4)							
Correction for precipitation/evaporation							
Corrected change in level = CL =							
Measured percent water loss in 24 hrs. =			$\frac{(CL) \times (\text{surface area}) \times (100)}{(\text{initial water volume}) (\text{number of test days})}$				

Notes and Field Observations ** _____

* Attach a sketch showing a plan of structure and measurement locations.
 ** Place date and initials at the beginning of each entry.

END OF TIGHTNESS TEST REPORT FORM

This page intentionally left blank.

SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.2 SUMMARY

A. Section Includes:

- 1. General requirements for coordinating and scheduling commissioning activities.
- 2. Commissioning meetings.
- 3. Commissioning reports.
- 4. Use of commissioning process test equipment, instrumentation, and tools.
- 5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
- 6. Commissioning tests and commissioning test demonstration.
- 7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

- 1. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
- 2. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
- 3. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.

1.3 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- B. Commissioning Schedule: A schedule, prepared by Contractor, that outlines the organization and schedule for commissioning of the project.
- C. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are installed and tested to comply with the Contract Documents. The scope of the commissioning process is defined in Section 011000 "Summary."

- D. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
 - 1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:
 - a. Completion of tests and acceptance of test results.
 - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
 - c. Comply with requirements in Section 017900 "Demonstration and Training."
 - d. Completion and acceptance of submittals and reports.
- E. Owner's Witness: Owner's Project Manager or Engineer-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- F. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- G. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- H. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

1.4 INFORMATIONAL SUBMITTALS

- A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.
- B. Commissioning schedule.

1.5 CLOSEOUT SUBMITTALS

- A. Commissioning Documents:
 - 1. At Construction-Phase Commissioning Completion, include the following:
 - a. All Certificate of Proper Installation forms for all installed equipment, completed and signed.
 - b. All approved test procedures for each piece of installed equipment.
 - c. All test data forms, completed and signed.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.
- B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:
 - 1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
 - 2. Calibrated and certified.
 - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
 - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
 - 3. Maintain test equipment and instrumentation.
 - 4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.
 - 1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
 - 2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

- A. General Format and Organization:
 - 1. Bind report in three-ring binders.
 - 2. Label the front cover and spine of each binder with the document title, volume number, project name, Contractor's name, and date of report.
 - 3. Scan document and provide on compact disk or USB.

4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for contents itemized for specific equipment.
- B. Commissioning Document:
1. Include major tabs for each piece of equipment.
 2. Within tab, include the following:
 - a. Pre-startup reports.
 - b. Approved test procedures.
 - c. Test data forms, completed and signed.
 - d. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning process with the Construction Schedule.
- B. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
- C. Report test data and commissioning issue resolutions.
- D. Schedule personnel to participate in and perform Commissioning-Process Work.
- E. Installing Contractors' commissioning responsibilities include, but are not limited to, the following:
 1. Operating the equipment and systems they install during tests.

3.2 COMMISSIONING TESTING

- A. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.
- B. Pre-Startup: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.

C. Test Procedures and Test Data Forms:

1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
3. Completed test data forms are the official records of the test results.
4. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

D. Performance of Tests:

1. Perform and complete each step of the approved test procedures in the order listed.
2. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
3. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
4. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

E. Performance of Test Demonstration:

1. Notify Owner's witness at least three days in advance of each test demonstration.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
4. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
5. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
 - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.
6. False load test requirements are specified in related sections.
 - a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified.

Equipment and systems permanently installed in this work shall not be used to create the false load without Engineer's written approval.

F. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:
 - a. Identify delayed tests by test number and title.
 - b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Engineer and Owner at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Engineer and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

G. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
 - a. Submit commissioning compliance issue within 24 hours of the test.
 - b. Determine the cause of the failure.
 - c. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
5. Diagnose and correct failed test demonstrations as follows:
 - a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
 - b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
 - c. Record the results of each step of the diagnostic procedure.
 - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
 - e. Determine and record corrective measures.

- f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
6. Retest:
 - a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
 - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
 7. Do not correct commissioning compliance issues during test demonstrations.
 - a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.3 SEQUENCING

- A. Sequencing of commissioning activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
 1. Certificate of Proper Installation.
 2. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
 3. Performance Tests:
 - a. Static tests, as appropriate.
 - b. Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
 - c. Equipment and assembly performance tests.
 - d. System performance tests.
 - e. Intersystem performance tests.

3.4 SCHEDULING

- A. Commence commissioning process as early in the construction period as possible.
- B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."
 1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.

2. Schedule the start date and duration for the following commissioning activities:
 - a. Submittals.
 - b. Preliminary operation and maintenance manual submittals.
 - c. Installation checks.
 - d. Startup, where required.
 - e. Performance tests.
 - f. Performance test demonstrations.
 - g. Commissioning tests.
 - h. Commissioning test demonstrations.
 3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
 4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.
- C. Owner's Witness Coordination:
1. Coordinate Owner's witness participation via Engineer.
 2. Notify Engineer of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.5 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

- A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner through Engineer a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to complete commissioning process.
- B. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Engineer's services and expenses made necessary thereby, shall be at Contractor's expense.
- C. When construction-phase commissioning process or designated portion is complete, Owner will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected site elements.
 - 2. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
 - 2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
 - 3. Section 017300 "Execution" for cutting and patching procedures.
 - 4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Predemolition Photographs: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 030100.61 - CONCRETE REPAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes concrete repair consisting of the following:
 - 1. Removal of existing concrete.
 - 2. Bonding new concrete.
 - 3. Repair mortar.
 - 4. Crack and leaking construction joint repair (polyurethane chemical grout injection).
 - 5. Crack repair (epoxy adhesive injection).
 - 6. Spalled, deteriorated, and disintegrated concrete repair.
 - 7. Surface waterstop repair.
 - 8. Sealing of joints between existing and new concrete.
- B. Related Requirements:
 - 1. Section 018819 for tightness testing of liquid retaining structures.
 - 2. Section 024119 "Selective Demolition" for partial removal of various building components and systems.
 - 3. Section 030130.71 "Modifications to Existing Concrete" for modifying existing concrete.
 - 4. Section 031000 "Concrete Forming and Accessories" for concrete formwork.
 - 5. Section 031500 "Concrete Joints and Accessories" for concrete joints and joint accessories.
 - 6. Section 033000 "Cast-in-Place Concrete for ground and elevated cast concrete.
 - 7. Section 050519 "Post-Installed Anchors" for testing of drilled in injection adhesive anchor system.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Including manufacturers printed performance criteria, product life, working time after mixing, surface preparation and application requirements and procedures, curing, and volatile organic compound data.
 - 2. Storage requirements including temperature, humidity, and ventilation.
 - 3. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for:
 - a. Polyurethane chemical grout.

- b. Crack repair epoxy adhesive.
- c. Epoxy bonding agent.
- d. Adhesive anchor system.
- e. Repair mortars.
- f. Surface waterstop repair.
- g. Strip and seal system.
- h. Backer rods.
- i. Carbon fiber reinforced laminate system.
- j. Epoxy adhesive paste.

- 4. Include rated capacities, operating characteristics, and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: Notarized certificate for each repair material stating that product meets requirements of this Section and has manufacturer's current printed literature on product package or container.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with a minimum of 10 years' documented experience and having an ongoing program to train, certify, and technically support installers.
- B. Installer Qualifications: Fabricator of products.
- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- D. Contractor's Supervisor: Having attended a training program sponsored by manufacturer supplying project approved materials.
- E. Testing Agency Qualifications: Qualified according to ASTM C 1021 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Deliver materials in original, new, and unopened packages and containers clearly labeled with information referenced in Division 01 and the following information:
 - 1. Manufacturer's stock number and batch number.
 - 2. Date of manufacture.
 - 3. Expiration or use-by date.
- B. Storage of Materials:
 - 1. Store only approved materials on site.

1.7 FIELD CONDITIONS

- A. Conform to temperatures and other environmental factors as stated within manufacturer's published installation instructions for storage, substrate conditions, application, curing, and other procedures required by work of this Section.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Use materials in compliance with state and local regulations.
- B. Use materials where completed system is in compliance with ANSI/NSF 61 requirements for potable water and after 30 days is non-toxic and free of taste and odor.

2.2 MATERIALS

A. Polyurethane Chemical Grout:

1. Single component, expanding, moisture reactive polyurethane grout designed to seal cracks and open joints in concrete that is certified by ANSI/NSF 61 for use in potable water applications. Provide cured chemical grout that forms a compressed closed cell urethane foam that completely fills the crack or joint.
2. Accelerator: May be used if recommended by approved polyurethane chemical grout manufacturer.
3. Provide injection packers for application of polyurethane chemical grout.
4. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. BASF Corporation: MasterInject 1230 IUG.
 - b. Sika Corporation: SikaFix HH.
 - c. W. R. Grace & Co.: Sealfoam PRe, by DE NEEF.

B. Crack Repair Epoxy Adhesive:

1. ASTM C 881/ C 881M, Type V, Grade 2, Class C; two-component, solvent-free, moisture insensitive epoxy resin material suitable for repairing cracks in concrete by injection or gravity feed; formulated for specific size of opening or crack being injected.
 - a. When using crack repair epoxy adhesive in structures containing potable water or water to be treated for potable use the epoxy paste used for the surface seal shall be certified by ANSI/NSF 61 for use in potable water applications.
2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Euclid Chemical Company: EUCO #452.
 - b. Five Star Products Inc.: Bonding Adhesive.
 - c. Sika Corporation: Sikadur 32, Hi Mod.

C. Epoxy Bonding Agent:

1. Two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bind plastic concrete to hardened concrete and complying with requirements of ASTM C 881, Type V, Grade 2, Class C.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Euclid Chemical Company: Dural 452 MV.
 - b. Sika Corporation: Sikadur 32, Hi Mod.
 - c. Simpson Strong-Tie Company Inc.: FX-762.
- D. Adhesive Anchor System: A system utilizing an injection adhesive manufactured for installation of drilled-in reinforcing steel dowels.
1. Injection Adhesive: Two-component epoxy system including a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate. Provide side-by-side cartridges designed to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
 - a. Provide adhesive formulation that is certified by ANSI/NSF 61 for use in potable water applications.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Hilti: HIT-RE 500-V3; referenced as Basis-of-Design materials, unless otherwise noted.
 - b. Redhead: Epcon C6+.
 - c. Simpson Strong: Tie Epoxy SET-XP.
- E. Horizontal Repair Mortars - Polymer-Modified Portland Cement Mortar:
1. Two-component polymer-modified, portland cement-based mortar used to repair horizontal surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 7,000 psi at 28 days tested in accordance with ASTM C 881 or ASTM C 109.
 - a. Provide adhesive formulation that is certified by ANSI/NSF 61 for use in potable water applications.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. BASF Corporation: MasterEmaco T 310CI.
 - b. Euclid Chemical Company: DuralTop Flowable Mortar.
 - c. Sika Corporation: SikaTop 122 Plus.
- F. Vertical and Overhead Repair Mortars - Polymer-Modified Portland Cement Mortar:
1. Two-component polymer-modified, portland cement based, fast setting, non-sag mortar used to repair vertical and overhead surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 5,000 psi at 28 days tested in accordance with ASTM C 881 or ASTM C109.

- a. Provide adhesive formulation that is certified by ANSI/NSF 61 for use in potable water applications.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Euclid Chemical Company: DuralTop Gel.
 - b. Sika Corporation: SikaTop 123 Plus.
 - c. US MIX Company: US SPEC H2.
- G. Surface Waterstop Repair - Elastomeric Coating System:
1. General: High solids elastomeric modified polyurethane or urethane coating manufactured to bridge moving cracks and joints in concrete structures, having a minimum elongation of 300 percent, per ASTM D 412, a minimum tensile strength of 1,000 psi, per ASTM D 412, 100 mil thick sheet and minimum tear strength 180 psi, per ASTM D 624 (Die C).
 - a. Provide adhesive formulation that is certified by ANSI/NSF 61 for use in potable water applications.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. C.I.M. Industries, Inc.: CIM 1061.
 - b. Tnemec Company, Inc.: Tnemec Series 264 Elasto-Shield.
- H. Strip and Seal System:
1. Provide a strip and seal joint repair system consisting of two components, an epoxy resin adhesive and hypalon sheeting designed to seal moving joints and cracks in concrete.
 - a. Provide adhesive formulation that is certified by ANSI/NSF 61 for use in potable water applications.
 2. Two-Component Epoxy Resin:
 - a. Component A: Modified epoxy resin of epichlorohydrin bisphenol A type containing suitable viscosity control agents and pigments. It shall not contain butyl glycidyl ether.
 - b. Component B: Primarily a reaction product of a selected amine blend with an epoxy resin of epichlorohydrin bisphenol; a type containing suitable viscosity control agents, pigments, and accelerators.
 - c. Ratio of Component A to Component B: 2:1 by volume.
 3. Properties of Cured Epoxy Resin Adhesive:
 - a. Tensile Properties at 14 days according to ASTM D 638:
 - 1) Tensile Strength: 3,600 psi.
 - 2) Elongation at Break: 0.4 percent.
 - 3) Modulus of Elasticity: 7.5 x 10⁵ psi.
 - b. Compressive Properties at 28 days according to ASTM D 695:

- 1) Compressive Strength: 12,000 psi.
 - 2) Modulus of Elasticity: 3.9×10^5 psi.
 - c. Flexural Properties (ASTM D 790) at 14 days:
 - 1) Flexural Strength (Modulus of Rupture): 4,400 psi.
 - 2) Tangent Modulus of Elasticity in Bending: 1.0×10^6 psi.
 - d. Shear Strength at 14 days: 3,400 psi according to ASTM D 732.
 - e. Water Absorption (ASTM D 570) at 1 day: 0.79 percent.
 - f. Bond Strength (ASTM C 882/C 882M) Hardened Concrete to Hardened Concrete:
 - 1) Dry Cure: 3,300 psi 2 days.
 - 2) Moist Cure: 2,400 psi, 14 days.
 - g. Epoxy Resin: ASTM C 881/C 881M.
 4. Hypalon Sheeting:
 - a. Hypalon rubber perforated along bonding edges to provide a mechanical key. Provide sheeting with ability to be vulcanized with hydrocarbon solvent to permit its adhesion to an epoxy resin adhesive.
 - b. Sheeting Width: As indicated on Drawings.
 - c. Sheeting Thickness: 40 mils.
 - d. Provide sheeting designed to be lapped or seamed by heat or by an aromatic hydrosolvent strip.
 - e. Provide a removable center expansion strip with the sheeting.
 5. Properties of Hypalon Sheeting:
 - a. Tensile Properties according to ASTM D 412:
 - 1) Tensile Strength: 1,000 psi.
 - 2) Elongation at Break: 800 percent.
 - 3) Tensile Set after Break: 400 percent.
 - b. Tear Resistance according to ASTM D 624, Die C:
 - 1) Resistance to Tear: 250 psi.
 - c. Low Temperature of Performance: Maintained to minus 40 degrees F.
 6. Acceptable Manufacturers and Products: Provide following or equal:
 - a. Sika Corporation: Sikadur Combiflex SG.
- I. Epoxy Paste Adhesive:
1. Two-component, solvent-free, moisture insensitive epoxy resin material used as an adhesive for mating surfaces where the glue line is 1/8 inch or less and to bond fresh, plastic concrete to clean, sound hardened concrete and complying with requirements of ASTM C 881, Type IV, Grade 3, Class C.

- a. Provide adhesive formulation that is certified by ANSI/NSF 61 for use in potable water applications.
2. Test Data: Base test upon material and curing condition of 73 plus/minus two degrees F and 50 plus/minus five percent Relative Humidity.
3. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Sika Corporation: Sikadur 31 Hi-Mod Gel.
 - b. Euclid Chemical Company: Dural 452 Gel.
 - c. BASF Corporation: MasterEmaco ADH 1420.

2.3 ACCESSORY MATERIALS

A. Backer Rods:

1. Open Cell Backer Rod: Extruded, open cell polyurethane foam. Diameter shall not be less than 200 percent of the joint width dimension.
2. Closed Cell Backer Rod: Extruded, non-staining, resilient closed cell polyethylene foam, compatible with sealant. Diameter shall not be less than 25 percent greater than the joint width. Sealant shall not adhere to backer rod.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, installation tolerances and any conditions affecting performance of the Work.

3.2 PREPARATION

A. Surface Waterstop Repair:

1. Prior to and during installation of elastomeric coating, check daily for presence of concrete substrate moisture by performing standard test method for indicating moisture in concrete by plastic sheet method in accordance with ASTM D 4263.
 - a. If presence of moisture is indicated, take measures to force dry concrete substrate using indirect heaters and fans prior to commencing with coating system application.
 - b. Perform test once for every 200 sq. ft. of area to be coated, once per day, or more frequently at darkened concrete areas.
 - c. If substrate moisture source cannot be eliminated by force drying, advise the Engineer.
2. Provide and record adhesion of elastomeric coating material in accordance with ASTM D 4541 using the following procedure:
 - a. Clean coating surface to remove all oil, dirt, dust, or other contaminants.

- b. Cut through coating material into substrate using a circular core drill.
 - c. Mix and apply a rapid setting two component epoxy adhesive onto an abrasive blast cleaned disk or plug. Install disk or plug firmly over cut out circular area and hold in place using tape or other means to secure it until adhesive has cured.
 - d. Remove disk or plug with a Pull-off Testing instrument, strictly following instrument manufacturer's instructions.
 - e. Read or calculate adhesive tensile pull value and record in pounds per square inch (psi). Have adhesive tensile pull value exceeding 300 psi. Remove concrete that is attached to underside of disk or plug. If it does not, perform two additional adhesion tests in same repaired area. If above requirements are still not met, coating installation in this area will be deemed unacceptable. Remove and immediately reinstall until acceptable adhesion is achieved. Repair test locations to achieve a pinhole free coating directly following acceptable results.
3. Measure and record elastomeric coating system thickness using the following methods.
- a. Use notched gauge in accordance with ASTM D 4414 for wet film thickness at least once every area where the coating is applied.
 - b. Following cure, test coating for dry film thickness (DFT) once for every 500 sq.ft. of surface area using a Positector 100 DFT Gauge calibrated in accordance with instrument manufacturer's instructions. Where areas are found to be below specified DFT above filled bugholes and above the prepared substrate profile, apply an additional application of coating or remove and recoated to meet total DFT requirement. Additional thickness may be problematic in areas where mechanical moving equipment tolerances are critical; at such locations, remove and reapply coating to specified film thickness.
- B. When removing materials or portions of existing structures and when making openings in existing structures, erect barriers, shoring and bracing, and other protective devices to prevent damage to structures beyond the limits of new work, protect personnel, control dust, and prevent damage by falling or flying debris. Comply with requirements of Section 015000 "Temporary Facilities and Controls."

3.3 GENERAL

- A. Store, mix, apply, and cure materials for each repair system in strict compliance with manufacturer's installation instructions. Make repairs necessary, without additional compensation, so completed work complies with Contract Document work scopes.
- B. Where concrete is repaired near an expansion joint or control joint, preserve isolation between components on either side of the joint.
- C. Identify reinforcing locations prior to drilling using reinforcing bar locators so that drill hole locations may be adjusted to avoid reinforcing interference. When drilling holes for dowels and bolts, stop drilling if reinforcing is encountered. Relocate hole to avoid reinforcing as approved by the Engineer. Do not cut reinforcing without prior approval by the Engineer.
- D. Concrete designated to be removed to specific limits indicated or directed by the Engineer, shall be done by saw cutting (1 inch deep) at limits of removal followed by line drilling, chipping, sandblasting, or airblasting, as appropriate in areas where deteriorated, damaged, or unsound

concrete is to be removed. Remove concrete such that surrounding concrete and existing reinforcing to be left in place and existing in place equipment are not damaged.

1. Perform full thickness saw-cutting at limits of concrete to be removed only if indicated, specified, or after obtaining written approval from the Engineer.
 - E. Saw-cut edges straight for vertically and horizontally repair areas. Make intersecting cuts perpendicular to each other.
 - F. Stop saw cutting if reinforcing is encountered. Do not cut reinforcing without prior approval by the Engineer. Identify reinforcing locations within one foot of saw cut locations in any direction prior to saw cutting using reinforcing bar locators.
 - G. Clean concrete surfaces of efflorescence, deteriorated concrete, dirt, laitance, and existing repair materials such as liners, adhesives, and epoxies. Remove foreign matter and deleterious films by sandblasting, airblasting, scarifying or other mechanical means to sound original concrete.
 - H. Thoroughly clean repair area with oil-free compressed air, then install bonding agent. Place repair materials within open time of epoxy bonding agent.
 - I. Consolidate repair material, completely filling all portions of area to be filled.
 - J. Bring finished repair surfaces into alignment with adjacent existing surfaces to provide a uniform, flush, and even surface. Match repair surfaces to adjacent existing surfaces in texture, including any coatings or surface treatments that had been provided for existing surface.
 - K. Remove excess material from faces of materials being repaired and adjacent walls, floors, and slabs. Leave exposed faces of surface materials clean and ready to accept subsequent work.
 - L. Repair or replace concrete indicated or specified to be left in place, but that is damaged because of the work of this Section. Perform work by approved means and methods.
- 3.4 CRACK AND CONSTRUCTION JOINT REPAIR (POLYURETHANE CHEMICAL GROUT INJECTION REPAIR TYPE "A")
- A. Apply polyurethane chemical grout to leaking cracks, joints, and voids in existing concrete.
 - B. Install polyurethane chemical grout through drilled-in injection ports installed as recommended by polyurethane chemical grout manufacturer. Install and cure polyurethane repair materials in accordance with manufacturer's requirements.
 - C. Remove injection ports and seal with grout. Leave repair area flush with surrounding concrete surfaces.
- 3.5 CRACK REPAIR (EPOXY ADHESIVE INJECTION REPAIR TYPE "B")
- A. Repair cracks on horizontal surfaces by gravity feeding crack repair epoxy adhesive into cracks. Pressure inject cracks less than 1/16 inch in thickness.

- B. Repair cracks on vertical surfaces by pressure injecting crack repair epoxy adhesive through injection ports sealed to surface with crack repair epoxy adhesive.
- C. Clean cracks by sandblasting, water jet, or high-pressure oil free air to remove loose matter, dirt, laitance, oil, grease or other contaminants. Prior to injection of the crack apply a surface seal of epoxy paste to crack faces.
 - 1. Establish openings in surface seal (injection ports) along the crack. Do not allow distance between injection ports to be greater than slab or wall thickness.
 - 2. Begin injection at first port at one end of the crack. For vertical or inclined surfaces begin injection at lowest point of the crack. Continue injection at first port until injected epoxy begins to flow out of second port in line.
 - 3. Plug first port and continue injection from second port. Inject entire crack following same sequence. Continue injecting crack and do not stop until crack is completely injected.
 - 4. After injected epoxy has cured, remove or cut off ports and grind flush with adjacent concrete surface. Do not allow indentations or protrusions caused by port placements.

3.6 SPALLED/DETERIORATED CONCRETE REPAIR (REPAIRS TYPE "C", "E", AND "F")

- A. Only use polymer-modified cementitious repair mortar for surface repair of spalled or deteriorated concrete.
- B. Comply with manufacturer's recommendations for concrete removal, surface preparation, mixing, application, lift thickness, finishing, moist curing, and form removal.
- C. Saw cut perimeter of deteriorated concrete to form a rectangle with straight edges to depth indicated. Remove fractured, loose, broken, softened, and deteriorated concrete by abrasive blasting, chipping, or other appropriate means to sound concrete. Chip concrete substrate to obtain a surface profile with a new fractured aggregate surface.
- D. Remove dirt, oil, grease, and other bond inhibiting materials from surface by dry mechanical means such as sand blasting, chipping, or wire brushing. Thoroughly clean surface of loose or weakened material and dust by dry mechanical means such as oil-free air blast. Follow recommendations of repair mortar manufacturer for additional surface preparation.
- E. Do not damage reinforcing steel that is to be incorporated into new concrete. Where reinforcing steel with active corrosion is encountered, use following procedure:
 - 1. Use dry mechanical means to remove loose material, contaminants and rust from exposed reinforcing steel.
 - 2. When more than half of reinforcing bar diameter is exposed, chip out behind reinforcing steel, 1 inch minimum.
 - 3. Make distance chipped behind a reinforcing bar equal to or exceed minimum placement depth of material being used, 1 inch minimum.
 - 4. If existing reinforcing steel has lost more than 15 percent of its original cross-sectional area, splice in new reinforcing as shown on Drawings.
- F. Repair cracks encountered in substrate area of spalled or deteriorated concrete repair as specified directed by the Engineer.

G. Repair Mortar Placement:

1. Follow procedures recommended by manufacturer for mixing and placement of repair mortar.
2. After initial mixing of repair mortar, do not add water to change the consistency, should the mix begin to stiffen.
3. Saturate substrate surface dry (SSD) with no standing water during application.
4. Apply scrub coat to substrate, filling all pores and voids.
5. While scrub coat is still plastic, apply polymer-modified repair mortar. Place repair mortar to an even, uniform plane to restore the member to its original surface.
6. For applications greater than 1 inch in depth, apply repair mortar in lifts. Score exposed surface of each lift to produce a roughened surface before applying the next lift. Allow lift to reach final set before proceeding with subsequent lift.

H. Finishing:

1. Apply repair mortar with a smooth, steel trowel finish, unless otherwise noted.
2. Have no sharp edges when repair is completed. Make exterior corners, such as at penetrations, with a 1 inch radius. Make interior corners square.

I. Curing: Perform as recommended by repair mortar manufacturer, except that cure period shall be at least 24 hours and done by means of a continuous fog spray or moist cure with wet burlap.

J. Repairs Requiring Formwork:

1. Remove fractured, loose, deteriorated, and unsound concrete by bush hammering, chipping, high pressure water blast, or other appropriate dry mechanical means. Remove dirt, oil, grease, and other bond inhibiting materials from concrete surface.
2. Treat existing anchor bolts, exposed reinforcing steel, and reinforcing to be incorporated into repair mortar, as specified below.
3. Construct leakproof forms as required by project conditions. Line or coat forms with release agents recommended by repair mortar manufacturer. Provide forms of adequate strength, securely anchored in place and shored to resist the forces imposed by repair mortar and its placement.
4. Saturate existing concrete surfaces with water, with no standing water during application. Prime concrete surface with a scrub coat of repair mortar. Restore area to original limits or as shown using repair mortar before scrub coat dries. Extend repair mortar with 3/8 inch aggregate only as recommended by manufacturer of repair mortar.

3.7 SURFACE WATERSTOP REPAIR TYPE "D"– ELASTOMERIC COATING SYSTEM

A. Surface Preparation of Existing Concrete Substrates:

1. Abrasive blast-clean previously coated concrete surfaces to remove existing protective coating materials, degraded concrete, and to produce a sound and clean substrate free of laitance, surface contaminants, loose materials, or other deleterious substances that would reduce or prevent bond. Clean substrate in accordance with SSPC-SP-13/NACE.
2. Roughen existing concrete surfaces to produce a minimum, uniform substrate anchor pattern or profile similar to CSP 4 to 6 in accordance with ICRI 03732.

3. If cleaning does not remove degraded concrete, use chipping or other abrading tools to remove deteriorated concrete until a sound and clean substrate is achieved, which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and other deleterious substances that would reduce or prevent bond.
 - a. Use abrasive blast cleaning or other means necessary to open air voids or bugholes to expose their complete perimeter. Do not leave shelled over or hidden air voids beneath the exposed concrete surface.
 - b. Leave concrete substrate dry prior to application of surface filler or coating materials.
 4. Following inspection of concrete surface preparation and acceptance by the Engineer, thoroughly vacuum clean concrete surfaces to be coated to remove loose dust, dirt, and spent abrasive leaving a dust free and sound concrete substrate. Remove debris produced by blast cleaning and dispose. Reinspect and if specified conditions are met, the Engineer will accept the substrate prior to commencement of coating installation.
- B. Control of Ambient Conditions in Tank Structures to be Coated:
1. Control ambient conditions in tank structures to be coated, and provide protective enclosures during surface preparation, application, and curing, to meet the manufacturer's recommendations. Continue control work throughout coating system installation and curing.
 2. Do not apply coating materials when dust is being generated.
 3. Verify that temporary lighting during the work as provided under Division 26 is equivalent to a minimum of one 200-watt explosion proof incandescent lamp per 100 square feet of work area.
- C. Installation of Coating System:
1. Install coating system to provide a watertight seal at construction joints indicated. Install in strict compliance with coating system manufacturer's instructions.
 2. Repair deep voids or damaged areas of concrete substrates to be coated as indicated.
 3. Apply binder coat or primer coat required by coating system manufacturer's instructions only to areas where elastomeric system is intended. Protect adjacent surfaces with tape prior to application of system.
 4. Trowel, roll, or spray apply approved coating material evenly over concrete surfaces as recommended and instructed by coating manufacturer to a minimum total dry film thickness of 60 mils above prepared profile, filled air voids, and bugholes. Install more than one application of coating material if necessary to achieve total dry film thickness. To ensure a pinhole free coating surface and to remove sags or trowel marks, roll or otherwise treat wet coating to leave a relatively smooth coating surface free of excessive trowel marks, sags, or other variations in thickness. Force coating material into surface profile or roughness of substrate.
 5. When concrete substrates surface temperatures are rising or when these substrates are in direct sunlight, out-gassing of air from concrete will result in bubbling, pinhole formations, or blistering in coating or resurfacing materials. When this occurs, postpone coating application until cooler evening hours or take other measures to prevent such rising substrate temperatures. Repair bubbles, pinholes, or discontinuities in applied materials, as recommended by the manufacturer.

6. Smooth sloughs, sags, ridges, runs, or other surface irregularities by means and methods approved by the manufacturer prior to application of successive coats and prior to cure of coating material.
7. Provide completed cured elastomeric coating that is smooth, free of cracks, pinholes or other defects adversely affecting the waterproofing characteristics of the material, and free of seams or cold joints. The Engineer may authorize repairs of defects in elastomeric coating by approved methods.

3.8 STRIP AND SEAL SYSTEM

- A. Clean both sides of joint by mechanical methods as approved by system manufacturer.
- B. Remove unsound or deteriorated concrete adjacent to joint prior to repair. Rebuild to original or required concrete dimensions as directed by the Engineer.
- C. Where shown on Drawings, pack open cell polyurethane foam backer rods saturated with polyurethane chemical grout into joint. Spray saturated foam with water to activate grout and create a seal.
- D. Apply adhesive on each side of joint and work into substrate for positive adhesion.
- E. Firmly roll Hypalon sheet to joint. At expansion joints, provide continuous sheets and drape sheets into expansion joint indicated on Drawings.
- F. Apply top layer of adhesive from each edge of joint to outer edge of sheet to seal outer edge of the sheet. Remove expansion strip from sheeting before setting of epoxy resin.

3.9 FIELD QUALITY CONTROL

- A. At completion of repairs, Contractor, Engineer, and material Installer shall meet to inspect installed work. Repair leaking joints, cracks, or voids in accordance with manufacturer's instructions. At completion of various repairs, Contractor, Engineer, and Installer shall reinspect repaired problem areas. Make subsequent repairs until work is in conformance with Contract Documents.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Prepare test and inspection reports.

END OF SECTION 030100.61

This page intentionally left blank.

SECTION 030130.71 - MODIFICATIONS TO EXISTING CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:

- 1. Cutting, removing, or modifying parts of existing concrete structures or appurtenances.
- 2. Addressing existing steel reinforcing bars encountered.
- 3. Bonding new concrete or grout to existing concrete.

- B. Related Requirements:

- 1. Section 018819 "Watertightness Performance Requirements" for tightness testing of liquid retaining structures.
- 2. Section 024119 "Selective Demolition" for selective demolition and modification procedures.
- 3. Section 030100.61 "Concrete Repairs" for repair materials and related repair work.
- 4. Section 031000 "Concrete Forming and Accessories" for formwork and related repair work.
- 5. Section 032000 "Concrete Reinforcing" for reinforcing and related repair work.
- 6. Section 033000 "Cast-In-Place Concrete" for concrete materials, and related work.
- 7. Section 031500 "Concrete Joints and Accessories" for related work.
- 8. Section 033500 "Concrete Finishing" for related work.
- 9. Section 033900 "Concrete Curing" for related work.
- 10. Section 036000 "Grouting" for grout and related accessories.
- 11. Section 050519 "Post-Installed Anchors" for anchors and related accessories.
- 12. Section 055000 "Miscellaneous Metals" for various metals and related fabrications.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Submit manufacturer's technical literature and installation instructions that include:
 - a. Current printed recommendations and product data sheets for products including performance criteria, product life, working time after mixing, surface preparation and application requirements and procedures, curing, volatile organic compound data, and safety requirements.
 - b. Storage requirements including temperature, humidity, and ventilation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Documentation of the qualifications for Contractor qualifications, Manufacturer's qualifications, and Contractor's supervisor as specified in Paragraph 1.8.
- B. Material Certificates: For each material provided.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Have a minimum of ten years' experience within last 10 years in manufacture and use of specified products and have an ongoing program of training, certifying, and technically supporting Contractor's personnel.
- B. Contractor Qualifications: Complete a program of instruction in application of approved manufacturer's material and provide certification from manufacturer attesting to their training and status as an approved applicator.
- C. Contractor's Supervisor: Have attended a training program sponsored by manufacturer supplying materials approved for this project.
- D. Manufacturer's Representative: A representative of product manufacturer who will visit the site for first three days of installation to give instructions to installation crew. Make periodic site visits to ensure products being installed are in accordance with published instructions.
- E. Do not shift, cut, remove, or otherwise altered existing structure or concrete until authorization is given by the Engineer.
- F. When removing materials from or making openings in existing structures, take precautions and erect necessary barriers, shoring and bracing, and other protective devices. Prevent damage to structures beyond limits necessary for new work, protect personnel, control dust, and to prevent damage to structures or contents by falling or flying debris.
- G. Unless otherwise permitted, shown, or specified, cut existing concrete by line drilling.
- H. Construction Tolerances: Comply with requirements specified elsewhere in Division 03, except as modified herein, and elsewhere in Contract Documents.
- I. Make locations and phases of the work available for access by the Engineer or other personnel designated by the Engineer. Provide ventilation and safe access to the work.
- J. Be solely responsible for workmanship and quality of modification work. Inspections by the manufacturer, the Engineer, or others do not limit Contractor's responsibility for work quality.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in original, new and unopened packages and containers clearly labeled with the following information:
 - 1. Manufacturer's name.
 - 2. Name or title of material, and other product identification.

3. Manufacturer's stock number and batch number.
 4. Date of manufacture.
 5. Instructions.
 6. Expiration date.
- B. Storage: Store products in accordance with manufacturers' published recommendations and the following supplementary requirements:
1. Store only approved materials on site and in locations as directed.
 2. Keep area clean and accessible.
 3. Comply with health and fire regulations including those of the Occupational Safety and Health Administration (OSHA).
- C. Handling: Handle products carefully and in accordance with manufacturers' published recommendations and the following supplementary requirements:
1. Prevent inclusion of foreign materials.
 2. Do not open containers or mix components until necessary preparatory work has been completed and application work will start immediately.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with this Section and applicable state and local regulations.
- B. Epoxy Bonding Agent:
1. Product: Two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bind plastic concrete to hardened concrete and complying with requirements of ASTM C 881, Type V, Grade 2, Class C.
- C. Epoxy Paste Adhesive:
1. Product: Two-component, solvent-free, moisture insensitive epoxy resin material used as an adhesive for mating surfaces where the glue line is 1/8 inch or less and to bond fresh, plastic concrete to clean, sound hardened concrete and complying with requirements of ASTM C 881, Type IV, Grade 3, Class C that is certified by ANSI/NSF 61 for use in potable water applications.
- D. Repair Mortar (Polymer-Modified Portland Cement Mortar):
1. Horizontal Surfaces:
 - a. Product: Two-component polymer-modified, Portland cement-based mortar used to repair horizontal surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 7,000 psi at 28 days tested in accordance with ASTM C 881 or ASTM C 109 that is certified by ANSI/NSF 61 for use in potable water applications.

2. Vertical and Overhead Surfaces:
 - a. Product: Two-component polymer-modified, portland cement based, fast setting, non-sag mortar used to repair vertical and overhead surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 5,000 psi at 28 days tested in accordance with ASTM C 881 or ASTM C 109 that is certified by ANSI/NSF 61 for use in potable water applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

- A. Cut, remove, or otherwise modify parts of existing structures or appurtenances as indicated, specified, or as necessary to complete the work. Finishes, joints, reinforcements, sealants, and similar materials are specified in their respective Sections. Install work complying with requirements of this Section and as indicated.
- B. Locations, details, and limits of modifications are indicated on Drawings. Comply with requirements of this Section and as indicated on Drawings.
- C. Examine areas and conditions under which modification work is to be installed and notify Engineer in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.
- D. Store, mix, apply, and cure materials in strict compliance with manufacturer's instructions.
- E. Where concrete is to be modified near an expansion joint or control joint, preserve isolation between components on either side of the joint.
- F. When drilling holes for dowels and bolts, stop drilling if reinforcing is encountered. Do not cut reinforcing without prior approval by the Engineer. Relocate hole to avoid reinforcing as approved by the Engineer.
 1. Identify reinforcing locations prior to drilling using reinforcing bar locators so that drill hole locations may be adjusted to avoid reinforcing interference.
- G. Saw-cut edges for modification areas vertically and horizontally straight. Make intersecting cuts perpendicular to each other.

- H. Stop saw cutting if reinforcing is encountered. Do not cut reinforcing without prior approval by the Engineer. Identify reinforcing locations within 1 foot of saw cut locations in any direction prior to saw cutting using reinforcing bar locators.
- I. Clean concrete surfaces of efflorescence, deteriorated concrete, dirt, laitance, and existing repair materials such as liners, adhesives, and epoxies. Remove foreign matter and deleterious films by sandblasting, oil-free air-blasting, scarifying, or other mechanical means to sound original concrete.
- J. Consolidate modification materials, completely filling portions of the area to be filled.
- K. Bring finished surfaces into alignment with adjacent existing surfaces to provide a uniform, flush, and even surface. Match repair surfaces to adjacent existing surfaces in texture including any coatings or surface treatments that had been provided for the existing structure.
- L. Repair or replace concrete indicated or specified to be left in place that is damaged because of the work by approved means without additional compensation.

3.3 CONCRETE REMOVAL

- A. Concrete designated to be removed to specific limits indicated or directed by the Engineer, perform saw cutting 1 inch deep at limits of removal followed by line drilling and chipping, sandblasting, or oil-free airblasting, as appropriate in the areas where concrete is to be taken out. Remove concrete such that surrounding concrete and existing reinforcing to be left in place and existing in place equipment are not damaged.
 - 1. Perform full thickness saw-cutting at limits of concrete to be removed only if indicated, herein specified, or after obtaining written approval from the Engineer.
- B. Where existing reinforcing is exposed due to saw cutting or line drilling and no new material is to be placed on cut surface, apply a 1/4 inchthick surface treatment of epoxy paste to entire cut surface.
- C. Where joint between new concrete or grout and existing concrete will be exposed in finished work, remove concrete edge by making a 1 inch deep saw cut on each exposed surface of existing concrete or as indicated.

3.4 CONNECTION SURFACE PREPARATION

- A. Concrete areas requiring patching, repairs, or modifications, prepare connection surfaces as specified, as indicated, or as directed by the Engineer.
- B. Remove loose and deteriorated materials, efflorescence, existing repair materials, dirt, oil, grease, and other bond inhibiting materials from concrete surface by dry mechanical means such as sandblasting, chipping, wire brushing, or other mechanical means as approved by the Engineer.

1. Uniformly roughen concrete surface to approximately 1/4 inch amplitude with pointed chipping tools. Thoroughly clean surface of loose or weakened material by sandblasting or air-blasting.
 2. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete.
- C. If reinforcing steel is exposed, mechanically clean to remove loose material, contaminants, and rust as approved by the Engineer. If half of reinforcing steel diameter is exposed, chip out behind the steel. Chip distance behind the steel to a minimum of 1 inch. Do not damage reinforcing to be incorporated in new concrete or repair mortar during removal operation.
- D. Clean reinforcing from existing removed or deteriorated concrete that is shown to be incorporated in new concrete or repair mortar by mechanical means to remove loose material and products of corrosion before proceeding. Cut, bend, or lap to new reinforcing as indicated and provide with 1 inch minimum clear cover.
- E. Use following specific concrete surface preparation Methods where indicated, specified, or as directed by the Engineer:
1. Method A:
 - a. Roughen and clean existing concrete surface at connection.
 - b. Thoroughly saturate surfaces with water; prevent standing water during application.
 - c. Scrub repair mortar into substrate filling concrete pores and voids.
 - d. While scrub coat is still plastic, force repair material against surface. Use epoxy bonding agent if area is too large.
 - e. Place new repair mortar as detailed.
 2. Method B:
 - a. Roughen and clean existing concrete surface at connection.
 - b. Apply epoxy bonding agent at connection surfaces.
 - c. Place new concrete or grout mixture to limits indicated within time constraints recommended by manufacturer to ensure bond.
 3. Method C:
 - a. Use adhesive anchoring system, as specified in Section 050519 "Post-Installed Anchors", for installation of reinforcing steel dowels into existing concrete where indicated.
 - b. Perform installation complying strictly with manufacturer's recommendations, including drill bit diameter, surface preparation, injection, and installation of dowels.
 - c. Drill concrete to embedded deformed bars to indicated depths.
 - d. Use oil-free compressed air to blast out loose particles and dust from drilled holes. Clean dowels to be free of dirt, oil, grease, ice, or other deleterious material that would reduce bond.
 - e. Concrete in existing structures is considered to have a strength of 3,000 psi.
 4. Method D:

- a. Combination of Method B & Method C.

3.5 GROUTING

- A. Grout: As specified in Section 036000 “Grouting.”

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed installations.
 - 1. Perform inspection with Contractor, material installer, and the Engineer present. Give minimum of 72 hours’ notice prior to time of inspection.
 - 2. Repair modifications not in conformance with Contract Documents in accordance with manufacturer's instructions at no additional cost to Owner.
 - 3. At completion of non-conforming repairs, Contractor, material installer, and the Engineer shall reinspect the repaired problem areas.
 - 4. Prepare inspection reports, identifying acceptable work, type and locations of unacceptable work, and actions taken to correct unacceptable work.
 - 5. Complete field quality control work without additional compensation.

END OF SECTION 030130.71

This page intentionally left blank.

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Formwork for cast-in-place concrete.
2. Shoring, bracing, and anchorage.
3. Form accessories.
4. Form stripping.

- B. Related Requirements:

1. Section 032000 "Concrete Reinforcing" Reinforcing steel and required supports for cast-in-place concrete.
2. Section 033000 "Cast-in-Place Concrete".
3. Section 033500 "Concrete Finishing".
4. Section 050519 "Post-Installed Anchors" for testing of drilled in injection adhesive anchor system.
5. Section 055000 "Metal Fabrications" Product requirements for metal fabrications for placement by this Section.
6. Various Sections in Divisions 21, 22, and 23: Product requirements for fire suppression, plumbing, and HVAC items for placement by this Section.
7. Various Sections in Divisions 26, 27, and 28: Product requirements for electrical, communications, and security items for placement by this Section.
8. Section 315000 - Excavation Support and Protection: Execution requirements for shoring and underpinning required by this Section.

1.3 COORDINATION

- A. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

1.4 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on void form materials and installation requirements.

C. Shop Drawings:

1. Indicate:

- a. Formwork, shoring, and reshoring.
- b. Pertinent dimensions, openings, details of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
- c. Means of leakage prevention for concrete exposed to view in finished construction.
- d. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
- e. Procedure and schedule for removal of shores.
- f. Location and sequence of concrete placement.
- g. Form release agent.
- h. Form ties.
- i. Bond breakers.

- D. Review of submittals will be for appearance, performance, and strength of completed structure only. Approval by the Engineer will not relieve Contractor of responsibility for the strength, safety, or correctness of methods used, the adequacy of equipment, or from carrying out the work as shown on Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings with design calculations and assumptions for formwork and shoring.
2. Indicate loads transferred to structure during process of concreting, shoring, and reshoring.
3. Include signed and sealed structural calculations to support design for project records. Calculations will not be reviewed.
4. Submit completed PE Certification Form for design of formwork in accordance with Section 013300. Complete PE Certification Form and stamp by a professional engineer registered in the State where project work site exists.

- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statement:

1. Submit qualifications for licensed professional.

- E. Certify form release agent is made for use in contact with potable water (non-toxic and free of taste and odor after 30 days). Certify that form release agent complies with Federal, State and local VOC limitations.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 347, 301, and 318.
- B. For wood products furnished for Work of this Section, comply with AF&PA.

1.7 SYSTEM DESCRIPTION

- A. Delegated Design Structural Design Responsibility: Provide forms, shoring, and reshoring designed by a professional engineer registered in the State of Florida. Design formwork in accordance with the requirements of ACI 301, ACI 318 and ACI 347. Comply with all applicable regulations and codes. Consider any special requirements due to the use of plasticized and/or retarded set concrete.

1.8 QUALIFICATIONS

- A. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the State of Project location.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design, engineer, and construct formwork, shoring, and bracing according to ACI 318, ACI 347, ACI 347.2R, conforming to Florida Building Code requirements to achieve concrete shapes, lines, and dimensions as indicated and required by project conditions.

2.2 FORMS, GENERAL

- A. Make forms for cast-in-place concrete of wood, steel, or other approved materials. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing except as specified in Section 033500 "Concrete Finishing."
 - 1. Construct wood forms of sound lumber or plywood free from knotholes and loose knots.
 - 2. Construct steel forms to produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.

- B. Provide rigid forms that will not deflect, move, or leak. Design forms to withstand high hydraulic pressures resulting from rapid filling of forms and heavy high frequency vibration of the concrete. Limit deflection to 1/400 of each component span. Lay out form joints in a uniform pattern or as indicated on Drawings.
- C. Dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Tape, gasket, plug, or caulk joints and gaps in forms to provide watertight joints that will withstand placing pressures without exceeding specified deflection limit or creating surface patterns.
- D. Provide 3/4 inch chamfer on form corners unless otherwise indicated.

2.3 FORMS FOR STRUCTURAL CONCRETE

A. Plywood Forms:

- 1. Make forms for exposed and non-submerged exterior and interior concrete of new and unused Plyform exterior grade plywood panels.
- 2. Species: Douglas fir.
- 3. Grade: B grader or better.
- 4. Edges: Clean and true.
- 5. Exposed Concrete:
 - a. Comply with APA/EWA PS 1.
 - b. Panels: Full size, 4 by 8 feet.
 - c. Label each panel with grade trademark of APA/EWA
- 6. Surfaces to Receive Membrane Waterproofing:
 - a. Minimum Thickness: 5/8 inch.
 - b. Grade: APA/EWA "B-B Plyform Structural I Exterior."
- 7. "Smooth Finish" Indicated on Drawings:
 - a. Minimum Thickness: 3/4 inch.
 - b. Grade: APA/EWA "HD Overlay Plyform Structural I Exterior."
- 8. Design and construct forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing, except as specified in Section 033500 "Concrete Finishing."

B. Preformed Steel Forms:

- 1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- 2. Minimum Thickness: 16 gage.

C. FRP Forms: Matched, tightly fitted, and stiffened to support weight and pressure of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

D. Steel Forms: Description: Sheet steel, suitably reinforced.

- E. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.

2.4 FORMWORK ACCESSORIES

A. Form Ties:

1. Type: Removable.
2. Material: Stainless-Steel.
3. Length: Adjustable.
4. Furnish waterproofing washer.
5. Back Break Dimension: **1** inch.
6. Free of defects capable of leaving holes larger than 1 inch in concrete surface.
7. Coil and Wire Ties: Provide ties manufactured so that after removal of projecting part, no metal remains within 1-1/2 inch of concrete face. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a plastic or wooden cone at least 1/2 inch1/2-in diameter and 1-1/2 inch long. Provide cone washer type form ties in concrete exposed to view.
8. Flat Bar Ties for Panel Forms: Provide ties that have plastic or rubber inserts with a minimum depth of 1-1/2 inch and manufactured to permit patching of the tie hole.
9. Provide ties for liquid retaining structures that have a steel waterstop tightly attached to each strut or that have a neoprene rubber washer on each strut.
10. Alternate form ties consisting of tapered through-bolts at least 1 inch in diameter at smallest end or through-bolts that utilize a removable tapered sleeve of same minimum size may be used. Install in forms so that large end is, where applicable, on liquid or backfilled side of the wall. Clean, fill, and seal form tie hole with rubber plug installed from the liquid or backfilled side and non-shrink cement grout to provide watertight form tie holes. Make repairs needed to make watertight.

B. Spreaders:

1. Description: Standard, non-corrosive, metal-form clamp assembly of type acting as spreaders and leaving no metal within 1 inch of concrete face.
2. Wire ties, wood spreaders, or through bolts are not permitted.

C. Form Release Agent:

1. Description: Colorless form coating that will not stain concrete or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.
2. Form Release Agent. Coat form surfaces in contact with concrete with an effective, non-staining, non-residual, water based, bond-breaking form coating, unless otherwise indicated or specified. Use form release agent made for use in contact with potable water, non-toxic and free of taste and odor after 30 days. Form release agent shall not impair the bond of paint, sealant, waterproofing, dampproofing, or other coatings.
3. For concrete surfaces which are to be painted, use forms with high density overlay or a similar material which does not require a form release agent unless Contractor can

substantiate to satisfaction of the Engineer that form release agent will not remain on formed surface after it is stripped.

D. Bond Breaker:

1. Bond breakers for precast and tilt-up construction when cast against concrete shall be a non-staining, non-residual type, which will provide a positive bond prevention.
2. Acceptable Manufacturers: One of the following or equal:
 - a. Dayton Superior Specialty Chemical Corporation: Sure-Lift (J-6).
 - b. Universal Form Clamp Co: Super Clean and Tilt.
 - c. Nox-Crete Products Group: Silcoseal Select.

E. Corners, Recesses for Joint Sealant, Rustications, and Drip Edges:

1. Type: Chamfer,.
2. Provide rustications as indicated. Mill and plane smooth moldings for chamfers and rustications. Provide rustications and chamfer strips of nonabsorbent material, compatible with the form surface and fully sealed on all sides to prevent the loss of paste or water between the two surfaces.
3. Size: As indicated on drawings.
4. Lengths: Maximum possible.

F. Nails, Spikes, Lag Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork.
- B. Verify that dimensions agree with Drawings and Shop Drawings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Earth Forms: Not permitted.
- B. Formwork:
 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
 2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.

3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
4. Positioning:
 - a. Carefully verify horizontal and vertical positions of forms.
 - b. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.
6. Erect formwork, shoring, and bracing according to ACI 301, 318 and 347.
7. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
8. Install fillet and chamfer strips for corners, recesses for sealant, rustications, and drip edges exposed corners of beams, joists, columns, slabs and walls.
9. Form Release Agent:
 - a. Apply according to manufacturer instructions.
 - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
 - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
 - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
 - e. Apply form coatings before placing reinforcing steel.
10. Leave forms in place for minimum number of days according to ACI 347.
11. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and until the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces.
12. Do not remove shores until concrete has attained at least 70 percent of its specified design strength and also sufficient to support safely its own weight and the construction live load on it.
13. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
14. Stripping:
 - a. Arrange and assemble formwork to permit dismantling and stripping.
 - b. Do not damage concrete during stripping.
 - c. Permit removal of remaining principal shores.
15. Be responsible for damage resulting from removal of forms and make repairs at no additional compensation. Leave in place forms and shoring for horizontal structural members in accordance with ACI 301 and ACI 347. Conform to requirements for form removal specified in Section 033000 "Cast-in-Place Concrete."
16. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
17. Discard damaged forms.
18. Reuse and Coating of Forms:
 - a. Thoroughly clean forms and reapply form coating before each reuse.
 - b. For exposed Work, do not reuse forms with damaged faces or edges.

- c. Apply form coating to forms according to manufacturer instructions.
 - d. Do not coat forms for concrete indicated to receive "scored finish."
19. Do not patch formwork.
20. Form Cleaning:
- a. Clean forms as erection proceeds to remove foreign matter within forms.
 - b. Clean formed cavities of debris prior to placing concrete.
 - c. Flush with water or use compressed air to remove remaining foreign matter.
 - d. Ensure that water and debris drain to exterior through cleanout ports.
 - e. Cold Weather:
 - 1) During cold weather, remove ice and snow from within forms.
 - 2) Do not use de-icing salts.
 - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
- C. Forms for Smooth Finish Concrete:
- 1. Use steel, plywood, or lined-board forms.
 - 2. Use clean and smooth plywood and smooth sheet form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 - 3. Install smooth sheet form lining with close-fitting square joints between separate sheets without springing into place.
 - 4. Use full-sized sheets of smooth sheet form liners and plywood wherever possible.
 - 5. Tape joints to prevent protrusions in concrete.
 - 6. Apply forming and strip wood forms in a manner to protect corners and edges.
 - 7. Level and continue horizontal joints.
- D. Forms for Surfaces to Receive Membrane Waterproofing:
- 1. Use plywood or steel forms.
 - 2. After erection of forms, tape form joints to prevent protrusions in concrete.
- E. Framing, Studding, and Bracing:
- 1. Framing, Studding, and Bracing: Stud or No. 3 structural light-framing grade.
 - 2. Maximum Spacing of Studs:
 - a. Boards: Maximum 16 inches o.c.
 - b. Plywood: 12 inches o.c.
 - 3. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
 - 4. Construct beam soffits of material minimum 2 inches thick.
 - 5. Distribute bracing loads over base area on which bracing is erected.
 - 6. When placed on ground, protect against undermining, settlement, and accidental impact.
- F. Form Anchors and Hangers:

1. Do not use anchors and hangers leaving exposed metal at concrete surface.
2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
3. Penetration of structural-steel members is not permitted.

G. Inserts, Embedded Parts, and Openings:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
6. Install formed openings for items to be embedded in or passing through concrete Work.
7. Locate and set in place items required to be cast directly into concrete.
8. Position recessed dovetail slots for brick veneer masonry anchors according to spacing and intervals as indicated on Drawings.
9. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
10. Frame openings in concrete where indicated on Drawings.
11. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
12. Coordinate Work to avoid cutting and patching of concrete after placement.
13. Temporary Openings:
 - a. Provide temporary ports or openings in formwork as required to facilitate cleaning
 - b. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
 - c. Locate openings at bottom of forms to allow flushing water to drain.
 - d. Remove chips, sawdust, and other debris.
 - e. Thoroughly blow out forms with compressed air just before concrete is placed and inspection.
 - f. Clean forms and surfaces against which concrete is to be placed.
 - g. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.

H. Form Ties:

1. Provide sufficient strength and quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from edge of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.

I. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

J. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip, and tighten forms to conceal shrinkage.
3. Appearance:
 - a. Show no overlapping of construction joints.
 - b. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true, and sharp.

K. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.

L. Screeds:

1. Set screeds and establish levels for tops of and finish on concrete slabs.
2. Slope slabs to drain where required or as indicated on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete, thoroughly wet forms, and remove freestanding water.

M. Screed Supports:

1. For concrete over waterproof membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
2. Staking through membrane is not permitted.

N. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

3.3 TOLERANCES

- A. Construct formwork to maintain tolerances according to ACI 301 and 117.
- B. Camber:

1. According to ACI 301.

- C. Formed Surface Including Mass Concrete, Pipe Encasement, Electrical Raceway Encasement and Other Similar Installations: No minimum requirements for surface irregularities and surface alignment. The overall dimensions of the concrete shall be plus or minus 1 inch from the intended surface indicated.
- D. Rustications Exposed to View: Straight, plumb and true with a variation of no more than 1/8 inch in 10 feet measured in any direction.
- E. Formed Surfaces to be Painted: Surface irregularities limited to 1/16 inch at any point. Variation in alignment not to exceed 1/16 inch per 4 feet. Do not allow maximum deviation of finish surface at any point to exceed 1/4 inch from intended surface indicated.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection:
 - 1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
 - 2. Notify Engineer after placement of reinforcing steel in forms at least six working hours prior to proposed concrete placement.
 - 3. Schedule concrete placement to permit formwork inspection before placing concrete.
 - 4. Failure of forms to comply with specified requirements or to produce concrete complying with requirements specified shall be grounds for rejection of that portion of concrete work. Repair or replace rejected work as directed by the Engineer at no additional compensation. Make required repair or replacement subject to requirements of these Specifications and approval of the Engineer.

3.5 SCHEDULE

- A. Concrete Not Exposed to View: Site-fabricated plywood coated with form oil.
- B. Concrete Exposed to View: New and unused Plyform exterior grade plywood panels or steel forms.
- C. Supported Floor Slabs: steel forms.

END OF SECTION 031000.00

This page intentionally left blank.

SECTION 031500 - CONCRETE JOINTS AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes construction of durable, watertight joints in concrete structures.
- B. Related Requirements:
 - 1. Section 018819 “Watertightness Performance Requirements” for watertightness test of water containing structures.
 - 2. Section 030131.71 “Modifications to Existing Concrete”.
 - 3. Section 031000 “Concrete Forming and Accessories” for formwork.
 - 4. Section 032000 “Concrete Reinforcing” for reinforcing.
 - 5. Section 033000 “Cast-In-Place Concrete” for cement, and related concrete products.
 - 6. Section 033500 “Concrete Finishing” for concrete finish related work.
 - 7. Section 033600 “Grout” for grout related work.
 - 8. Section 055000 “Metals Fabrications” for various metal fabrications.

1.3 ACTION SUBMITTALS

- A. Plastic Waterstops: Product data including sample, catalogue cut, dimensions, technical data, storage requirements, splicing methods, conformity to CRD standards, details and samples of factory fabrications.
- B. Special Waterstops: Product data including location of use, sample, catalogue cut, technical data, storage requirements, splicing methods, installation instructions, and conformity to CRD, ASTM or FS standards, as applicable.
- C. Premolded Joint Fillers: Product data including location of use, sample, catalogue cut, technical data, storage requirements, and conformity to ASTM standards.
- D. Preformed Expansion Joint Material: Product data including location of use, catalogue cut, dimensions, technical data, storage requirements, installation instructions, and conformity to ASTM standards.
- E. Sealant: Product data including location of use, catalogue cut, technical data, storage requirements, mixing and application instructions, and conformity to ASTM standards.

1.4 INFORMATIONAL SUBMITTALS

A. System and Material Certificates:

1. Certify that materials used within joint system are compatible with each other.
2. Certify that sealant is made for use in continuous immersion in contact with potable water and is certified by NSF/ANSI Standard 61.
3. NSF/ANSI Standard 61 certification for plastic waterstops and preformed adhesive waterstops.

1.5 QUALITY ASSURANCE

A. Sealant Manufacturer's Field Representative Qualifications:

1. Experience: Performed at least five projects of similar size and complexity within last five years. Be present at work site prior to mixing to instruct on mixing, application, and inspection procedures. Inspect finish of prepared surfaces prior to sealant application.
2. Make at least one additional visit to site as the work progresses and report on each visit to Contractor and the Engineer. Advise whether the application is in accordance with this Section and manufacturer's printed installation instructions.

B. Installer Qualifications: Fabricator of products.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Use materials in a given joint that are compatible with one another. Coordinate selection of suppliers and products to provide compatibility. Do not use asphaltic bond breakers or asphaltic joint fillers in joints receiving sealant.
- B. Products that can come into contact with potable water shall be certified by NSF/ANSI Standard 61.
- C. Product Experience: Provide plastic waterstops and adhesive waterstops products specifically manufactured for intended purpose and have five years' successfully experience in similar applications.

2.2 MATERIALS - STANDARD WATERSTOPS

- A. Plastic Waterstops: Conform to CRD C572, fabricate by extruding elastomeric plastic compound with virgin polyvinylchloride as basic resins and with compound containing no reprocessed materials. Incorporate an integral fastening system or provide with grommets or prepunched holes between outermost ribs at a spacing of 12 inches on center.

1. Waterstops For Non-Expansion Joints and Joints Indicated:
 - a. Type: Ribbed type waterstops.
 - b. Minimum Tensile Strength: 1,750 psi per ASTM D 638.
 - c. Size: 6 inches by 3/8 inch.
 - d. Provide Greenstreak Plastic Products: Style 679 or equal:
2. Factory Fabrications:
 - a. Provide factory fabrications for waterstop changes of direction, transitions, and intersections:
 - 1) Intersections: Vertical ells, flat ells, vertical tees, flat tees, vertical crosses, flat crosses, and special, unusual, or complicated intersections including waterstop intersections of different sizes or configurations, and intersections due to joint offsets.
 - b. Make and inspect factory fabrications by waterstop manufacturer.
 - c. Provide stub ends of sufficient length to leave only straight butt joints for field splicing.
3. Provide waterstops certified by NSF/ANSI Standard 61.

2.3

2.3 MATERIALS - SPECIAL WATERSTOPS

A. Expansive Waterstops for Construction Joints Where Indicated:

1. Type B - Preformed Hydrophilic Rubber Strips:
 - a. Installation Adhesives: Use with expansive waterstops as recommended by waterstop manufacturer.
 - b. Acceptable Manufacturers: Provide products manufactured by one of the following or equal:
 - 1) Greenstreak Plastic Products: Hydrotite CJ-1020-2K.

2.4 MATERIALS - ACCESSORIES

A. Premolded Joint Filler - Structures: ASTM D 1752, Type III, self-expanding cork.

1. Thickness: 1 inch, unless otherwise indicated.

B. Bond Breaker:

1. Bond Breaker Tape: Adhesive-backed glazed butyl or polyethylene tape that adheres to premolded joint filler or concrete surface. Provide tape of same width as the joint.
2. Bond breaker for concrete other than where tape is indicated or specified: Either bond breaker tape or a non-staining type bond prevention coating.
 - a. Acceptable Coating Manufacturers: Provide products manufactured by one of the following or equal:

- 1) Cresset Chemical Company: Crete-Lease Bond Breaker for Tilt-Up.
 - 2) Dayton Superior: Sure-Lift J-6 WB.
 - 3) Nox-Crete: Silcoseal Select.
- C. Preformed Expansion Joint Material: Non-extrudable watertight strip material used to fill expansion joints between structures meeting following criteria:
1. Compressibility: Capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in first 30 minutes after unloading.
 2. Basis-of-Design: Provide products as manufactured by Chase Construction Products, or equal:
 - a. Phyzite 380.
- D. Grout: Non-metallic, non-shrinking as specified in Section 033600 "Grouting."

2.5 MATERIALS - SEALANTS

- A. Sealant:
1. Comply with ASTM C 920 for following conditions:
 - a. Sealant for Joints in Horizontal Surfaces: Type S or M, Grade P or NS, Class 25.
 - b. Sealant for Joints in Sloping and Vertical Surfaces: Type S or M, Grade NS, Class 25.
 - c. Sealant in Pedestrian and Vehicular Traffic Areas: Use T₁.
 - d. Sealant in Non-Traffic Areas: Type S or M, Grade P, Use NT.
 2. Provide sealants made for use in continuous immersion in contact with potable water and certified by NSF/ANSI Standard 61. Provide gray colored sealants unless otherwise indicated, specified, or approved.

PART 3 - EXECUTION

3.1 INSTALLATION - WATERSTOPS, GENERAL

- A. Install waterstops for joints indicated and according to manufacturer's published installation instructions and approved submittals.
- B. Include waterstops continuous around corners and intersections to provide a continuous seal.
- C. Provide a minimum number of connections or splices. Replace connections or splices that do not meet specified requirements at no additional cost to Owner.
- D. Secure waterstops in joints before concrete is placed.
- E. Install plastic waterstops so that half of width is embedded on each side of joint. Provide waterstops completely embedded in void-free concrete.

- F. Terminate waterstops 2 inch below exposed top of walls.
- G. Protect waterstops from damage in intervals between placing waterstops and subsequent placing of concrete. Replace damaged or punctured waterstops at no additional cost to Owner.
- H. Protect plastic waterstops from sunlight when exposed more than 30 days between concrete placements.
- I. Provide waterstops free from form release agent, bond breaker, dirt, concrete splatter, ice, mortar, paint, or other deleterious material that could reduce or destroy bond between waterstop and adjacent concrete.

3.2 INSTALLATION - PLASTIC WATERSTOPS

- A. Field Splices: Make only straight butt joints. Fabricate splices on a bench.
 - 1. Use a power saw and guide to cut straight ends to be spliced.
 - 2. Heat fuse weld splices using a Teflon coated thermostatically controlled waterstop splicing iron following manufacturer's recommendations.
 - 3. Provide finished splices having a cross-section that is dense and free of porosity. Engineer may conduct destructive tests of splices by cutting along one-half of splice length and by cutting perpendicular to splice at several locations on remaining half of splice length.
 - 4. Completed Splices: Exhibit a continuous and uniform bead of excess melted material with welded material looking similar to parent material.
 - 5. Show no misalignment of ribs greater than 1/16 inch, lack of fusion, porosity, pinholes, cracks, charred or burnt material, bubbles, or separation of cooled splice when bent by hand. If a splice displays any of these defects, reject the splice, recut back at least 1 inch from rejected splice on each side, and reweld.
- B. Secure waterstops in wall joints before concrete is placed. If waterstop does not incorporate an integral fastening system, grommets, or prepunched holes, drill holes in waterstops between outermost ribs at each edge. Center waterstop in the joint. Tie both edges of waterstop to reinforcing steel with tie wire as specified for tying reinforcing steel. Secure waterstop centered on and perpendicular to joint and to maintain its position during concrete placement.
- C. Space waterstop ties to match spacing of adjacent reinforcing, but ties need not be spaced closer than 12 inches on center.
- D. Clamp horizontal waterstops in slabs in position with form bulkhead, unless previously set in concrete. Lift waterstop edge while placing concrete below the waterstop. Manually force waterstop against and into placed concrete and cover with fresh concrete, to provide complete encasement of waterstop in concrete.

3.3 INSTALLATION - SPECIAL WATERSTOPS

- A. Install special waterstops at joints only where specifically indicated on Drawings. Provide waterstops continuous around corners and intersections to provide a continuous seal.
- B. Use waterstops of maximum practicable length to provide a minimum number of joints, connections, or splices. Make joints, connections, and splices conforming to manufacturer's recommended.
- C. Expansive Type and Preformed Adhesive Waterstops:
 - 1. Clean and prepare joint surfaces, install primers or adhesives, and install Type B expansive waterstops on dry surfaces in accordance with manufacturer's instructions, including concrete cure, temperature conditions, and splices.
 - 2. Use mechanical fasteners to secure Type B expansive waterstops to previously placed vertical and overhead concrete surfaces and other locations, as recommended by manufacturer. Protect installed waterstops from moisture and keep dry until subsequent placement of concrete.

3.4 INSTALLATION - CONSTRUCTION JOINTS

- A. Make construction joints only at locations indicated or as approved by the Engineer. Submit additional or relocation of construction joints proposed by Contractor to the Engineer for written approval. Do not eliminate construction joints.
- B. Locate additional or relocated joints where they least impair member strength. In general, locate joints within middle third of spans of slabs, beams, and girders.
 - 1. Locate joints in walls and columns at underside of floors, slabs, beams, or girders and at tops of footings or floor slabs.
- C. Unless otherwise indicated, provide joints perpendicular to main reinforcement. Continue reinforcing steel through joint as indicated.
- D. Provide waterstops in wall and slab construction joints in liquid retaining structures and at other locations indicated.
- E. Roughened Construction Joints:
 - 1. At construction joints and at concrete joints indicated, uniformly roughen concrete surface with chipping tools to expose a fresh face 1/4 inch of a full amplitude, distance between high and low points and side to side.
 - 2. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding.
 - 3. At least two hours before and again shortly before new concrete is deposited, saturate joints with water.
 - 4. After glistening water disappears, coat joints with neat cement slurry mixed to consistency of very heavy paste. Apply a coating to surfaces at least 1/8 inch, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before neat cement dries.

3.5 INSTALLATION - PARTIAL CONTRACTION JOINTS

- A. Make partial contraction joints at locations indicated. Do not eliminate or relocate partial contraction joints.
- B. Provide waterstops, sealant grooves, and sealants in wall and slab partial contraction joints in liquid retaining structures and at other locations indicated.
- C. Extend every other bar of reinforcing steel through partial contraction joints or as indicated on Drawings. Coat concrete surface with a bond breaker prior to placing new concrete against it as indicated on Drawings.
 - 1. Do not coat reinforcement or waterstops with bond breaker. Mask waterstops and reinforcing passing through joint to prevent bond breaker from running or dripping on to them. Remove masking prior to concrete placement.

3.6 INSTALLATION - SEALANTS

- A. Install sealants in clean dry recesses free of frost, oil, grease, form release agent, loose material, laitance, dirt, dust, and other deleterious materials that will impair bond.
- B. Apply sealant conforming to manufacturer's recommendations including concrete cure, temperature, moisture, mixing, primer, primer cure time, joint and recess preparation, tooling, and curing.
- C. Apply masking tape to each side of joint prior to sealant installation. Remove masking tape afterwards, along with any spillage to leave a sealant installation with neat straight edges.

3.7 INSTALLATION - PREFORMED EXPANSION JOINT MATERIAL

- A. Install preformed expansion joint material in conformance with manufacturer's recommendations; including surface preparation, adhesive installation, heat welding, and set time.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect system components verifying that installation conforms to manufacturer's installation instructions.
 - 1. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

- A. Clean adjacent surfaces removing excess spills.
- B. Protect installed products until subsequent work is installed. For exposed materials, protect from damage until Substantial Completion.

END OF SECTION 031500

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Reinforcing bars.
- 2. Welded wire fabric.
- 3. Reinforcement accessories.

- B. Related Requirements:

- 1. Section 031000 - Concrete Forming and Accessories: Form materials, and accessories required to form cast-in-place concrete.
- 2. Section 033000 - Cast-in-Place Concrete: Cast-in-place concrete.
- 3. Section 033500 - Concrete Finishing: Reinforcement for concrete floor toppings.

1.3 COORDINATION

- A. Coordinate Work of this Section with placement of formwork, formed openings, masonry dowels, and other Work.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.

- B. Shop Drawings:

- 1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel.
- 2. Indicate bending and cutting schedules.
- 3. Indicate supporting and spacing devices.
- 4. Placement Drawings:
 - a. Walls: Show elevations from outside, looking towards the structure, at a minimum scale of 1/4 inch to one foot.
 - b. Slabs: Show top and bottom reinforcement on separate plan views, as needed for clarity.

- c. Show additional reinforcement around openings, at corners and at other locations indicated, diagrams of bent bars, arrangements and assemblies, all as required for the fabrication and placement of concrete reinforcement.
- d. Reference bars to same identification marks shown on bar bending details. Identify bars to have special coatings or to be of special steel or special yield strength.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Submit certified copies of mill test report of reinforcement materials analysis.
- C. Certified copy of test reports for each foreign manufactured steel proposed for use. Provide tests specifically made for this project by a domestic independent testing laboratory certified to perform the tests. Test for conformity to applicable ASTM Standard.
- D. Certified copy of test results for compliance for galvanized reinforcement and accessories. Submit test report indicating weight of nickel-zinc and applicable ASTM Standard.
- E. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 318.
- B. Prepare Shop Drawings according to ACI SP-66.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Ship and store reinforcement with bars of same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing same "mark" designations as those shown on submitted placement drawings. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture by storing off ground, in clean, and dry location.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Comply with ASTM A 615.
2. Yield Strength: 60 ksi.
3. Billet Bars: Deformed.
4. Finish: Uncoated.

2.2 FABRICATION

- A. Fabricate concrete reinforcement according to ACI 318.
- B. Form standard hooks for 180-degree bends, 90-degree bends, stirrups and tie hooks as indicated.
- C. Form reinforcement bends with minimum diameters according to ACI 318.
- D. Bend bars cold. Do not straighten or rebend bars.
- E. Bend bars around a revolving collar having a diameter not less than that recommended by the CRSI or ACI 318.
- F. Saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Terminate saw cut ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.
- G. Fabricate column reinforcement with offset bends at reinforcement splices.
 1. Provide a minimum of 1-1/2 finishing turns at the top and bottom.
 2. Splices. Provide tension lap splices at least 48 bar diameters, but not less than 12 inches in length. Do not use welded splices unless specifically approved by the Engineer.
 3. Provide spacers as recommended by the CRSI.
- H. Form ties and stirrups as indicated

2.3 ACCESSORY MATERIALS

A. Tie Wire:

1. Minimum 16 gage, annealed type. Use black wire to tie uncoated reinforcing.
- B. Reinforcing Steel Accessories:
1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.
 2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.
 3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with CRSI 10-MSP for surface condition, bending, spacing and tolerances of placement for reinforcement. Provide the amount of reinforcing indicated at the spacing and clearances indicated on the Drawings.
- B. Coat uncoated reinforcement which will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.
- C. Do not weld reinforcing steel bars either during fabrication or erection. Remove immediately all bars that have been welded, including tack welds, without such approval.
- D. Reinforcing steel interfering with the location of other reinforcing steel, piping, conduits or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Obtain the approval of the Engineer if greater displacement of bars to avoid interference is needed. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- E. Place, support, and secure reinforcement against displacement. Secure dowels in place before placing concrete.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- G. Do not deviate from required position beyond specified tolerance.
- H. Do not field bend reinforcing unless indicated or specifically authorized in writing by the Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace damaged at no additional cost to Owner. Do not bend reinforcement after it is embedded in concrete unless indicated.
- I. Do not displace or damage vapor retarder.
- J. Chairs, Bolsters, Bar Supports, and Spacers:
1. Size and Shape: To support reinforcement and prevent displacement of reinforcing during concrete placement conditions.

2. Use precast concrete blocks where reinforcing steel is to be supported over soil.
3. Use plastic protected bar supports or steel supports with plastic tips where reinforcing steel is to be supported on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use stainless-steel supports or plastic tipped metal supports in all other locations unless otherwise noted on the Drawings or specified herein.
4. Provide #5 minimum size support bars. Do not reposition upper bars in a bar mat for use as support bars.
5. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

K. Spacing:

1. Space reinforcement bars with minimum clear spacing according to ACI 350.
2. If bars are indicated in multiple layers, place upper bars directly above lower bars.

L. Splicing:

1. Tension Members: Avoid splicing of reinforcing steel in concrete elements indicated as "tension members." Offset splices in adjacent bars the distance of a Class B splice or 30 inches, whichever is greater.
2. Welded Wire Fabric: Provide lap splices in accordance with the requirements of ACI 318 but not less than 12 inches. Tie the spliced fabrics together with wire ties spaced not more than 24 inches on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.
3. Locate reinforcement splices at point of minimum stress, unless indicated otherwise.
4. Obtain approval of splice locations from Engineer.

M. Bond and ground reinforcement as specified in Section 260600 - Grounding System.

N. Place dowels for concrete masonry units in accordance with approved placement drawings.

3.2 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Install reinforcement within following tolerances for flexural members, walls, and compression members:

1. Reinforcement Depth Greater Than 8 Inches:
 - a. Depth Tolerance: Plus or Minus 3/8 inch.
 - b. Concrete Cover Tolerance: Minus 3/8 inch.
2. Reinforcement Depth Less Than or Equal to 8 Inches:
 - a. Depth Tolerance: Plus or Minus 1/2 inch.

- b. Concrete Cover Tolerance: Minus 1/2 inch.

3.3 FIELD QUALITY CONTROL

- A. Inspection by Engineer: When reinforcing is complete and ready for inspection, notify Engineer at least six working hours prior to proposed concrete placement.
- B. Do not cover reinforcing steel with concrete until reinforcement, including the size, spacing and position has been inspected by the Engineer and the Engineer's release to proceed with concreting has been obtained. Keep forms open until the Engineer has completed inspection of the reinforcement.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Cast-in-Place Concrete for various items indicated in Contract Documents.
- B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of the Contractor. Provide field sampling, testing, inspection and related laboratory tests.
- C. Related Requirements:
 - 1. Section 031000 - Concrete Forming and Accessories: Formwork and accessories.
 - 2. Section 032000 - Concrete Reinforcing: Requirements for reinforcing steel and supports.
 - 3. Section 031500 - Concrete Joint and Joint Accessories.
 - 4. Section 033500 - Concrete Finishing: Finishing of concrete floor and wall surfaces.
 - 5. Section 033900 - Concrete Curing: Curing of concrete surfaces.
 - 6. Various Sections in Division 07: Preparing concrete surfaces to receive dampproofing and waterproofing.
 - 7. Various Sections in Divisions 21 through 23: Mechanical items for casting into concrete.
 - 8. Various Sections in Divisions 26 through 28: Electrical items for casting into concrete.

1.3 COORDINATION

- A. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.4 ACTION SUBMITTALS

- A. Submit, in accordance with Section 013300, product data for:
 - 1. Sources of cement, fly ash or ground granulated blast furnace slag, aggregates, and batched concrete. Indicate name and address of mill, quarry, or plant.
 - 2. Air entrainment admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
 - 3. Water reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.

4. Cold weather and hot weather concreting plans demonstrating how concrete will meet the requirements of this Section including but not limited to concrete mixes, placement, curing and protection.
 5. Crystalline waterproofing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
- B. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.
- C. Samples: Fine and coarse aggregates, if requested for examination by the Engineer.

1.5 INFORMATIONAL SUBMITTALS

A. Test Reports:

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, deleterious substance content, and mortar bar expansion test results.
2. Cement and fly ash or ground granulated blast furnace slag: Conformance to ASTM standards, including chemical analysis and physical tests.
3. Concrete Mixes: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard, water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. Provide either subparagraph a. or b., below, for each mix proposed.
 - a. Standard deviation data for each proposed concrete mix based on statistical records. Provide the following for each strength data point used in the calculation of the standard deviation for determination of the minimum required average strength:
 - 1) Date of sampling and name of testing laboratory.
 - 2) Name of concrete batch plant.
 - 3) Water cementitious ratio.
 - 4) Slump of batch.
 - 5) Air content of batch.
 - 6) Compressive strengths of all cylinders tested at that age in that batch.
 - 7) If available, temperature and unit weight of batch.
 - 8) Provide data from projects not more strictly controlled than outlined in these specifications. Provide summary sheet showing all pertinent data and the computation of the standard deviation.
 - b. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at 7, 14, and 28 days for laboratory concrete mix designs.
4. Concrete Mixes: shrinkage.

B. Certifications:

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify admixtures are made for use in concrete in contact with potable water after 30 days of concrete curing.
3. Certify that Contractor is not associated with independent testing laboratory proposed for use by Contractor nor does Contractor or its officers have a beneficial interest in the laboratory.
4. Certify that cement is produced by a manufacturer that does not use hazardous waste derived fuel as an energy source for its kilns.
5. Certificate of conformance for concrete production facilities from the NRMCA.

C. Qualifications:

1. Independent Testing Laboratory:
 - a. Name and address
 - b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
 - c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
 - d. Names and qualifications of the supervising laboratory technicians.
 - e. Statement of conformance provided by evaluation authority defined in ASTM C 1077. Provide report prepared by evaluation authority when requested by the Engineer.
 - f. Submit as required above for other organizations that will provide external technical services.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017300 - Execution: Requirements for submittals.
- B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.7 QUALITY ASSURANCE

- A. Comply with ACI 318 and ACI 350 and other stated specifications, codes and standards. Apply the most stringent requirements of other stated specifications, codes, standards, and this Section when conflicts exist.
- B. Independent Testing Laboratory: Meet requirements of ASTM E 329 and ASTM C 1077. Do not use laboratories affiliated and having a beneficial interest with Contractor or its officers.
- C. Provide concrete uniform in color and appearance.
- D. Preconstruction Meeting: At least 10 working days before first concrete placement, hold a meeting to review concrete placement requirements, waterstop placement, jointing, concrete curing, hot and cold weather concreting, and finishing. Review, with the attendance of the plasticizer manufacturer, the properties and techniques of batching and placing concrete

containing high-range water-reducing admixture. Notify all parties involved, including the Engineer, of the meeting at least 10 working days prior to its scheduled date. Prepare an agenda for the meeting. Take meeting minutes and distribute to meeting attendees.

- E. If during work progress, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the specified properties. Make ordered changes without additional compensation.
- F. If during work progress, materials from the sources originally accepted change in characteristics, make new acceptance tests of materials and establish new concrete mixes with assistance of an independent testing laboratory, without additional compensation.
- G. Provide field testing and inspection services and related laboratory tests. Perform testing methods conforming to latest applicable ASTM methods. Test following items to verify conformity with this Section:
 - 1. Concrete Placements: Compressive strength (cylinders), temperature, slump, and air content.
 - 2. Other materials that may require field testing.
- H. Concrete Placement: Compressive strength (cylinders), temperature, slump, and air content.
- I. Samples of constituents and as-placed concrete will be subjected to laboratory tests by Owner. Materials incorporated in the work shall conform to accepted samples.
- J. Perform Work according to ACI 301, 318 and 350.
- K. Comply with ACI 305R when placing concrete during hot weather.
- L. Comply with ACI 306.1 when placing concrete during cold weather.
- M. Acquire cement and aggregate from one source for Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic Portland cement conforming to ASTM C 150. Do not use air entraining cements. Do not use cement produced by a manufacturer that uses hazardous waste derived fuel as an energy source for its kilns. Cement brand must be approved by the Engineer and one brand shall be used throughout the work.
 - 1. Comply with ASTM C150, Type II - Moderate Sulfate Resistant.
 - 2. Type: Portland.
- C. Aggregates:

1. Fine Aggregate: Washed inert natural sand conforming to ASTM C 33.
 2. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C 33. Grading requirements are listed in ASTM C 33, Table 3 for the specified coarse aggregate size number listed in Table 1. Limits of deleterious substances and physical property requirements are listed in ASTM C 33, Table 4 for severe weathering regions. Do not use coarse aggregates known to be deleteriously reactive with alkalis in cement.
 3. Fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C 1260 and using project proposed cement. If aggregates proposed do not meet this requirement, then satisfy subparagraph a. below.
 - a. Total equivalent alkali content of the cement: Do not exceed 0.60 percent as provided in the Optional Chemical Requirements of ASTM C 150.
- D. Water:
1. Comply with ACI 318 and ACI 350.
 2. Potable, without deleterious amounts of chloride ions.
- E. Admixtures: Use admixtures free of chlorides and alkalis, except for those attributable to drinking water. Provide admixtures from same manufacturer when it is required to use more than one admixture in the same concrete mix. Use admixtures compatible with concrete mix including other admixtures and made for use in concrete in contact with potable water after 30 days of concrete curing. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from the Engineer. Use retarding or accelerating water reducing admixtures when so approved.
1. Air Entrainment: Comply with ASTM C260.
 2. Chemical:
 - a. Comply with ASTM C 494.
 - b. Type A - Water Reducing.
 - c. Type F - Water Reducing, High Range.
 3. Plasticizing:
 - a. Comply with ASTM C 1017
 - b. Type I, plasticizing.
 4. Crystalline Waterproofing (Clearwell No.2 top slab only):
 - a. Xypex Admix, by Xypex Chemical Corporation, Richmond, B.C., Canada.
- F. Supplementary Cementitious Materials:
1. Fly Ash: Class F fly ash complying with ASTM C 618, including the requirements of Table 1 but with the Loss on Ignition (LOI) limited to 3 percent maximum and the optional physical requirements of Table 3. Test in compliance with ASTM C311 with a minimum of one sample weighing four pounds taken from each 200 tons of fly ash supplied for the project.

2. Ground Granulated Blast Furnace Slag: Grade 100 or Grade 120 ground granulated blast furnace slag complying with ASTM C 989. Provide ground granulated blast furnace slag from a single source and uniform in color. Mill test reports submitted must be within 6 months of submittal date.
3. Silica Fume: Comply with ASTM C 1240.

2.2 CONCRETE MIX

- A. Engage an independent testing laboratory to establish concrete mixes and perform sampling and laboratory testing of products and materials.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce placeable, durable concrete conforming to these specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.
- C. Base concrete mixes on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.
 1. For concrete mixes based on standard deviation data of prior mixes, submit standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318, ACI 350 and based on the modification factors for standard deviation tests contained in ACI 318 and ACI 350.
 2. For concrete mixes developed by laboratory testing, base cementitious content of the concrete on curves showing the relation between water cementitious ratio and 7, 14 and 28-day compressive strengths of concrete made using the proposed materials. Determine curves by four or more points, each representing an average value of at least three test specimens and one water-cementitious ratio at each age. Provide curves with a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. Cementitious content of the concrete mixes to be used, as determined from the curve, shall correspond to the required average compressive strength in Table 5.3.2.2 of ACI 318. Resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 1.
- D. Test fly ash or ground granulated blast furnace slag and concrete mixture to provide test data confirming that materials in combination with the cement meet strength requirements and are compatible with other concrete additives.
- E. Test aggregates for potential alkali reactivity in accordance with ASTM C 1260. If initial testing indicates aggregates are not potentially reactive repeat test at three-month intervals.
- F. Compression Tests: Provide testing of the proposed concrete mixes to demonstrate compliance with compression strength requirements in conformity with the provisions of ACI 318.
- G. Entrained Air: Measure by ASTM C 231 as shown in Table 1.

1. If proposed air entrainment admixture requires testing methods other than ASTM C 231 to accurately determine air content, make special note of this requirement in admixture submittal specified under Paragraph 1.4, A.
- H. Concrete Slump: Measure by ASTM C 143 as shown in Table 1. If a high-range water-reducing admixture (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 inches to 10 inches.
- I. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).
- J. Where Type III cement is approved, use concrete conforming to Table 1, except attain design strength at 7 days.

TABLE 1

Class	Design Strength 1	Cement 2	Fine Aggregate 3	Coarse Aggregate 3	Cementitious Content 4
B	3000	Type II	Sand	57	480
E2	4500	Type II	Sand	57	580
E3	4500	Type II	Sand	67	610

Class	W/C Ratio 5	SCM 6	AE Range 7	WR 8	HRWR 9	Slump Range Inches
B	0.54 max.	Yes	3.5 to 5	Yes	No	1-3
E2	0.42 max.	Yes	3.5 to 5	Yes	No	3-5
E3	0.42 max.	Yes	3.5 to 5	Yes	No	3-5

TABLE NOTES:

1. Minimum compressive strength in psi at 28 days.
2. ASTM designation in ASTM C 150.
3. Size Number in ASTM C 33.
4. Minimum cementitious content in lbs per cubic yard where fly ash or ground granulated blast furnace slag is used cementitious content is defined as cement content plus fly ash or ground granulated blast furnace slag content.
5. W/C is Maximum Water Cementitious ratio by weight.
6. Supplementary Cementitious Material (SCM) fly ash content in the range of 20-25 percent of the total cement content plus fly ash content, by weight. If ground granulated blast furnace slag is used in lieu of fly ash, the content of ground granulated blast furnace slag shall be in the range of 25-45 percent of the total cement plus ground granulated blast furnace slag content, by weight.

7. AE is percent air entrainment.
 8. WR is water reducing admixture.
 9. HRWR is high-range water-reducing admixture. Use of HRWR must be Approved by Engineer.
- K. Shrinkage Tests: Perform shrinkage tests on the design mix for Class E2 and Class E3 concrete. The tests shall conform to ASTM C157 as modified by ASTM C 596 for curing, storage, and comparator readings. Use concrete specimens. Do not use mortar specimens.
1. Average Shrinkage: At 25 days of air storage do not exceed 0.036 percent.
 2. Make tests with at least three different brands of cement. Only brands demonstrating a shrinkage value within 10 percent of the brand with the lowest shrinkage value at 25 days of air storage will be acceptable.
- L. Admixtures:
1. Include admixture types approved by Engineer and their quantities in concrete mix designs.
 2. Cold Weather:
 - a. ASTM C 494 Type E admixture may be used in cold weather, if approved by the Engineer.
 - b. Use of admixtures will not relax cold-weather placement requirements.
 3. Hot Weather:
 - a. ASTM C 494 Type D admixture may be used in hot weather, if approved by the Engineer.
 - b. Use of admixtures will not relax hot-weather placement requirements.
 4. Do not use calcium chloride or admixtures containing calcium chloride.
 5. Add air entrainment admixture to all concrete.
 6. Add water reducing admixture to all concrete.
 7. Add Crystalline Waterproofing admixture to Clearwell No. 2 top slab only
- M. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C 94.

PART 3 - EXECUTION

3.1 MEASURING MATERIALS

- A. Provide concrete composed of Portland cement, fly ash or ground granulated blast furnace slag, fine aggregate, coarse aggregate, water and admixtures as specified and produced by a plant complying with ACI 318 and ASTM C 94. Batch all constituents, including admixtures, at the plant. When a High-range water reducing admixture is approved it may be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within tolerances given in ASTM C 94 except as otherwise specified. Use scales last certified by the local Sealer of Weights and Measures within one year of use.

- C. Weigh cement and fly ash or ground granulated blast furnace slag in individual weigh batchers that are separate and distinct from weigh batchers used for other materials. When cement and fly ash or ground granulated blast furnace slag are weighed in a cumulative weigh batcher, the cement shall be weighed first.
- D. Measure the amount of free water in fine aggregates within 0.5 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record number of gallons of water as-batched on printed batch tickets.
- E. Dispense admixtures either manually using calibrated containers or measuring tanks or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air entrainment and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.2 MIXING AND TRANSPORTING

- A. Provide ready-mixed concrete produced by equipment complying with ACI 318 and ASTM C 94 and produced by a plant certified by the NRMCA. Do not hand-mix. Use truck mixers carrying a rating plate conforming to TMMB 100. Clean each transit mix truck drum and reverse drum rotation before truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Transport ready-mix concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- C. Keep water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Incorporate water directed to be added by additional mixing of at least 50 revolutions at mixing speed after the addition of all water. Meter all added water and show the amount of water added on each delivery ticket.
- D. Comply with ACI 318 and ASTM C 94 for central plant and rolling stock equipment and methods.
- E. Select equipment of size and design to provide continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding one vertical to two horizontal and not less than one vertical to three horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Do not retemper (mix with or without additional cement, aggregate, or water) concrete or mortar which has partially hardened.
- G. Handle concrete from mixer to placement providing concrete of specified quality in the placement area and not exceeding the maximum time interval specified in Paragraph 3.2 N.4. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required to avoid excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Remix for a minimum of 5 minutes prior to discharge or testing.

- H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Indicate for each batch the weight of fine and coarse aggregate, cement, fly ash or ground granulated blast furnace slag, and water, moisture content of fine and coarse aggregate at time of batching, and types, brand and quantity of each admixture, the quantity of concrete delivered, the time any water is added and the amount, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.
- I. Temperature and Mixing Time Control:
 - 1. In cold weather (see Paragraph 3.8, C) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 3.
 - 2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
 - 3. In hot weather (see Paragraph 3.8, D), cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. Well-crushed ice may be substituted for all or part of the mixing water.
 - 4. Maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed the values shown in the following Table 2:

TABLE 2

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER)	MAXIMUM TIME
--	-----------------

(27 Degree C) 80 Degree F to 90 Degree F (32 Degree C)	45 minutes
(21 Degree C) 70 Degree F to 79 Degree F (26 Degree C)	60 minutes
(5 Degree C) 40 Degree F to 69 Degree F (20 Degree C)	90 minutes

- 5. If an approved high-range water-reducing admixture (plasticizer) is used to produce plasticized concrete, the maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed 90 minutes.

3.3 EXAMINATION

- A. Section 017300 - Execution: Requirements for installation examination.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, piping, electrical conduits and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.
- D. At all times batch, mix, transport, place, and cure concrete to the inspection of the Engineer. Advise the Engineer of readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting, including preparation of previously

placed concrete, reinforcing and alignment, cleanliness, and tightness of formwork. Do not place concrete without the inspection and acceptance of the Engineer.

3.4 EMBEDDED ITEMS

- A. Secure to forms as required or set for embedment as required, miscellaneous metal items, sleeves, reglets, anchor bolts, anchors, inserts and other items furnished under other Sections and required to be embedded into concrete. Set and secure such items in the locations and alignments needed so they are not displaced by concrete placement.
- B. Clean embedded items free of rust, mud, dirt, grease, oil, ice, or other contaminants which would reduce or prevent bonding with concrete.
- C. Coat or isolate all aluminum embedments to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- D. Do not embed piping in concrete unless indicated on Drawings.
- E. Fabricate piping and conduit such that cutting, bending, or relocation of reinforcing steel is not required. Satisfy the following for pipes and conduits embedded within a slab or wall (other than those merely passing through), unless otherwise indicated on Drawings or approved:
 - 1. Maximum outside dimension of pipe or conduit: Be not greater than one third the overall thickness of slab or wall.
 - 2. Spacing of pipes or conduits: Be greater than or equal to three diameters or widths on center.
- F. Close open ends of piping, conduits, and sleeves embedded in concrete with caps or plugs prior to placing concrete.
- G. Ensure specified tests and inspections on embedded piping are completed and satisfactory before starting concrete placement. Ensure mechanical or electrical tests and inspections are completed and satisfactory prior to starting concrete placement. Do not place concrete until unsatisfactory items and conditions have been corrected.
- H. Position embedded anchor bolts using templates.
- I. Correct embedded items not installed in the location or alignment needed or displaced by concrete placement without additional compensation.

3.5 PREPARATION

- A. Section 017300 - Execution: Requirements for installation preparation.
- B. Previously Placed Concrete:
 - 1. Prepare joints as specified in Section 031500 - Concrete Joints and Accessories.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.

- D. Remove water from areas receiving concrete before concrete is placed.

3.6 CONCRETE APPEARANCE

- A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Reject remixed concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Make, at no additional cost to the Owner, changes in the concrete mix design for future deliveries only by adjusting one or more of the following if the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finish ability are observed:
 - 1. Gradation of aggregate.
 - 2. Proportion of fine and coarse aggregate.
 - 3. Percentage of entrained air, within the allowable limits.
- B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified in Section (03 35 00).

3.7 INSTALLATION

- A. Placing Concrete:
 - 1. Place concrete according to ACI 301, 318 and 350.
 - 2. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
 - 3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints, and are not disturbed during concrete placement.
 - 4. Verify that formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, standing water, dirt, debris, and other foreign materials from forms and exposed joint surfaces. Confirm that reinforcement and other embedded items are securely in place. Have a worker at the location of the placement who can check that reinforcement and embedded items remain in designated locations and alignments while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Do not place concrete on frozen subgrade, snow, or ice.
 - 5. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Place concrete continuously at a rate that allows the concrete previously placed to be integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
 - 6. Pumping of concrete will be permitted. Use a mix design and aggregate sizes chosen for pumping and submit for approval. Do not use pipelines made of aluminum or aluminum alloy. When concrete is pumped, determine slump at point of truck discharge and determine air content at point of placement.

7. Remove temporary spreaders from forms when the spreader is no longer needed. Temporary spreaders may remain embedded in concrete only when made of galvanized steel or concrete and if prior approval has been obtained.
8. Do not place concrete for supported elements until concrete previously placed in the supporting element has attained design strength.
9. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms to bring the full surface of the mortar against the form. Prevent the formation of surface voids.
10. Slabs:
 - a. After bulkheads, screeds and jointing materials have been positioned, place concrete continuously between joints beginning at a bulkhead, edgeform, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in placement. If there is a delay in placement, spade and consolidate concrete placed after the delay at the edge of previously placed concrete to avoid cold joints. Bring concrete to correct level and strike off with a straightedge. Use bullfloats or darbies to smooth the surface, leaving it free of humps or hollows.
 - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow one hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep top surface of the wall moist to prevent cold joints.
11. Formed Concrete:
 - a. Place concrete in forms using tremie tubes taking care to prevent segregation. Maintain bottom of tremie tubes near the surface of concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12 inch to 24 inch lifts, keeping the surface horizontal. If a high-range water-reducing admixture is used do not permit concrete to drop freely more than 15 feet; maximum lift thickness not to exceed 7 feet.
12. Bollards: Conform to requirements specified above for formed concrete and completely fill pipe with concrete as indicated.
13. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
14. Place floor slabs in indicated saw-cut pattern.

B. Compacting:

1. Consolidate concrete by vibration and puddling, spading, rodding, or forking so that concrete is completely worked around reinforcement, embedded items and openings and into corners of forms. Continuously perform puddling, spading, rodding, and forking along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting, or planes of weakness.
2. Compact concrete with mechanical vibrators. Do not order concrete until vibrators (including standby units in working order) are on the job. Use mechanical vibrators having a minimum frequency of 8000 vibrations per minute. Insert vibrators and withdraw at points from 18 inches to 30 inches apart. Vibrate sufficiently at each

- insertion to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep standby vibrators on the site during concrete placing operations.
3. Concrete Slabs: Vibrate concrete slabs less than 8 inch thick by vibrating screeds. Vibrate concrete slabs 8 inches and thicker by internal vibrators and (optionally) with vibrating screeds. Place vibrators into concrete vertically. Do not lay vibrators horizontally or lay over.
 4. Walls and Columns: Use internal vibrators rather than form vibrators, unless otherwise approved by the Engineer. General: for each vibrator needed to level the batch at the point of discharge, use one or more additional vibrators to densify, homogenize, and perfect the surface. Insert vibrators vertically at regular intervals, through fresh concrete and slightly into the previous lift, if any.
 5. Amount of Vibration: Use vibrators to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:
 - a. Frequency of vibrator returns to normal.
 - b. Surface appears liquefied, flattened and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into surface but has not disappeared.

3.8 PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Protect finished surfaces and slabs whenever ambient conditions of humidity, temperature, sunlight and wind may result in the rapid evaporation of water from the concrete, to prevent checking and crazing, until the beginning of curing.
- C. Cold Weather Concreting:
 1. For this Specification, 'cold weather' is defined as a period when for more than three successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate average daily temperature as the average of highest and lowest temperature during the period from midnight to midnight.
 2. Batch, deliver, place, cure, and protect concrete during cold weather in compliance with the recommendations of ACI 306R and the additional requirements of this Section.
 3. Review cold weather concreting plan at preconstruction meeting. Include methods and procedures for use during cold weather including the production, transportation, placement, protection, curing, and temperature monitoring of concrete and procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
 4. Maintain minimum temperature of concrete immediately after placement and during the protection period as indicated in Table 3. The temperature of the concrete in place and during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3

Minimum Concrete
Temperatures For
Section Dimensions

Minimum Concrete	<u>< 12 inches</u>	<u>12 - 36 inches</u>
Temperature:	55 degrees F	50 degrees F

5. Protect concrete during periods of cold weather to provide continuous warm, moist curing (with supplementary heat when required by weather conditions) for a total of at least 350 degree-days of curing.
 - a. Degree-days are defined as the total number of 24-hour periods multiplied by the weighted average daily air temperature at the surface of the concrete, where 7 days at an average 50 degrees F equals 350 degree-days.
 - b. To calculate the weighted average daily air temperature, sum hourly measurements of air temperature in the shade at concrete surface taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
6. Do not use salt, manure or other chemicals for protection.
7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, do not expose concrete to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated and air-dry concrete for at least 3 days prior to first exposure to freezing temperatures.
8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.

D. Hot Weather Concreting:

1. For this Specification, 'hot weather' is defined as any combination of high air temperatures, low relative humidity, and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 pounds per square foot per hour.
2. Batch, deliver, place, cure, and protect concrete during hot weather in compliance with the recommendations of ACI 305R and the additional requirements of this Section.
 - a. Temperature of concrete being placed shall not exceed 90 degrees F. Maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall not cause loss of slump, flash set or cold joints.
 - b. Promptly deliver concrete to the site and promptly place the concrete upon its arrival at the site, not exceeding the maximum time interval specified in Paragraph 3.2 N.4. Provide vibration immediately after placement.
 - c. The Engineer may direct the Contractor to immediately cover concrete with sheet curing material.
3. Review hot weather concreting plan at preconstruction meeting. Include methods and procedures for use during hot weather, including production, placement, and curing.

3.9 REMOVAL OF FORMS

- A. Do not remove forms before concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing, whichever is longer.

TABLE 4

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.8C).

- B. Do not remove shores until concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.
- C. In cold weather when temperature of concrete exceeds ambient air temperature by 20 degrees F at the end of the protection period, loosen forms and leave in place for at least 24 hours to allow concrete to cool gradually to ambient air temperature.

3.10 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 017300 - Execution: Requirements for testing, adjusting, and balancing.
- C. Perform inspection and testing according to ACI 318 and Florida Building Code.
- D. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- E. Submit proposed mix design of each class of concrete to testing firm for review and approval prior to commencement of Work.
- F. Concrete Inspections:
1. Continuous Placement Inspection: Inspect for proper installation procedures.
 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- G. Strength Test Samples:
1. Sampling Procedures: Comply with ASTM C 172.
 2. Cylinder Molding and Curing Procedures:
 - a. Comply with ASTM C 31.
 - b. Cylinder Specimens: Standard cured.
 3. Sample concrete and make one set of five cylinders for every **75** cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and

walls. Form specimens in 6 inch diameter by 12 inch long non-absorbent cylindrical molds.

4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch, if less than five batches are used.
5. Make one additional cylinder during cold weather concreting and field cure.

H. Field Testing:

1. Slump Test Method: Comply with ASTM C 143.
2. Air Content Test Method: Comply with ASTM C 173.
3. Temperature Test Method: Comply with ASTM C 1064.
4. Compressive Strength Concrete:
 - a. Measure slump and temperature for each sample. When concrete is pumped, slump will be determined at point of truck discharge. If the slump is outside the specified range, the concrete will be rejected.
 - b. Measure air content in air-entrained concrete for each sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C 231 or by the volumetric method complying with ASTM C 173. If aggregates with high absorptions are used, use the latter test method. When concrete is pumped, air content will be determined at point of placement.

- I. Cooperate in the making of tests by allowing free access to the work for the selection of samples. Provide four firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold ten specimens, complete with cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication until shipment to the testing lab. Protect the specimens against injury or loss through construction operations. Furnish material and labor required for purpose of taking concrete cylinder samples. Owner will pay for shipping of specimens.

J. Cylinder Compressive Strength Testing:

1. Test Method: Comply with ASTM C 39.
2. Test Acceptance: According to ACI 318.
3. Test one cylinder at seven days.
4. Test one cylinder at fourteen days.
5. Test two cylinders at 28 days.
6. Retain one cylinder for 56 days for testing when requested by Engineer.
7. Dispose of remaining cylinders if testing is not required.
8. When the average 28-day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum seven-day or 14-day strengths (where proper relation between seven, 14- and 28-day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths without additional compensation.

K. Core Compressive Strength Testing:

1. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete

quality. Use results of tests on such cores as basis for acceptance, rejection, or determining the continuation of concrete work. The right of the Engineer to take such cores shall not be construed as creating any obligation to take such cores, and not exercising this right to do so shall not relieve Contractor from meeting specification requirements. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Repair core holes with non-shrink grout as specified in Section 036000 - Grouting. Work of cutting, testing, and repairing the cores will be at the expense of Contractor if defective work is uncovered. If no defective work is found, such cost will be at the expense of Owner.

2. Sampling and Testing Procedures: Comply with ASTM C 42.
3. Test Acceptance: According to ACI 318.
4. Drill three cores for each failed strength test from failed concrete.

L. Water-Soluble Chloride Ion Concentration Test Method:

1. Comply with ASTM C 1218.
2. Test at 28 days.
3. Maximum Chloride Ion Concentration: As permitted by applicable code.

M. Patching:

1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
2. It is the intent of these Specifications to require quality work including forming, mixing, and placement of concrete and curing so completed concrete surfaces will require no patching or repairs.
3. As soon as forms have been stripped and concrete surfaces exposed: remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.
4. Immediately after removal of forms, remove tie cones and metal portions of ties as specified in Section 031000 - Concrete Forming and Accessories. Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16 inch brush coat of neat cement slurry mixed to consistency of a heavy paste. Immediately plug hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.
5. When filling tie cone holes and patching or repairing exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color to match by addition of white cement. Rub lightly with a fine carborundum stone at an age of one to five days as necessary to bring surface down with parent concrete. Do not damage or stain virgin skin of surrounding parent concrete. Wash thoroughly to remove rubbed matter.
6. For very heavy (generally formed) patches, the Engineer may order the addition of pea gravel to the mixture and the proportions modified as follows:

<u>Material</u>	<u>Volumes</u>	<u>Weights</u>
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

7. Patch imperfections as directed by Engineer according to ACI 318.
8. Defective concrete and honeycombed areas: Chip down square and at least 1 inch 1-in deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8 inch wide around the steel. For areas less than 1-1/2 inches deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2 inch layers on successive days, each layer being applied with slurry as described above.

N. Defective Concrete:

1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
2. Repair or replacement of defective concrete will be determined by Engineer.
3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.11 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer may require changes in proportions or materials, or both, to apply to the remainder of the work in accordance with Paragraph 1.7E. Furthermore, the Engineer may require additional curing on those portions of the structure represented by the test specimens which fall below the values given in Table 1. The cost of such additional curing shall be at no additional cost to the Owner. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, without additional compensation. In such cases of failure to meet strength requirements, Contractor and Owner shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C 94. The "purchaser" referred to in ASTM C 94 is the Contractor.
- B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C 42 and C 39. In cases where tests of cores fall below the values given in Table 1, the Engineer, in addition to other recourses, may require load tests on any one of the slabs and walls in which such concrete was used. Test need not be made until concrete has aged 60 days. The Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Perform coring and testing, load tests, and any strengthening or concrete replacement required because strengths of test specimens are below that specified, without additional compensation.
- C. Should the strength of test cylinders fall below 60 percent of required minimum 28-day strength, concrete shall be rejected, removed, and replaced without additional compensation.

3.12 SCHEDULE

- A. Following Table 5 are general applications for various concrete classes and design strengths:

TABLE 5

<u>Class</u>	<u>Design Strength</u> (psi)	<u>Description</u>
B	3,000	Concrete fill, concrete fill for bollards, electrical raceway encasement and pipe encasement.
E2	4,500	Structural concrete greater than 10 inches in thickness including walls, slabs on grade, elevated slab and beam systems, columns, grade beams, and all other structural concrete greater than 10 inches in thickness.
E3	4,500	Structural concrete 10 inches or less in thickness including walls, slabs on grade, elevated slab and beam systems, columns and all other structural concrete 10 inches or less in thickness.

END OF SECTION 033000

SECTION 033500 - CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Finishing of concrete.
- 2. Floor surface treatment.

- B. Related Requirements:

- 1. Section 031000 - Concrete Forming and Accessories: Cast-in-place concrete formwork, form ties and form release agent.
- 2. Section 031500 - Concrete Joints and Accessories: Waterstops, premolded joint filler, sealant and neoprene bearing pads.
- 3. Section 033000 - Cast-in-Place Concrete: Cast-in-place concrete.
- 4. Section 033900 - Concrete Curing: Procedures for curing horizontal and vertical concrete surfaces.

1.3 COORDINATION

- A. Coordinate Work of this Section with concrete placement and concrete curing.

1.4 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on concrete hardener, sealer, curing compounds, compatibilities, and limitations.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- C. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 - Closeout Procedures: Requirements for closeout submittals.
- B. Operation and Maintenance Data: Submit information on maintenance renewal of applied coatings.

1.7 QUALITY ASSURANCE

- A. Perform Work according to ACI 301 and 302.1.
- B. Provide the services of a qualified field representative of the manufacturer of sealer or hardener to instruct the contractor on the proper application of the product under prevailing job conditions.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.9 RESPONSIBILITY FOR CHANGING FINISHES

- A. The surface finishes specified for concrete to receive coatings or other finish materials are those required for the proper application of the products specified under other Sections. Where products different from those specified are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
- B. Perform changes in finishes made to accommodate products different from those specified at no additional compensation. Submit proposed new finishes to the Engineer for approval.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Temporary Heat: Maintain minimum ambient temperature of 50 deg. F (10 deg. C).
- C. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources from affecting personnel or concrete.

PART 2 - PRODUCTS

2.1 COMPOUNDS - HARDENERS AND SEALERS

- A. Cementitious and component materials required for finishing concrete surfaces: As specified in Section 033000.
- B. Chemical Hardener:
 1. Description: Magnesium fluorosilicate and zinc fluorosilicate blend.
 2. Type: Dry powder.
 3. Manufacturers:
 - a. W.R. Meadows, Inc.
 - b. Vexcon Chemicals Inc..
 - c. Substitutions: As specified in Section 016000 - Product Requirements.
- C. Nonmetallic Hardener:
 1. Premixed.
 2. Dry powder.
 3. Clear.
 4. Material: Quartz aggregate.
 5. Abrasion resistant.
 6. Manufacturers:
 - a. Euclid Chemical Company
 - b. W.R. Meadows, Inc.
 - c. Substitutions: As specified in Section 016000 - Product Requirements.
- D. Sealer:
 1. Manufacturers:
 - a. Euclid Chemical Company.

- b. Vexcon Chemicals Inc.
- c. Substitutions: As specified in Section 016000 - Product Requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive Work of this Section.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FORMED SURFACES

- A. Form Removal: Conform to Sections 031000 and 033000.
- B. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.
- C. Off-Form Finish:
 - 1. Remove fins and other projections and fill tie cones and defects as specified in Section 031000 "Concrete Forming and Accessories".
- D. Rubbed Finish:
 - 1. Immediately upon stripping forms and before concrete changes color, carefully remove fins with a hammer. While surface is still damp apply a thin coat of medium consistency neat cement slurry using bristle brushes to provide a bonding coat within pits, air holes or blemishes in parent concrete. Do not coat large areas of the surface with this slurry.
 - 2. Before slurry dries or changes color, apply a dry (almost crumbly) grout consisting of one volume cement to 1-1/2 volumes of clean masonry sand having a fineness modulus of approximately 2.25 and complying with gradation requirements of ASTM C 144. Apply grout uniformly using damp (neither dripping wet nor dry) pads of coarse burlap approximately 6 inch square used as a float. Scrub grout into pits and air holes to provide a dense mortar in concrete imperfections to be patched.
 - 3. Allow mortar to partially harden for one or two hours depending upon weather. If the air is hot and dry, keep surface damp during this period using a fine, fog spray. When grout has hardened sufficiently so it can be scraped from the surface with perpendicular edge of a steel trowel without damaging the grout in small pits or holes, cut off grout that can be removed with a trowel. Grout allowed to remain on surface too long will get too hard and will be difficult to remove.
 - 4. Allow the surface to dry and rub it vigorously with clean dry burlap to completely remove dried grout. No visible film of grout should remain after this rubbing. Entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow grout to dry after it has been cut off with trowel so it can be wiped off clean with the burlap.
 - 5. On the day following repair of pits, air holes, and blemishes, wipe surfaces clean with dry, used pieces of burlap containing old hardened mortar, which will act as a mild abrasive. After this treatment, there should be no built-up film remaining on the parent

surface; if however a built-up film remains, use a fine abrasive stone to remove such material without breaking through original concrete surface film. Scrub lightly to remove excess material without working up a lather or mortar or changing concrete texture.

6. Follow final bagging or stoning operation with a thorough wash-down with stiff bristle brushes to remove extraneous materials from the surface. Spray surface with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after repair grout application.
7. Rubbed Finish application may be deleted by the Engineer if unfinished concrete surface is of superior quality and without surface voids.

E. Abrasive Blast Finish:

1. Coordinate with Rubbed Finish application. Do not begin until materials applied during Rubbed Finish operation have cured or before concrete has reached minimum 7-day strength. Apply abrasive blast finish only where indicated on Contract Documents.
2. Prepare a sample area of minimum 4 feet (1.2 meters) high by 16 feet (4.9 meters) wide Blast Finish as directed by Engineer on a portion of new wall construction which will not be exposed in the final work. Sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials, and blasting techniques for selection by Engineer. Leave final accepted sample exposed until completion of all Blast Finish operations.
3. Perform Blast Finish operations meet regulatory agency requirements. Obtain required permits or licenses to perform the work.
4. Perform abrasive blast finishing in as continuous an operation as possible, utilizing same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.
5. Use an abrasive grit of proper type and gradation, as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:
 - a. Medium: Generally expose coarse aggregate to a 1/4 inch to 3/8 inch reveal.
6. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure and blasting techniques required to match the approved mock-up.
7. Upon completion of Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit.
8. After concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by manufacturer.

3.3 FLOORS AND SLABS

- A. Consider the potential for longer setting time in concrete containing fly ash or ground granulated blast furnace slag.
- B. Compact with internal vibrators as specified in Section 033000 "Cast-In-Place Concrete" and screed to established grades.
- C. Following screeding as specified above, float slabs as approved by the Engineer. Continue floating operation until sufficient mortar is brought to surface to fill voids. Test surfaces with a

straightedge to detect and eliminate high and low spots. Do not overwork concrete as evidenced by excess water and fine material on its surface.

- D. Do not use "jitterbugs" or other special tools designed for the purpose of forcing the coarse aggregate away from the surface and allowing a layer of mortar to accumulate on any slab finish. Do not dust surfaces with dry materials. Round off edges of slabs and tops of walls with a steel edging tool. Use steel edging tool with radius of 1/4 inch for slabs subject to wheeled traffic.
- E. Measure floor flatness the day after a concrete floor is finished and before the shoring is removed, in order to eliminate any effects of shrinkage, curling, and deflection.
- F. Finish Descriptions:
 - 1. Steel Trowel Finish:
 - a. Finish by screeding and floating with straightedges to bring the surfaces to indicated elevations. While concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, wood float surface to a true and even plane with no coarse aggregate visible.
 - b. Apply sufficient pressure on wood floats to bring moisture to the surface. After surface moisture has disappeared, hand steel trowel to produce a smooth, impervious surface, free from trowel marks.
 - c. Trowel the surface again for the purpose of burnishing. Final troweling shall produce a ringing sound from the trowel.
 - d. Do not use dry cement or additional water in troweling.
 - 2. Wood Float Finish:
 - a. Finish by screeding with straightedges to bring the surfaces to indicated elevations.
 - b. Use a wood float to compact and seal surface. Remove laitance and leave a clean surface.
 - 3. Light Broomed Finish:
 - a. Steel trowel finish, as specified above, but omit final troweling and finish by drawing a fine-hair broom lightly across concrete surface.
 - b. Broom in direction and parallel to expansion joints, or in the case of inclined slabs, perpendicular to slope or as directed otherwise.
 - 4. Broomed Finish:
 - a. Steel trowel finish, as specified above, but omit the final troweling
 - b. While the concrete is still soft enough, finish the surface with a stiff coarse fiber broom to produce the pattern and depth of scoring as approved by the Engineer.
 - 5. Power Machine Finish:
 - a. In lieu of hand steel trowel finishing, use an approved power machine for finishing concrete floors and slabs in accordance with directions of machine manufacturer and as approved by the Engineer.

- b. Do not use a power machine until the concrete has attained necessary set to allow finishing without introducing high and low spots in the slab.
- c. Hand steel trowel those areas of slabs not accessible to power equipment. Provide a final steel troweling done by hand over all areas.

3.4 APPLICATION

A. Floor Surface Treatment:

- 1. Apply dry-shake hardener on floor surfaces in accordance with manufacturer's recommendations.
- 2. Apply sealer on floor surfaces in accordance with manufacturer's recommendations.

3.5 TOLERANCES

A. Section 014000 - Quality Requirements: Requirements for tolerances.

B. Measure for FF and FL tolerances for floors and slabs according to ASTM E 1155, within 48 hours after slab installation.

3.6 FIELD QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.

B. Acceptance:

- 1. Areas requiring corrective Work will be identified by Engineer.
- 2. Correct defects in defined floor or slab by grinding or removal and replacement of defective Work.
- 3. Remeasure corrected areas by procedure as specified in TOLERANCES Article.

3.7 SCHEDULE OF FINISHES

A. Finish concrete in various specified manners either to remain as natural concrete or to receive an additional applied finish or material under another Section. Where products different from those specified are approved for use, comply with requirements of PART 1 Article entitled "Responsibility for Changing Finishes."

B. Finish base concrete for following grouped conditions as scheduled in following Paragraphs and as further specified in this Section.

C. Exposed Exterior Concrete:

- 1. Concrete for exterior on stairs and other horizontal areas: Broomed finish, non-slip.
- 2. Tops of curbs and pads: Steel trowel finish.

D. Exposed Interior Concrete:

1. Exposed interior concrete including underside slabs, beams, walls, columns and stairs and sides of openings, beams and stairs: Rubbed finish.
2. Concrete for interior walking surfaces, excluding stairs: Wood float finish.
3. Concrete for interior stairs and metal pan stairs: Light broomed finish, non-slip.

E. Concrete Associated with Structures:

1. Exposed exterior concrete excluding slabs and walking surfaces: Rubbed finish. Rub open tank walls above and to 1 foot below normal water line.
2. Walls of open topped tanks: Rubbed finish above and to 1 foot below normal water line. Off-form finish from 1 foot below normal water line to base of wall.
3. Concrete stairs, landings and platforms below normal water level in liquid retaining structures: Broomed finish, non-slip.
4. Concrete on which liquids flow or are contained: Steel troweled finish.
5. Concrete tank bottoms to be covered with grout: Broom finish as approved. Refer to Section 036000 "Grouting" for additional requirements.

F. Concrete to Receive Additional Finishes or Coatings:

1. Concrete to receive dampproofing: Off-form finish.
2. Concrete to receive capillary waterproofing: Off-form finish at vertical and overhead surfaces, light broomed finish at horizontal surfaces.
3. Concrete to receive cementitious slurry waterproofing: Off-form finish at vertical surfaces, light broomed finished horizontal surfaces.
4. Concrete to receive chemical hardener: Light broomed finish, non-slip.
5. Concrete to receive paint: Rubbed finish.
6. Concrete to receive seamless flooring: Once-over steel trowel finish.
7. Concrete to receive ceramic and quarry tile: Broomed finish as approved.
8. Concrete to receive vinyl and rubber surfacing and carpet: Steel trowel finish.
9. Concrete to receive rubberized asphalt sheet membrane waterproofing: Wood float finish at horizontal surfaces, rubbed finish at vertical surfaces.
10. Concrete to receive roof insulation: Consolidate, screed and wood float to required grades.

G. Miscellaneous Concrete:

1. Ribbed Concrete: Off-form finish.
2. Concrete not exposed in finished work and not scheduled to receive an additional applied finish or material: Off-form finish at vertical surfaces, consolidate and screed to grade at horizontal surfaces.
3. Concrete to have an abrasive blast finish: Refer to appropriate Paragraph in above PART 3 Article entitled "Formed Surfaces."

END OF SECTION 033500

SECTION 033900 - CONCRETE CURING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Requirements:
 - 1. Section 033000 - Cast-in-Place Concrete: Coordinate Work of this Section with concrete placement, including Hot and Cold Weather and other environmental factors affecting concreting procedures.
 - 2. Section 033500 - Concrete Finishing: Surface finishing of concrete slabs and walls.

1.3 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's information on curing compounds, mats, paper, sheets, and film, including compatibilities and limitations.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- C. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.
- D. Certifications:
 - 1. Certify curing compound is suitable for use in contact with potable water after 30 days and is non-toxic and free of taste or odor.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI350.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Membrane-Curing Compound, Type A:
 - 1. Comply with ASTM C 309, Type 1, Class A, containing no wax, paraffin or oil and be non-yellowing.
 - 2. Comply with Federal, State and local VOC limits.
- B. Non-membrane-Forming Curing Compound, Type C:
 - 1. Liquid, penetrating, silicate-based type.
 - 2. Type: Combination curing, hardening, and dustproofing.
- C. Water: Potable; not detrimental to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 - Execution: Requirements for application examination.
- B. Verify that substrate surfaces are ready to be cured.

3.2 APPLICATION

- A. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain a temperature of at least 50 degrees F (10 degrees C) at concrete surface for a minimum of seven days after placement. Use the following curing methods as specified:
 - 1. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling, or covered with saturated burlap. Begin water curing as soon as concrete attains an initial set and maintain water curing 24 hours a day. Do not permit concrete surface to dry out at any time during curing period. Provide temperature of curing water within 20 degrees F (-7 degrees C) of concrete temperature.
 - 2. Sheet Material Curing: Cover entire surface with sheet material. Anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
 - 3. Membrane Curing: Apply over entire concrete surface except as follows.
 - a. Do not apply curing compound on any concrete surface where additional concrete or grout is to be placed, where concrete sealers or surface coatings are to be used, or where concrete finish requires an integral floor product.
 - b. Apply curing compound as soon as free water on the surface has disappeared and no water sheen is visible.
 - c. Do not apply after the concrete is dry or when curing compound can be absorbed into the concrete. Apply in compliance with manufacturer's recommendations.
- B. Specified Applications of Curing Methods:
 - 1. Slabs for Liquid Retaining Structures: Water cure only.
 - 2. Slabs on Grade and Footings (not used to retain liquids): Water cure or sheet material cure or membrane cure.
 - 3. Structural Slabs (other than Liquid Retaining Structures): Water cure or membrane cure.
 - 4. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water cure.
 - 5. Formed Surfaces:
 - a. No curing, if nonabsorbent forms are left in place seven days.
 - b. Water cure if absorbent forms are used.
 - c. Water cure if forms are removed prior to seven days.
 - d. Sheet cure or membrane cure if forms are removed prior to seven days.
 - e. Water cure exposed horizontal surfaces of formed walls or columns for seven days or until next placement of concrete is made.

6. Surfaces of Concrete Joints: Water cure or sheet material cure.
 - C. When approved by the Engineer, curing time may be reduced to 3 days for concrete placement using Type III cement.
 - D. Protect finished surfaces and slabs whenever ambient conditions of humidity, temperature, sunlight and wind may result in the rapid evaporation of water from the concrete, to prevent checking and crazing, until the beginning of curing.

3.3 PROTECTION

- A. Section 017300 - Execution: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected surfaces.
- C. Reference Section 033000 "Cast-In-Place Concrete" for additional protection requirements.

END OF SECTION 033900

SECTION 036000 - GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Portland cement grout.
2. Nonshrink epoxy grout.
3. Nonshrink cementitious grout.

- B. Related Requirements:

1. Section 024119 - Selective Demolition: Demolition and removals.
2. Section 030130.71 - Modifications to Existing Concrete: Modifications to existing concrete.
3. Section 031000 - Concrete Forming and Accessories.
4. Section 033000 - Cast-in-Place Concrete.
5. Section 032000 - Concrete Reinforcing.
6. Section 055000 - Metal Fabrications: Grout related to miscellaneous metals.

1.3 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.

1. Commercially manufactured nonshrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.
2. Commercially manufactured nonshrink epoxy grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.
3. Cement grout. Include the type and brand of cement, the gradation of fine aggregate, product data on any proposed admixtures and the proposed grout mix.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and nonshrink grouts.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.
- E. Product Certificates: Provide certification of the following:
 - 1. Manufactured grout products and admixtures for cement grout are made for use in contact with potable water 30 days after installation (non-toxic and free of taste and odor).

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.
- B. Independent testing laboratory shall meet the requirements of ASTM E329 and ASTM C1077 and be acceptable to the Engineer. Laboratories affiliated with the Contractor or in which the Contractor or officers of the Contractor's organization have beneficial interest are not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.
- D. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location.
 - 2. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.

- B. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.
- C. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT GROUT

- A. Portland Cement: Comply with ASTM C 150, Type I and II.
- B. Water:
 - 1. Potable.
 - 2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
 - a. Corrosion of steel.
 - b. Volume change increasing shrinkage cracking.
 - c. Efflorescence.
 - d. Excess air entraining.
- C. Fine Aggregate:
 - 1. Washed natural sand.
 - 2. Gradation:
 - a. Comply with ASTM C 33.
 - b. Represented by smooth granulometric curve within required limits.
 - 3. Free from injurious amounts of organic impurities according to ASTM C 40.
- D. Mix:
 - 1. Portland cement, sand, and water.
 - 2. Do not use ferrous aggregate or staining ingredients in grout mixes.

2.2 NONSHRINK EPOXY GROUT

- A. Description:
 - 1. Pre-proportioned, prepackaged, three-component, nonshrink epoxy grout, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate.
- B. Performance and Design Criteria:
 - 1. Minimum Compressive Strength:

- a. 10,000 psi at seven days.
 - b. Comply with ASTM C 579.
2. Coefficient of Expansion:
- a. 30×10^{-6} inch per degree F.
 - b. Comply with ASTM C 531.
3. Minimum Tensile Strength:
- a. 1,800 psi.
 - b. Comply with ASTM C 307.
- C. Product: Provide one of the following:
1. Masterflow 648 CP; by BASF Building Systems.
 2. Five Star HP Epoxy Grout; by Five Stars Products, Inc.
 3. Sikadur 42 Grout-Pak; by Sika Corp.
 4. E3-G Epoxy Grout; by Euclid Chemical Co.
 5. Or equal.

2.3 NONSHRINK CEMENTITIOUS GROUT

- A. Description:
1. Pre-mixed and ready-for-use formulation requiring only addition of water.
 2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
 3. No shrinkage when tested in conformity with ASTM C 827.
- B. Performance and Design Criteria:
1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C 1107 for Grades B, C, D and CRD-C621 nonshrink grout:
 - a. Setting Time:
 - 1) Initial: Approximately two hours.
 - 2) Final: Approximately three hours.
 - 3) Comply with ASTM C 191.
 - b. Maximum Expansion: 0.10 to 0.40 percent.
 - c. Minimum Compressive Strength:
 - 1) One-Day: 4,000 psi.
 - 2) Seven-Day: 7,000 psi.
 - 3) 28-Day: 10,000 to 10,800 psi.
 - 4) Comply with CRD-C621.

2.4 FORMWORK

- A. As specified in this Section and in Section 031000 - Concrete Forming and Accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 - Execution: Requirements for installation examination.
- B. Verify areas to receive grout.

3.2 PREPARATION

- A. Section 017300 - Execution: Requirements for installation preparation.
- B. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by the Engineer.
- C. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
 - 1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.
- D. Roughen concrete lightly, but not to interfere with placement of grout.
- E. Remove foreign materials from metal surfaces in contact with grout.
- F. Align, level, and maintain final positioning of components to be grouted.
- G. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface or other method acceptable to the Engineer. Upon completion of the 24-hour period, remove visible water from the surface prior to grouting.
- H. Nonshrink epoxy grouts do not require saturation of concrete substrate. Do not wet concrete surfaces to receive nonshrink epoxy grout. Completely dry surfaces in contact with epoxy grout before grouting.
- I. Support equipment during alignment and installation of grout by shims, wedges, blocks or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking coatings and remove after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges, and blocks.

3.3 INSTALLATION - GENERAL

A. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.
3. As specified in Section 031000 - Concrete Forming and Accessories.

B. Mixing - Portland Cement Grout:

1. Use proportions of two parts sand and one part cement, measured by volume.
2. Prepare grout with water to obtain consistency to permit placing and packing.
3. Mix water and grout in two steps:
 - a. Premix using approximately 2/3 of water.
 - b. After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.
4. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
5. Do not add additional water after grout has been mixed.
6. Minimum Compressive Strength (ASTM C 579):
 - a. In 48 hours: 2,400 psi (17 MPa).
 - b. In 28 days 7,000 psi (48 MPa).

C. Placing of Grout:

1. Place grout material quickly and continuously.
2. Do not use pneumatic-pressure or dry-packing methods.
3. Apply grout from one side only to avoid entrapping air.
4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
5. Thoroughly compact final installation and eliminate air pockets.
6. Do not remove leveling shims for at least 48 hours after grout has been placed.

D. Curing:

1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or] by using wet burlap bags, soaker hoses or ponding.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

E. Reflect all existing underlying expansion joints, partial contraction joints, and construction joints through the grout.

3.4 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with manufacturer's recommendations. Mix full batches only, to maintain proper proportions of resin, hardener and aggregate. Do not vary the ratio of components or add

solvent to change the consistency of the grout mix. Do not overmix. Do not entrain air bubbles by mixing too quickly.

- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 degrees F or above 90 degrees F.
- C. Place grout rapidly and continuously to avoid cold joints. Place grout in lifts in accordance with manufacturer's recommendations.
- D. Provide forms as specified in Paragraph 3.3A. Place grout into the designated areas and prevent entrapment of air. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.
- E. Minimize 'shoulder' length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- F. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- G. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1,000 psi or as recommended by the manufacturer, whichever is longer.
- H. Provide grout control joints as indicated on Drawings.

3.5 SCHEDULE

- A. Use particular types of grout as follows:
 - 1. General Purpose Nonshrink Cementitious Grout (CRD-C621 Grade D): Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long.
 - 2. Flowable (precision) Nonshrink Cementitious Grout (CRD-C621 Grade B or C): Use under base plates greater in area than 3-feet wide by 3-feet long. Use at locations indicated to receive flowable (precision) nonshrink grout. Flowable (precision), nonshrink, cementitious grout may be substituted for general purpose nonshrink cementitious grout.
 - 3. Nonshrink Epoxy Grout: Use at all locations specifically indicated to receive nonshrink epoxy grout.
 - 4. Cement Grout: Use where indicated.

END OF SECTION 036000

This page intentionally left blank.

SECTION 050519 - POST-INSTALLED ANCHORS AND REINFORCING BARS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Post-installed adhesive and expansion anchors for concrete substrates.
 - 2. Post-installed reinforcing bar dowels using adhesive anchoring system.

- B. Related Requirements:

- 1. Section 033000 "Cast-In-Place Concrete" and related Sections for concrete, reinforcement, and accessories.
 - 2. Various Sections in Division 05 related to metals.
 - 3. Various Sections in Divisions and 26 related to facility utilities.
 - 4. Various Sections in Divisions 40, 41, 43, 44, and 46 related to process mechanical equipment.

1.3 ACTION SUBMITTALS

- A. Submit in accordance with Section 013300.

- B. Post-Installed Expansion Anchors:

- 1. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics for expansion anchors.
 - 2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed expansion anchors installed into cracked concrete.
 - 3. Installation Procedures: Submit procedures stating product proposed for use, and complete installation method.

- C. Post-Installed Adhesive Anchoring System:

- 1. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics, including temperature, humidity, and moisture limitations for adhesive anchoring system.
 - 2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed adhesive anchoring system installed into cracked concrete.

3. Installation Procedures: Submit procedures stating method of drilling, product proposed for use, and complete installation method.

1.4 INFORMATIONAL SUBMITTALS

- A. Installation procedure: Submit installation procedure for post-installed adhesive anchoring system; including method of drilling.
- B. Evaluation Reports: From ICC-ES for expansion anchors and adhesive anchoring system, for installation of post-installed anchors into cracked concrete, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

1.5 QUALITY ASSURANCE

- A. General: Coordinate with the work of other Sections, field verifying dimensions and work of other trades adjoining items of work before installing items specified in this Section.
- B. Adhesive Anchoring System:
 1. Installer Training: Conduct thorough training by the manufacturer or the manufacturer's representative. Training shall consist of the complete installation process for post-installed anchors and reinforcing bar dowels, including but not limited to:
 - a. Tool selection.
 - b. Hole drilling procedure.
 - c. Hole preparation and cleaning techniques.
 - d. Adhesive injection technique and dispenser training and maintenance.
 - e. Anchor preparation and installation.
 - f. Reinforcing bar dowels preparation and installation.
 - g. Proof loading and torquing.
 - h. Temperature, humidity, and moisture limitations.
 - i. Working time limitations.
 - j. Setting time.
 2. Include training for anchors and reinforcing bar dowels installed horizontally or upwardly inclined to support sustained tension loads. Install horizontally or upwardly inclined anchors and reinforcing bar dowels by personnel certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent.
 3. Manufacturer's Certificate of Proper Installation: Submit upon completion of work, for the post-installed anchors and reinforcing bar dowels, including non-production and production anchors and reinforcing bar dowels.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.

- B. Handle materials with cranes or derricks. Do not dump material off transportation vehicles or handle in ways that will cause damage.
- C. Store materials elevated above grade and block up so they will not become bent or otherwise damaged.
- D. Repair items that have become damage or corroded to satisfaction of the Engineer prior to incorporating them into the work.

PART 2 - PRODUCTS

2.1 EXPANSION ANCHORS

- A. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.
- B. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.
- C. Meet ICC ES AC01 or ICC ES AC193.
- D. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.
- E. Basis-of-Design:
 - 1. Anchorage designs indicated are based on Hilti, Kwik-Bolt TZ, unless otherwise noted.
 - 2. Acceptable Anchors: Hilti Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD1, DeWalt Power-Stud+ SD6 for stainless steel; or equal.

2.2 ADHESIVE ANCHORING SYSTEM

- A. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.
 - 1. Anchors: Meet ICC ES AC308.
 - 2. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.
 - a. Adhesive: Made for use in contact with potable water.
 - 3. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
 - 4. Anchor: Zinc plated carbon steel or Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.

- a. Basis-of-Design:
 - 1) Anchorage designs indicated are based on Hilti HIT-RE 500 V3, unless otherwise noted.
 - 2) Acceptable Manufacturers: Hilti HIT-RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon C6+; or equal.
5. Reinforcing Bar Dowels: Reinforcing bar, per Section 032000.
 - a. Basis-of-Design:
 - 1) Anchorage designs indicated are based on Hilti HIT-RE 500 V3, unless otherwise noted.
 - 2) Acceptable Manufacturers: Hilti HIT-RE 500 V3; Simpson Strong Tie SET-XP; ITW Ramset Red Head Epcon C6+; or equal. Changes to the anchorage adhesive may require changes in spacing, edge distance, and number of anchors required.

2.3 PERFORMANCE REQUIREMENTS

- A. Performance: design anchors and reinforcing bar dowel anchorage for all anticipated loads and load combinations per ASCE/SEI 7 including omega-naught (Ω_o) factors as applicable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install anchoring system in strict compliance with manufacturer's published installation instructions and approved Shop Drawings. Comply with recommended surface preparation, temperature, and moisture of substrate and ambient conditions.
 2. Coordinate installation with Special Inspector.
 3. Use drill bit of correct diameter and drill to required depth using rotary impact type hammer drills with carbide-tipped bits.
 4. Drill holes perpendicular to concrete surface, unless otherwise indicated.
 5. Use oil free compressed air to blast out loose particles and dust from drilled holes.
- B. Expansion anchors:
 1. Check expansion anchors for tightness a minimum of 24 hours after initial installation.
- C. Adhesive anchoring system:
 1. Perform installation only by personnel trained in anchor installation and having certification required in PART 1 - GENERAL.
 2. Inject adhesive and install anchors or reinforcing bar dowels that are clean and free of dirt, oil, grease, ice or other deleterious material which would reduce bond.

END OF SECTION 050519

This page intentionally left blank.

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Miscellaneous items fabricated from steel, aluminum or stainless steel.
2. Aluminum beams.
3. Aluminum angles.
4. Aluminum closure angles.
5. Aluminum access hatch.
6. Aluminum grates.
7. Aluminum diamond plate and floor plate.
8. Aluminum stop plates.
9. Aluminum stair nosings.
10. Aluminum stair treads
11. Stainless steel beams.
12. Stainless steel angles.
13. Castings.
14. Metal ladders.
15. Metal bollards.
16. Loose bearing and leveling plates for applications where they are not specified in other Sections.

- B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

- C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 036000 "Grouting" for non-shrink grout.
3. Section 050519 "Post-Installed Anchors and Reinforcing Bars" for anchors in various substrates.
4. Various Sections in Divisions 40 - 46 for process mechanical work scopes.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Metal nosings and treads.
 - 3. Paint products.
- B. Samples:
 - 1. Submit samples as requested by the Engineer during construction.
- C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Metal ladders.
 - 4. Metal floor plate and supports.
 - 5. Metal bollards.
 - 6. Aluminum access hatch
 - 7. Abrasive metal nosings treads.
 - 8. Miscellaneous steel items.
 - 9. Miscellaneous aluminum items.
 - 10. Miscellaneous stainless steel items.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by aluminum, steel and stainless steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
 - 1. Certify that welders have been qualified under AWS, within previous 12 months, to perform welds required under this Section.

- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.2, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless steel."
- C. Evaluation Reports: Post-installed concrete anchors, from ICC-ES for expansion anchors and adhesive anchor system, for installation into cracked concrete, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Wide Flange Shapes: ASTM A992.
- C. Steel Other Shapes, Plates, Shapes, and Bars: ASTM A 36.
- D. Stainless steel Sheet, Strip, and Plate: ASTM A 240 or ASTM A 666, Type 316.
- E. Stainless steel Bars and Shapes: ASTM A 276, Type 316.
- F. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
- G. Rolled-Stainless Steel Floor Plate: ASTM A 793.
- H. Abrasive-Surface Floor Plate: Steel plate with abrasive material metallurgically bonded to steel.
- I. Steel Tubing: ASTM A 500, Grade B cold-formed steel tubing.

- J. Steel Pipe: ASTM A 53, Type S Grade B Standard Weight (Schedule 40) unless otherwise indicated.
- K. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
 - 1. Size of Channels: As indicated.
 - 2. Material: Galvanized steel, ASTM A 653, structural steel, Grade 33, with G90 coating; 0.108-inch nominal thickness.
 - 3. Material: Cold-rolled steel, ASTM A 1008, structural steel, Grade 33; 0.0966-inch minimum thickness; hot-dip galvanized after fabrication.
- L. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47, unless otherwise indicated.
- M. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated.
- N. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- O. Aluminum Extrusions: ASTM B 221, Alloy 6061 T6.
- P. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, Alloy 6061-T6.
- Q. Aluminum Castings: ASTM B 26, Alloy 443.0-F.
- R. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).
- S. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).
- T. Nickel Silver Extrusions: ASTM B 151, Alloy UNS No. C74500.
- U. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).
- V. Gray Iron Castings: ASTM A48, Class 35.
- W. Ductile Iron Castings: ASTM A536, Grade 65-45-12.
- X. Stainless steel Bolts: ASTM F593, Type 316.
- Y. Stainless steel Nuts: ASTM F594, Type 316.
- Z. Carbon Steel Bolts and Studs: ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
- AA. High Strength Steel Bolts, Nuts and washers: ASTM F3125, Grade A325 (mechanically galvanized per ASTM B695, Class 50, where noted).
 - 1. Elevated Temperature Exposure: Type I.
 - 2. General Application: Type I or Type II.
- BB. Galvanizing: ASTM A123, Zn w/0.05 percent minimum Ni.

- CC. Galvanizing, hardware: ASTM A153, Zn w/0.05 percent minimum Ni.
- DD. Galvanizing, anchor bolts: ASTM F2329, Zn w/0.05 percent minimum Ni.
- EE. Welding electrodes, steel: AWS A5.1 E70xx.

2.2 FASTENERS

- A. Unless otherwise noted, provide steel machine bolts for the connection of carbon steel or iron; galvanized steel or stainless-steel machine bolts for the connection of galvanized steel or iron; and stainless steel machine bolts for the connection of aluminum or stainless-steel.
- B. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless steel fasteners for fastening aluminum.
 - 2. Provide stainless steel fasteners for fastening stainless steel.
 - 3. Provide stainless steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- D. Stainless steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
 - 1. Provide standard headed bolts with heavy hex nuts and Grade A washers.
 - 2. Where galvanized anchor bolts are indicated or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, galvanize in accordance with ASTM F 2329.
- F. Machine bolts and nuts conforming to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- G. Toggle Bolts: shall be Hilti, Toggler Bolt or equal.
- H. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts

2.3 MISCELLANEOUS ALUMINUM

- A. Miscellaneous Aluminum: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Weld on unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous Aluminum Items: Beams, angles, closure angles, grates, floor plates, stop plates, stair nosings, and other miscellaneous aluminum indicated and not otherwise specified.
- D. Angle Frames for Floor Hatches, Beams, Grates, and Similar Items: Complete with welded strap anchors attached.
- E. Stair Treads for Aluminum Stairs: As specified for grating and having cast abrasive non-slip nosing as approved.
- F. Aluminum Finishes:
 - 1. Mill Finish: Have a cleaned and degreased mill finish on aluminum items.

2.4 MISCELLANEOUS STEEL

- A. Miscellaneous Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal thread on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous Steel Items: Beams, angles, detailed on the Drawings, support brackets, base plates for other than structural steel or equipment, closure angles, hold-down straps and lugs, splice plates, and any other miscellaneous steel indicated and not otherwise specified.
- D. Steel pipe pieces for sleeves, lifting attachments and other functions: Schedule 40 pipe unless otherwise indicated. Wall and floor sleeves, of steel pipe: Provide welded circumferential steel waterstops at mid-length.

- E. Steel Finish Work: Thoroughly cleaned, by effective means, of loose mill scale, rust and foreign matter. Provide one shop coat of primer compatible with finish coat after fabrication but before shipment. Omit paint within 3 inches of proposed field welds. Apply paint to dry surfaces and be thoroughly and evenly spread and well worked into joints and other open spaces.
- F. Galvanizing: Coat all steel to be installed in, on or to exterior portions of buildings, including bolts and washers, and all steel framing members at stabilization angles, by hot-dip process after fabrication in accordance with ASTM A 123, except steel called out to be stainless. Inspect all hot-dipped galvanized steel for compliance with ASTM A 123 and mark with a stamp indicating the ASTM number and the number of ounces of zinc per square foot of steel. Provide a notarized certificate of compliance from the galvanizer. Apply zinc for galvanizing by the hot-dip process, Duragalv® by Duncan Galvanizing is listed as a reference standard for quality characteristics. Voigt and Schwiertz Inc. may be considered an equivalent galvanizer. The galvanizing bath shall contain special high grade zinc and other earthly materials. Immerse steel immediately before galvanizing in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards. **NOTE:** All items of work noted or specified to be galvanized shall be galvanized after fabrication. Where size of assembly is too large for galvanizing, only these assemblies will be galvanized prior to fabrication.

2.5 MISCELLANEOUS STAINLESS-STEEL

- A. Miscellaneous Stainless-Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints, jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Beams, angles, and other miscellaneous stainless steel.

2.6 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that are compatible with finish coats.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- E. Factory-Applied Primer Over Hot-Dip Galvanizing:
 - 1. Provide factory-applied prime coat certified VOC compliant, conforming to applicable regulations and EPA standards. Primergalv® by Ducan Galvanizing is listed as a reference standard for quality characteristics. Equivalent Colorzinq from Voigt and Schweitzer shall be considered acceptable. Apply primer within 12 hours after galvanizing and within 3 hours of surface preparation at the same facility where the galvanizing is done in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Epoxy primer shall be one of the following or approved equal:
 - a. Tnemec 27 WB
 - b. E.I. duPont Corlar 2.1-PR
 - c. Sherwin Williams Recoatable Epoxy Primer B67A5
- F. Galvanizing Repair Paint: Touch up damaged or abraded galvanized surfaces with ZRC Cold Galvanizing Compound as manufactured by ZRC products company or Zirp Cold Galvanizing Compound as manufactured by Duncan Industries or Brite Zinc as manufactured by Brite Products.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 CASTINGS:

- A. General: Good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes, and other defects. Thoroughly clean castings to remove foreign matter, and deleterious films. Castings will be subjected to a hammer inspection in the field by the Engineer. Damaged castings may be rejected and replaced at no cost to the Owner.
- B. Matching Surfaces: Machine to a true plane surface allowing contact surfaces to seat without rocking. Provide allowances in patterns so specified thickness is not reduced to obtain finished surfaces. Castings will not be acceptable if actual weight is less than 95 percent of theoretical weight computed from dimensions. Provide facilities for weighing castings in the presence of the Engineer.

2.8 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete, equip with integrally welded steel strap anchors, 1/4 by 1 inch, with a minimum 6 inch embedment and 1 1/2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.9 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.10 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.
2. Ladders, ladder accessories and ladder clearances shall conform to the requirements of OSHA.

B. Stainless steel Ladders:

1. Material: Fabricate from Type 316 stainless steel for ladders that will be submerged.
2. Siderails: Continuous 1/2-by-2-1/2-inch stainless steel bar, spaced at minimum of 18 inches, unless otherwise indicated.
3. Rungs: 3/4 inch diameter stainless steel rods spaced 12-in on center.
 - a. Fit rungs in centerline of siderails; fasten as indicated.
4. Wall Support Brackets: Type 316 stainless steel spaced 4 feet on center with Type 316 stainless steel fasteners. Fasten side rails to floor with 1/2 inch diameter Type 316 stainless steel expansion anchors.

2.11 LADDER SAFETY SYSTEM

1. Provide ladder safety post extensions on fixed ladders 20 feet or less in height located below hatches as indicated. Locking aluminum telescoping safety post extension in its vertical position and extend a minimum of 36-in above opening and be secured to ladder rungs with stainless steel fasteners and brackets.
 - a. Basis-of-Design: Ladder UP Safety Post, Model LU-4 by Bilco Co.; Series L1E Safety Extension by Halliday Products; or equal.

2.12 ACCESS HATCH

A. Access hatches:

1. Single leaf doors as indicated by the Drawings.
 - a. 1/4-in aluminum diamond pattern plate with welded stiffeners, as necessary.
2. 1/4-in aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter.
3. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open.
4. Hardware: durable and corrosion resistant with Type 316 stainless steel hardware used throughout.
5. Provide removable lock handle.
6. Finish: factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete.
7. Watertight and have a 1-1/2-in drainage coupling to the channel frame.
8. Provide hinged fall protection grating for all hatches.
9. Recessed padlock hasp feature with lock with shroud over lock.

10. Live load: 300 lbs/sq ft with a maximum deflection of 1/150th of the span, unless otherwise indicated. Type J-AL aluminum by Bilco Company, New Haven, CT or equal.

2.13 COVER PLATE

- A. Fabricate aluminum diamond plate and floor plate having a minimum thickness of As indicated. Fabricate frames and supports of aluminum construction. Fastening devices and hardware shall be Type 316 stainless-steel. Plates shall have a mill finish.
- B. Provide aluminum angle supports as indicated.
- C. Include aluminum angle stiffeners, and fixed and removable sections as indicated.
- D. Provide flush stainless steel bar drop handles for lifting removable sections, one at each end of each section.

2.14 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize exterior miscellaneous steel trim.

2.15 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 1. Cap bollards with round off top.
 2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards with 1-inch thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.
 1. Provide 1-inch minimum of nonshrink grout beneath bollard base plate to allow for plumb alignment of bollards.
- C. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch-thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

- D. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch wall-thickness steel tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4-inch steel machine bolt.
- E. Galvanize exterior bollards.

2.16 ALUMINUM METAL NOSINGS TREADS AND THRESHOLDS

- A. Cast-Metal Units: Cast aluminum, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
 - 1. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch nosing, for application over bent plate treads or existing stairs.
- B. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
 - 1. Provide two rows of holes for units more than 5 inches wide, with two holes aligned at ends and intermediate holes staggered.

2.17 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.18 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.19 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.20 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products. Limit maximum nickel (Ni) content of galvanizing zinc to 0.05%.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.21 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 03 and Division 04 respectively. Install items to be attached to concrete or masonry after such work is completed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding after welding.
- C. Clean and repair, after installation, zinc coating which has been burned by welding, abraded, or otherwise damaged. Thoroughly clean damaged area and remove all traces of welding flux and loose or cracked zinc coating prior to painting. Paint the cleaned area per the requirements of ASTM A780.
- D. Install specialty products in accordance with the manufacturer's recommendations.
- E. Weld headed anchor studs in accordance with manufacturer's recommendations.
- F. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with

edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- G. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- H. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- I. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- J. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- K. Corrosion Protection: Coat concealed surfaces of aluminum and steel that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Aluminum Contacting a Dissimilar Metal: Apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
 - 2. Aluminum Contacting Masonry or Concrete: Apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
 - 3. Aluminum Contacting Wood: Apply two coats of aluminum metal and masonry paint to the wood.
 - 4. Steel Contacting Exposed Concrete or Masonry: Apply heavy bitumastic troweling mastic.
 - 5. Between aluminum stair treads, and steel supports, insert 1/4 inch thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
 1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
 1. Do not fill removable bollards with concrete.
- B. Anchor bollards to existing construction where indicated with anchor bolts. Provide four 3/4-inch bolts at each bollard unless otherwise indicated.
 1. Embed anchor bolts at least 6 inches in concrete.
- C. Anchor bollards in place with concrete footings where indicated. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.
- D. Anchor internal sleeves for removable bollards in place with concrete footings. Center and align sleeves in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace sleeves in position until concrete has cured.
- E. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- F. Fill bollards solidly with concrete, mounding top surface to shed water.
 1. Do not fill removable bollards with concrete.

3.4 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Industrial Class stairs with steel-grating treads.
 - 2. Aluminum railings attached to metal stairs.
 - 3. Aluminum handrails attached to walls adjacent to metal stairs.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for metal stairs and railings.
 - 1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, blocking for attachment of wall-mounted handrails, and items with integral anchors, that are to be embedded in concrete or masonry.
 - 2. Deliver such items to Project site in time for installation.
- C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.
- D. Schedule installation of railings so wall attachments are made only to completed walls.
 - 1. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For metal grating stairs and the following:
 - 1. Gratings.
 - 2. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified Florida professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.7 DELIVERY, STORAGE AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep structural members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect structural members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
 - a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings, including attachment to building construction.

- B. Structural Performance of Stairs: Aluminum stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 lbf/sq. ft..
 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 5. Limit deflection of treads, platforms, and framing members to L/360.
- C. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
 3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

- A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Aluminum Bars for Grating Treads: ASTM B221 extruded aluminum, alloys as follows:
1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 2. 6061-T1, for grating crossbars.
- C. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated.
- D. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- E. Aluminum Extrusions: ASTM B 221, Alloy 6061 T6.
- F. Aluminum-Alloy Rolled Tread Plate: ASTM B 632, Alloy 6061-T6.
- G. Aluminum Castings: ASTM B 26, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.
 - 1. Select fasteners for type, grade, and class required.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
- E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Shop Primers: Provide primers that are compatible with final coating.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- D. Zinc-Rich Primer: Comply with SSPC-Paint 20, Type I-A, Level 1, and compatible with topcoat.
- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for exterior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Assemble stairs in shop to greatest extent possible.
 - 1. Disassemble units only as necessary for shipping and handling limitations.
 - 2. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #4 - Good quality, uniform undressed weld with minimal splatter.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
 - 2. Locate joints where least conspicuous.
 - 3. Fabricate joints that are exposed to weather in a manner to exclude water.
 - 4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.
- B. Stair Framing:

1. Fabricate stringers of aluminum plates or channels.
 - a. Stringer Size: As indicated on Drawings.
 - b. Provide closures for exposed ends of channel stringers.
 - c. Finish: Mill.
 2. Construct platforms and tread supports of aluminum plate or channel headers and miscellaneous framing members as indicated on Drawings.
 - a. Provide closures for exposed ends of channel framing.
 - b. Finish: Mill.
 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
- C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
1. Fabricate treads and platforms from pressure-locked aluminum grating with 1-1/4-by-3/16-inch bearing bars at 15/16 inch o.c. and crossbars at 4 inches o.c.
 - a. Surface: Serrated.
 - b. Finish: Mill.
 2. Fabricate grating treads with cast-abrasive nosing and with aluminum angle or plate carrier at each end for stringer connections.
 - a. Secure treads to stringers with bolts.
 3. Fabricate grating platforms with nosing matching that on grating treads.
 - a. Secure grating to platform framing with bolts.
- D. Risers: Open.
- E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.
 1. Material and Finish: Aluminum plate to match finish of other aluminum items.
 2. Fabricate to dimensions and details indicated.

2.7 FABRICATION OF STAIR RAILINGS

- A. Comply with applicable requirements in Section 055200 "Metal Railings."

2.8 FINISHES

- A. Aluminum stairs shall be Mill Finished.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING METAL STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by bolting base plates to concrete unless otherwise indicated.
 - 1. Grouted Baseplates: Clean concrete bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces.
 - a. Clean bottom surface of baseplates.
 - b. Set aluminum-stair baseplates on wedges, shims, or leveling nuts.
 - c. After stairs have been positioned and aligned, tighten anchor bolts.
 - d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
 - e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
 - 1) Neatly finish exposed surfaces; protect grout and allow to cure.
 - 2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
 - D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, or similar construction.
 - E. Fit exposed connections accurately together to form hairline joints.

3.3 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
 - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
 - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.

4. Secure posts and rail ends to building construction as follows:
 - a. Anchor handrail ends to concrete with flanges mechanically connected or welded to rail ends and anchored with post-installed anchors and bolts.
- B. Attach handrails to wall with wall brackets.
 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
 2. Secure wall brackets to building construction as required to comply with performance requirements.

3.4 REPAIR

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 055119

SECTION 055200 - METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Aluminum pipe guardrails, railings, balusters, and fittings.
- 2. Handrails.

- B. Related Requirements:

- 1. Section 033000 - Cast-In-Place Concrete: Execution requirements for placement of anchors, as specified in this Section, in concrete.
- 2. Section 050519 – Post Installed Anchors
- 3. Section 055000 - Metal Fabrications: Attachment plates and angles for metal stairs, including anchorage.
- 4. Section 055119 - Metal Grating Stairs.

1.3 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Design Data: Submit calculations or test data demonstrating that the railings will resist the loads specified in the Florida Building Code at the post spacing provided. Calculations shall be stamped by a professional engineer registered in the State of Florida.
- D. Samples: Submit railing samples when requested by engineer.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Test Reports: Certified copy of mill test reports on each aluminum proposed for use showing physical properties and chemical analysis.

- C. Certificates: Certify that welders have been qualified under AWS within previous 12 months to perform required welds.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 QUALITY ASSURANCE

- A. Perform Work for structural aluminum according to AA ADM 1.
- B. Finish welded joints according to NOMMA Guideline 1, Finish #1.
- C. Perform Work according to OSHA and Florida Building Code standards.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.2, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section and approved by manufacturer.
- B. Erector: Company specializing in performing Work of this Section and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide two rail mechanically fastened or welded pipe railing systems as indicated, fabricated with 1-1/2 inch nominal diameter pipe. Provide Schedule 80 pipe posts, minimum and rails and handrail of Schedule 40 pipe, minimum. Provide continuous posts and top rails. Spacing of posts not to exceed 5 feet 0 inches on center and shall be uniformly spaced except as otherwise indicated. Install railing posts in vertical position.

1. Welding: Provide circumferential welds ground smooth and even to produce a railing that is neat in appearance and structurally sound. Weld in conformity with AWS standards for materials being joined. Cope and fasten rail to post connections with continuous welds. Provide handrail system free of burrs, sharp edges or protrusions on welds. Clean and hand buff welds after fabrication so welds and surrounding area blend with the adjacent finish.
 - a. For welding aluminum, use a weld filler alloy that is compatible with alloys to be joined, that will not discolor the pieces to be joined, and that will not be discolored by anodizing.
 2. Mechanical Fasteners: Locate unobtrusively in countersunk holes with the top, flush with rail surface.
 3. Bending: Form bends in railings as indicated. No distortion of circular railing shape will be allowed. Provide corner bends with a 3 inch centerline radius.
- B. Assemble railing in sections as long as practical, but not greater than 24 feet in length. Provide field splice when an assembled section is to be attached to another section. Provide field splices in railing panels that cross over structure expansion joints.
1. Field Splices: Use internal splice sleeves located within 8 inches of railing posts. Weld sleeves to rails on one side and fasten with set screws to rails on other side. Detail field splice to take differential expansion between railing system and the supporting structure.
 2. When field splice occurs in a railing panel crossing a structure expansion joint, weld sleeves to rails on one side and be free to slide in the rails on other side. Detail field splice to take same movement as structure expansion joint.
- C. Provide bases or supports for railing posts and handrail as indicated on drawings.
1. Where guardrail and handrail is to be fastened to walls, provide screwed wall flanges fastened to walls with three 3/8 inch stainless-steel expansion anchors. The horizontal projection of handrail support off the wall shall provide 2-1/4 inch minimum clearance around the handrail.
- D. For railing openings, fabricate safety gates of matching pipe and rail material and configuration. Provide self-closing gates with approved stop, latch, and stainless-steel closure spring and hinges.
- E. Provide toe boards on railings adjacent to a drop elevation of 4 feet or more. Toeboards are not required on inclined portion of stairway railings or where concrete or steel curbs exist at 4 inches or more in height. Provide toeboards fabricated of 4 inch high channels of same material as railing, having a minimum thickness of 1/8 inch and flanges of not less than 3/4 inch or more than 1-1/2 inch in width. Position toeboards with a maximum clearance of 1/4 inch from floor and fasten to railing posts with 1/4 inch stainless-steel U-bolts, with J-bolts at corner posts, and with clip angles and two 1/4 inch stainless-steel expansion bolts at walls. Or provide proprietary toeboard with fastening system.
- F. Protect railings by paper, an approved coating, or both against scratching, splashes of mortar, paint, or other defacements during transportation, erection, and until adjacent work is complete. Remove protective materials and make surfaces clean and free from stains, marks, or defects.

2.2 MATERIALS

- A. Aluminum Railing System: provide a welded or mechanically fastened, seamless, extruded aluminum pipe system.
1. Rails: ASTM B 429 Alloy 6063-T6.
 2. Posts: ASTM B 429 Alloy 6061-T6.
 3. Splice and reinforcing sleeves, brackets, end caps, toeboards, and similar components: ASTM B 221 or ASTM B 209, Alloy 6063-T6 or 6061-T6.
 4. Cast Fittings: ASTM B 26, Alloy No. 214.
 5. Railing System Fastening Hardware: ASTM A 276, Type 316 stainless-steel.
 6. Finishes: Clear anodized finish after welding, AAMA 611, Class I, AA M12C22A41.

2.3 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site, but not to exceed 24ft in length.
- B. Fabricate components with joints tightly fitted and secured. Furnish sleeves to accommodate site assembly and installation.
- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required. Maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, and consistent with design of component, except where otherwise noted.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where otherwise noted.
- F. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- G. Accurately form components to suit stairs and landings, to each other, and to building structure.
- H. Accommodate expansion and contraction of members and building movement without damage to connections or members.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Supply items required to be cast into concrete with setting templates to appropriate Sections in other Divisions.

3.3 INSTALLATION

- A. Install items, except those to be embedded in concrete under Division 03. Install items to be attached to concrete after such work is completed in accordance with indicated details.
- B. Install components plumb, level, and square, accurately fitted, and free from distortion or defects.
- C. Anchor railings to structure with anchors, and cast aluminum bases.
- D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Assemble with sleeves to accommodate tight joints and secure installation.
- F. Protect surfaces that come into contact with exposed concrete or masonry with a protective coating of an approved heavy bituminous troweling mastic applied in accordance with manufacturer's instructions prior to installation.
- G. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- H. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to masonry or concrete. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- I. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- J. Between aluminum gratings, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4 inch thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

3.4 CLEANING AND PROTECTION

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

- B. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055200

SECTION 055313 - BAR GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes metal bar gratings.
- B. Related Requirements:
 - 1. Section 055100 "Metal Stairs" for grating treads and landings of steel-framed stairs.
 - 2. Section 055000 "Metal Fabrications" for grating supports.
 - 3. Section 055200 "Metal Railings" for structural metal pipe and tube handrails and railings.

1.3 COORDINATION

- A. Coordinate installation of grating with installation of related items. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Clips and anchorage devices for gratings.
 - 2. Manufacturers' published load tables.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work. Identify size, material, and location of supporting members and forward requirements to Section 055000 "Metal Fabrications".

1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of aluminum, certifying that products furnished comply with requirements.
- B. Welding certificates, qualified in the previous 12 months.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide grating conforming to ANSI/NAAMM MBG 531, Type P-19-4, size of grating as shown on Drawings. Do not exceed fabricator's maximum recommended grating span.
- B. Limit grating deflection to 1/4 inch maximum for a uniform live load of 100 psf on maximum span and concentrated live load of 300 lbs applied at the mid-point of the maximum span.

2.2 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

2.3 ALUMINUM

- A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.
- B. Extruded Bars and Shapes: ASTM B 221, alloys as follows:
 1. Grating Bearing Bars: 6061-T6 or 6063-T6.
 2. Grating Crossbars: 6061-T1.
- C. Aluminum Sheet: ASTM B 209, Alloy 5052-H32.
- D. Welding electrode, aluminum: 5356 filler alloy.

2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
- B. Grating clamps, nuts, bolts, washers and other fastening devices for grating shall be Type 316 stainless steel. Anchor grating to supporting system using saddle clips.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.

2.5 FABRICATION

- A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
- F. Provide for anchorage of type specified; coordinate with supporting structure.
- G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.
 1. Provide no fewer than four saddle clips for each grating section with each clip designed and fabricated to fit over two bearing bars.
- H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
- I. Additional Fabrication:
 1. Edge-band openings in grating that interrupt one or more bearing bars with bars of same size and material as bearing bars.
 2. Do not notch bearing bars at supports to maintain elevation.
 3. For openings 2 inches or greater in diameter or dimension, band grating edges with a bar of same depth and thickness as bearing bars. Weld cut bearing bars or cross bars to banding bar.

4. Provide trench grating with symmetrical cross bar arrangement.
5. Fabricate metal frames and supports for grating of same material as grating, unless otherwise indicated.

2.6 ALUMINUM FINISHES

- A. Mill finish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate locations and elevations of grating supports provided under provisions of Section 055000 "Metal Fabrications." Verify that members are properly installed to support bar gratings specified in this Section.
- B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install assemblies in accordance with manufacturer's installations instructions. Install products plumb, level, and square, unless otherwise required by the design.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction and grating supports.
- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- D. Provide additional supports at penetrations through grating in order to meet design criteria.
- E. Fit exposed connections accurately together to form hairline joints.
 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- F. Field Welding: Comply with AWS recommendations and the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners as specified.

END OF SECTION 055313

This page intentionally left blank.

SECTION 099010 - SHOP PRIMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes shop primers not included in other sections.
- B. Related Requirements:
 - 1. Division 09 for field applied painting.
 - 2. Other specifications that reference this specification for primers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include written statement, or published product data, that confirms that the shop primer materials are compatible with the finish and field coatings.
- B. Samples: For each exposed product.

1.4 QUALITY ASSURANCE

- A. Compatibility of Coating Systems - Shop priming with primers that are guaranteed, in writing, by the manufacturer to be compatible with field applied and other coatings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Submerged Surfaces - Shop primer for ferrous metals which will be in contact with water being treated, either submerged or which are subject to splash action or which are specified to be considered submerged service:
 - 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):
 - a. TNEMEC: Series 1 Omnithane.

- b. Carboline: Carboguard 561.
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amerlock 400.
 - e. Or equal.
- B. Non-Submerged Surfaces: Shop primer for ferrous metals which will not be in contact with water being treated, not submerged and not subject to splash action:
- 1. Shop Prime Coat: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):
 - a. TNEMEC: Series 1 Omnithane.
 - b. Carboline: Carboguard 561.
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series or PPG PMC Amercoat 68HS.
 - e. Or equal.
- C. Submerged Surfaces:
- 1. Shop Prime Coat for Ductile Iron Pipe: (Epoxy, Polyamidoamine Shop Primer):
 - a. TNEMEC: Series N140 Pota-Pox-Plus.
 - b. Carboline: Carboguard 561.
 - c. Sherwin-Williams Company (The): Macropoxy 846 NSF Winter Grade Epoxy Mill White.
 - d. PPG PMC Aquapon HB Potable Water Epoxy Coating 95-132 Series or PPG PMC Amerlock 2 Epoxy.
 - e. Or equal.
 - 2. Shop Prime Coat for Ferrous Metal Surfaces: (Zinc Micaceous Iron Oxide Polyurethane Aromatic Shop Primer):
 - a. TNEMEC: Series 1 Omnithane.
 - b. Carboline: Carboguard 561.
 - c. Sherwin-Williams Company (The): Corothane I Zinc Primer 1K Mio-Zinc.
 - d. PPG PMC Durathane MCZ 97-679 Series.
 - e. Or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface preparation: Comply with the manufacturer's written requirements for the substrate to be primed.

3.2 PROTECTION

- A. Non-Primed Surfaces – Apply a heavy shop coat of grease or other suitable rust-resistant coating to gears, bearings surfaces and other similar surfaces which are not to be field painted.

1. Maintain this coating to prevent corrosion until final acceptance testing of equipment.

END OF SECTION 099010

This page intentionally left blank.

SECTION 099100 – PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following substrates:
 - 1. Concrete.
 - 2. Steel and iron.
 - 3. Galvanized metal.
 - 4. Stainless steel.
 - 5. Bituminous-coated surfaces.
 - 6. Piping Systems.
- B. Section includes painting all exposed structural and miscellaneous steel; chemical tanks and systems; mechanical and electrical equipment; conveying systems, pipe, fittings and valves; electrical conduit and appurtenances; all as specified in the attached painting schedules and all other work obviously required to be painted unless otherwise specified. Minor items not mentioned in the schedule of work shall be included in the work of this Section where they come within the general intent of this Section as stated herein.
- C. Paint items noted in “Painting Schedule.”
- D. Provide vinyl film letters and numbers for markings as specified.
- E. Paint items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted.
- F. Paint all factory finish painted items replaced, repaired or damaged during construction.
- G. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.
- H. The following items will not be painted:
 - 1. Concrete except where specified above and scheduled to be painted and seamless flooring.
 - 2. Stainless steel louvers, doors and frames.
 - 3. Finish hardware.
 - 4. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
 - 5. Packing glands and other adjustable parts and name plates of mechanical equipment.

6. Maintenance equipment
7. Plumbing fixtures.
8. Mechanical and Electrical equipment which has been finished painted in the factory as specified in Divisions 40, 43, and 46.

I. Related Requirements:

1. Valve identification is included in Division 40.
2. Shop priming of equipment and piping (except copper piping) are specified in Section 099010 – Shop Priming and included in the respective Section with the item to be primed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Shop Primers, specified in Section 099010 “Shop Primers,” and other Sections are required to be certified by the manufacturer of the field applied painting manufacturer to be compatible with the materials specified in this section.

B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Engineer will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.

- b. Other Items: Engineer will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Engineer at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. All painting materials shall be delivered to the mixing room in unbroken containers, bearing the manufacturer's brand, date of manufacture, and name. They shall be used without adulteration and mixed, thinned, and applied in strict accordance with manufacturer's directions for the applicable materials and surface before using.
- B. Painting materials shall be delivered to the job site in the original unopened containers, bearing the manufacturer's label. A Product Data Sheet and Material Safety Data Sheet for all painting, activators, thinners, accelerators, and other materials shall be obtained from the manufacturer for each shipment of materials to the job site. Painting materials shall be stored in a dry, well-ventilated area, not in direct contact with the ground, where the temperature is maintained between 40 and 120 degrees F. Damaged materials and/or materials exceeding the shelf life shall not be used.
- C. Paints shall be mixed in proper containers of adequate capacity. All paints shall be thoroughly stirred before use and shall be kept stirred while using. No unauthorized thinners or other materials shall be added to any paint. Air shall not be used directly for agitation. Pigmented material shall be strained after mixing. Where application equipment has strainers, they should be sized so as to allow pigment to pass but not foreign material. Multiple (2 or more) component catalyzed materials may not be used beyond the recommended pot life.
- D. Work areas will be designated by the OWNER for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes, and no plumbing fixture shall be used for this purpose.
- E. All recommendations of the paint manufacturer in regard to the health and safety of workmen shall be followed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products by one of the following:

1. Tnemec, Inc.(TN);
2. The Sherwin Williams Company (SW)
3. PPG Architectural Finishes, Inc. (PPG)
4. Ameron (AME)
5. Or equal.

2.2 MATERIALS

- A. All painting materials shall be supplied by one manufacturer, unless otherwise approved by the Engineer. The paint schedule has been prepared on the basis of Tnemec Company Inc. products and application recommendations, unless otherwise noted in the schedule. Equals by Ameron (VyGuard), Sherwin Williams Company (SW), PPG Architectural Finishes, Inc., Ameron (AME) or equal.. All materials shall meet NSF Standard 61 and be fully equal to the Tnemec products listed in the following schedule. No brand other than those named will be considered for approval unless the brand and type of paint proposed for each item in the following schedule together with sufficient data substantiated by certified tests, conducted at no expense to the Owner, to demonstrate its equality to the paint(s) named. The type and number of tests performed shall be subject to the ENGINEER's approval.
- B. Shop priming shall be done with primers that are guaranteed by the manufacturer to be compatible with the finish paints to be used.
- C. No paint containing lead will be allowed. Oil shall be pure boiled linseed oil.
- D. All painting materials shall be delivered to the mixing room in unbroken packages, bearing the manufacturer's brand and name. They shall be used without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface and with the DESIGN/BUILDER's approval before using.
- E. Work areas will be designated by the DESIGN/BUILDER for storage and mixing of all painting materials. Materials shall be in full compliance with the requirements of pertinent codes and fire regulations. Proper containers outside of the buildings shall be provided and used for painting wastes and no plumbing fixture shall be used for this purpose.

2.3 COLOR CODING FOR PIPES AND EQUIPMENT

- A. The color code establishes, defines and assigns a definite color for each process system. Paint all elements which are an integral part of the system, that is originating from the equipment and/or supplying the equipment, between and up to but not including the fixed flanges nor the flexible conduit connections on the equipment. Paint valves and fittings in the color of the main body of the pipe.
- B. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.
- C. All pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports.

2.4 COLOR IDENTIFICATION

- A. All colors numbers and names herein refer to master color card. Colors of specified equal manufacturers may be substituted with approval of the DESIGN BUILDER. Samples of the proposed colors shown in this paragraph shall be presented to OWNER for final approval.
- B. Building surface colors shall be painted as selected by OWNER
- C. The following Tnemec colors shall be used as a basis for the Color Coding Schedule

<u>Colors</u>	<u>Tnemec</u>	<u>Tnemec#</u>
White	White	11WH
Ivory	Bone	08BR
Tan	Longhorn	13BR
Safety Orange	Tangerine Orange	04SF
International Orange	International Orange	05SF
Bright Yellow	Bright Yellow	03SF
Safety Yellow	Lemon Yellow	02SF
Safety Green	Spearmint Green	09SF
Dark Green	Hunter Green	08SF
Light Brown	Twine	68BR
Dark Brown	Terra Cotta	07DR
Safety Red	Candy Apple Red	06SF
Light Gray	Slate Gray	32GR
Medium Gray	Gray	33GR
Dark Gray	Sinker	46GR
Blue Gray	Midnight Gray	14GR
Safety Blue	True Blue	11SF
Light Blue	Fountainbleu	25BL
Medium Blue	Mediterranean Blue	34BL
Dark Blue	Academy Blue	35BL
Aqua	Mermaid	13GN
Blue Green	Merlin	06GN
Dark Bronze	Dark bronze	86BR
Magenta	Cinder Cone	07GR

2.5 LETTERING OF TITLES

- A. Indicate the name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids on each pipe system. Locate the titles shall not more than 26 feet apart and directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, and all pieces of equipment.
- B. Identify titles by the identity of the contents with complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Place identification title locations in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title to be clearly visible from operating positions and adjacent to all control valves.

- C. Die cut numbers and letters from 3.5 mil vinyl film and pre-space them on carrier tape. Protect adhesive and finish surface with one piece removable liners. Use white or black to provide high contrast to the substrate color.
- D. Letter size shall be as indicated in the following table:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LEGEND LETTERS
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

- E. Use Type B ASI/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Provide Optima Bold, upper case letter type. Use Grid 2 spacing. Match arrow to letter type and size. Follow the instructions of the manufacturer in respect to storage, surface preparation and applications of letters.

2.6 TITLES FOR EQUIPMENT

- A. Provide titles consisting of vinyl film as specified above on all equipment using 1-in high Optima Bold upper case, Grid 2 spacing. Use white or black to provide high contrast to the substrate color. Use titles shown on mechanical drawings for bidding purposes. Mount titles at eye level on machines or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, number the items consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example, Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left-hand side.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
- B. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- F. Retain "Shop-Primed Steel Substrates" Paragraph below if primers are shop applied and are not removed in the field.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Mock-up: Provide a sample area of the finished work prepared in strict accordance with this Section to demonstrate the quality and workmanship of painting. When paint colors are required to match existing installed colors, provide as many paint manufacturer's warehouse mixed colors until accepted by the Engineer.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 4. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. No outside spray painting shall be allowed if wind speed exceeds 5 miles per hour or the temperature/humidity exceeds the manufacturer's recommendations. The SUBCONTRACTOR shall be responsible for repairs due to overspray.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe supports.
 - e. Metal conduit.
 - f. Plastic conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 PAINTING SCHEDULE

- A. The following surfaces shall have the types of paints scheduled below applied at the dry film thickness (DFT) in mils per coat noted:

- B. Ferrous Metals

- 1. Submerged or subject to splashing (potable water)

Surface Preparation:	SSPC-SP10
Stripe Coat:	Series N140 (3.0-7.0 mils DFT) applied by brush over weld seams
1 st Coat:	Series N140 (3.0-7.0 mils DFT)
2 nd Coat:	Series N140 (3.0-7.0 mils DFT)
Min total DFT for 2 coats:	12/0 mils.

- 2. Nonsubmerged (exterior)

Surface Preparation:	SSPC-SP6
Stripe Coat:	Series 90-97 (2.5 - 3.5 mils DFT) applied by brush over weld seams
Primer:	Series 90-97 (2.5 - 3.5 mils DFT)
Int. Coat:	Series N69 (3.0 - 5.0 mils DFT)
Topcoat:	Series 73 (2.0 - 3.0 mils DFT)
Min total DFT for 3 Coats:	9.5 mils

- 3. Nonsubmerged (interior)

Surface Preparation:	SSPC-SP6
Strip Coat:	Series N69 (3.0 - 5.0 mils DFT) applied by brush over weld seams
1 st Coat:	Series N69 (3.0 - 5.0 mils DFT)
2 nd Coat:	Series N69 (4.0 - 6.0 mils DFT)
Min total DFT for 2 Coats:	9.0 mils

- 4. Surfaces exposed to temperatures above 250°F

Surface Preparation:	SSPCV-SP10 with anchor pattern of 1.0-1.5 mils
1 st Coat:	Series 39-1261 (0.7 – 1.5 mils DFT)
2 nd Coat:	Series 39-1261 (0.7 – 1.5 mils DFT)
Min total DFT for 2 Coats:	2.0 mils

- C. Non-Ferrous Metals and Galvanized Steel

1. Submerged or subject splashing (potable water)

Surface Preparation: SSPC-SP1 and SSPC-SP7
1st Coat: Series N140 (3.0 - 5.0 mils DFT)
2nd Coat: Series N140 (3.0 - 5.0 mils DFT)
Min total DFT for 2 Coats: 10.0 mils

2. Nonsubmerged (exterior)

Surface Preparation: SSPC-SP1 and scarify
Primer: Series N69 (3.0 - 5.0 mils DFT)
Topcoat: Series 73 (2.0 – 3.0 mils DFT)
Min total DFT for 2 Coats: 6.5 mils

3. Nonsubmerged (interior)

Surface Preparation: SSPC-SP1 and scarify
1st Coat: Series N69 (2.0 – 4.0 mils DFT)
2nd Coat: Series N69 (2.0 – 4.0 mils DFT)
Min total DFT for 2 Coats: 6.0 mils

4. Aluminum in contact with dissimilar metals (nonsubmerged)

Surface Preparation: SSPC-SP1 and scarify
1st Coat: Series N69 (2.0 – 4.0 mils DFT)
2nd Coat: Series N69 (2.0 – 4.0 mils DFT)
Min total DFT for 2 Coats: 6.0 mils

D. Concrete (precast and cast in place)

1. Submerged or subject to splashing (potable)

Surface Preparation: SSPC-SP13
Surfacer: Series 218 applied at 1/16”±
1st Coat: Series N140 (4.0 – 6.0 mils DFT)
2nd Coat: Series N140 (4.0 – 6.0 mils DFT)
Min total DFT for 2 coats (excluding surfacer): 10.0 mils

2. Nonsubmerged (exterior)

Surface Preparation: Clean and dry
1st Coat: Series 156 (4.0 – 6.0 mils DFT)
2nd Coat: Series 156 (4.0 – 6.0 mils DFT)
Min total DFT for 2 coats: 10.0 mils

3. Nonsubmerged (interior conditioned space)

Surface Preparation: Clean and dry
1st Coat: Series 6 (2.0 – 3.0 mils DFT)
2nd Coat: Series 6 (2.0 – 3.0 mils DFT)
Min total DFT for 2 coats: 5.0 mils

4. Nonsubmerged (unconditioned process rooms)

Surface Preparation: Clean and dry
1st Coat: Series 113 (4.0 – 6.0 mils DFT)
2nd Coat: Series 113 (4.0 – 6.0 mils DFT)
Min total DFT for 2 coats: 8.0 mils

E. Interior concrete surfaces of containment areas and sumps

1. For fuel oils and caustics

Surface Preparation: SSPC-SP13
Surfacer Series 218 applied at 1/16”+-
1st Coat: Series 61-5002 (8.0 – 12.0 mils DFT)
2nd Coat: Series 61-5001 (8.0 – 12.0 mils DFT)
3rd Coat: Series 61-5001 (8.0 – 12.0 mils DFT)
Min total DFT for 3 coats (excluding surface): 30.0 mils

2. For acids

Surface Preparation: SSPC-SP13
Surfacer Series 218 applied at 1/16”+-
1st Coat: Series 61-201 (4.0 – 8.0 mils DFT)
Base Coat: Series 61-275 (25.0 – 40.0 mils DFT)
Top Coat: Series 61-282 (4.0 – 8.0 mils DFT)
Min total DFT for 3 coats (excluding surface): 40.0 mils

F. Plastic piping nonsubmerged

1. Interior

Surface Preparation: SSPC-SP1 and scarify
1st Coat: Series N69 (2.0 – 3.0 mils DFT)
2nd Coat: Series N69 (2.0 – 3.0 mils DFT)
Min total DFT for 2 coats: 5.0 mils

2. Exterior

Surface Preparation: SSPC-SP1 and scarify
1st Coat: Series N69 (2.0 – 3.0 mils DFT)
2nd Coat: Series 73 (2.0 – 3.0 mils DFT)
Min total DFT for 2 coats: 5.0 mils

G. Ductile iron pipe

1. Immersion (potable water)

Surface Preparation: SSPC-SP6
1st Coat: Series N140 (6.0 – 8.0 mils DFT)

- 2nd Coat: Series N140 (6.0 – 8.0 mils DFT)
 - Min total DFT for 2 coats: 14.0 mils
 - 2. Interior non-immersion
 - Surface Preparation: SSPC-SP6
 - 1st Coat: Series N69 (6.0 – 8.0 mils DFT)
 - 2nd Coat: Series N69 (6.0 – 8.0 mils DFT)
 - Min total DFT for 2 coats: 12.0 mils
 - 3. Exterior
 - Surface Preparation: SSPC-SP6
 - 1st Coat: Series N69 (6.0 – 8.0 mils DFT)
 - 2nd Coat: Series 66 (2.0 – 4.0 mils DFT)
 - 3rd Coat: Series 77 (2.0 – 3.0 mils DFT)
 - Min total DFT for 3 coats: 12.0 mils
- H. Mill coated pipe
 - 1. Immersion (potable water)
 - Surface Preparation: Pressure clean (3500 psi) spot SSPC-SP10 (near white metal) and SSPC-SP7 (brush blast)
 - Spot Primer: Series N140 (3.0 – 5.0 mils DFT)
 - 1st Coat: Series N140 (4.0 – 6.0 mils DFT)
 - 2nd Coat: Series N140 (4.0 – 6.0 mils DFT)
 - 2. Exterior
 - Surface Preparation: SSPC-SP1 and scarify
 - 1st Coat: Series 66 (4.0 – 6.0 mils DFT)
 - 2nd Coat: Series 66 (4.0 – 6.0 mils DFT)
 - 3rd Coat: Series 73 (2.0 – 3.0 mils DFT)
 - Min total DFT for 3 coats: 12.0 mils
- I. Previously painted steel surfaces with solvent based coatings
 - 1. Below grade and interior non-immersion
 - Surface Preparation: SSPC-SP1 and scarify
 - 1st Coat: Series 66 (4.0 – 6.0 mils DFT)
 - 2nd Coat: Series N6 (4.0 – 6.0 mils DFT)
 - Min total DFT for 2 coats: 10.0 mils
 - 2. Interior non-immersion
 - Surface Preparation: Pressure clean (3500 psi) spot or solvent clean (SSPC-SP1) and spot power tool clean (SSPC-SP3)
 - Spot Primer: Series 135 (3.0 – 5.0 mils DFT)

Barrier Coat: Series 135 (3.0 – 5.0 mils DFT)
Top Coat: Series N69 (4.0 – 6.0 mils DFT)

3. Exterior:

Surface Preparation: Pressure clean (3500 psi) spot or solvent clean (SSPC-SP1) and spot power tool clean (SSPC-SP3)
Spot Primer: Series 135 (3.0 – 5.0 mils DFT)
Barrier Coat: Series 135 (3.0 – 5.0 mils DFT)
Top Coat: Series 73 (4.0 – 6.0 mils DFT)

J. Parking Stall Lines on asphalt pavement

1. Approved reflective pavement marking paint, white in color, conforming to AASHTO standards for materials and installation
 - a. PPG Industries
 - b. 1 Coat Traffic and Zone Marking

K. Any surfaces not specifically named in the Schedule and not specifically excepted shall be prepared, primed, and painted in the manner and with materials consistent with these specifications. The Engineer shall select which of the manufacturer's products, whether the type is indicated herein or not, shall be used for such unnamed surfaces. No extra payment shall be made for this painting.

3.7 COLOR SCHEDULE

A. The following list of piping is intended to identify all potential piping and establish a color selection for each based on industry standards. The final color selection will be determined by the Owner at the time of shop drawing review. The Contractor shall submit physical color charts for color selections.

**SCHEDULE 099100-A
Pipe Identification and Color Coding**

Pipe System	Paint Color	Bands	Abbreviation
Raw Water	Safety Green		RW
Finished Water	Safety Blue		FW
Potable Water	Safety Blue		PW
Non-Potable Water	Safety Green		NPW
Compressed Air	Green	Red	AIR
Drain	Dark Gray	Red	D
Sample	Light Grey	Red	SA
Sodium Hydroxide	Yellow	Blue Green	CA
Sodium Hypochlorite	Yellow	Dark Yellow	SH
Vent	Dark Green		V
Softened water	Blue	White	SW
Corrosion Inhibitor	Magenta	Yellow	CI
Carbon Dioxide	Blue	Yellow	CO ₂

END OF SECTION 099100

SECTION 233116 – FIBERGLASS DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Design, fabricate and install all fiberglass reinforced plastic (FRP) ductwork and accessories and any incidental work or components required to provide complete odor control exhaust ductwork systems as shown and specified herein.
- B. In general, these FRP duct systems shall include ductwork and fittings, transitions, reinforcing, fasteners, and structural supports, and accessories such as access panels, access doors, duct nozzles and drains, turning vanes, flexible connectors and manual gear operated isolation and balancing dampers. All ductwork shall be of size and material as specified herein and as shown on the Drawings. All duct sizes indicated on the Drawings are clear, inside dimensions.
- C. Any change in duct sizes, offsets, transitions and fittings required to accommodate job conditions shall be submitted to the Engineer for approval.

1.2 RELATED WORK

- A. Concrete is included in Division 03.
- B. Section 443133 “Odor Control Bioscrubbing Equipment”.

1.3 SUBMITTALS

- A. All submittals shall be clearly identified as follows:
 - 1. Date of submission
 - 2. Project number
 - 3. Project name
 - 4. Contractor identification
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
 - d. Manufacturer or supplier representative
 - 5. Identification of the product
 - 6. Reference to Contract drawing(s)
 - 7. Reference to specification section number, page and paragraph(s)
 - 8. Reference to applicable standards, such as ASTM or Federal Standards numbers
 - 9. Indication of Contractor’s approval
 - 10. Contractor’s Certification statement
 - 11. Identification of deviations from the Contract Documents, if any
 - 12. Reference to previous submittal (for resubmittals)

- B. Submit to the Engineer ductwork shop drawings, including dimensional and construction details of ductwork, transitions, elbows, fittings, and accessory items such as access panels or doors, turning vanes, hangers, and structural supports, and reinforcing. Coordinated layout drawings of individual duct systems shall be submitted; scale shall be 1/4-in = 1-ft-0-in minimum.
- C. The following additional data shall be submitted.
 - 1. Manufacturer's qualification and experience data, material specifications, installation instructions, factory and field quality control procedures, catalog data, brochures, descriptive matter, illustrations, diagrams, and color selector charts of ductwork coatings.
 - 2. Submit documentation indicating that the personnel responsible for lamination as required in this Specification qualified.
 - 3. Specific handling and storage requirements and Material Safety Data Sheets (MSDS) for ductwork, joint kits, and resin systems.
 - 4. Resin system data, including chemical environment service test data, case history data of similar installations (with contact addresses), resin pot life and time versus temperature data required for complete resin cure for laminate thicknesses actually proposed.
 - 5. Submit fabrication procedures for record purposes only.
 - 6. Submit a letter certifying that the laminates fabricated with the proposed resin system will give satisfactory performance under the specified physical and chemical service conditions and stating the service conditions for which certification is provided.
 - 7. Submit construction details for flexible connectors, expansion joints, elbows, transitions, junctions, spectacle flanges and flanged fittings and including dimensioned laminate cross sections and flange fabrication and assembly details.
 - 8. Submit results of factory readings taken with "Barcol Hardness Impressor" and provide procedure to field check for complete cure of resin.
 - 9. Detailed instructions for field joining of the ductwork; including field quality control procedures.
 - 10. Submit shop test reports for fiberglass reinforced plastic dampers.
 - 11. Certified service tables for the resins being used and the expected contaminants showing satisfactory service for the required design conditions.

1.4 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
 - 1. ANSI RTP-1 - Reinforced Thermoset Plastic Corrosion Resistant Equipment.
 - 2. ANSI/AMCA 500-D-07 Figure 5.8 Zero Leak (Bubble Tight) Damper Bubble Test.
 - 3. National Bureau of Standards Voluntary Product Standard PS 15-69, "Custom Contact Molded Reinforced Plastic Chemical Resistant Process Equipment"
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- C. American Society for Testing and Materials (ASTM)
 - 1. ASTM C581 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service.
 - 2. D 635 - Standard Test Method for Rate of Burning.
 - 3. D 638 - Test Method for Tensile Strength of Plastics.

4. D 790 - Standard Test Methods for Flexural Properties of Reinforced and Unreinforced Plastics.
5. D 2996 - Standard Specification for Filament Wound “Fiberglass (Glass Fiber reinforced Thermosetting Resin) Pipe.
6. D -6041- Standard Specification for Contact Molded “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Corrosion Resistant Pipe and Resins.
7. E - 84 Standard Test for Surface Burning Characteristics of Build Materials.
8. E - 3839 – Standard Guide for Underground Installation of Fiberglass (Glass Reinforced Thermosetting Resin) Pipe.

D. National Fire Protection Association (NFPA)

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.
2. NFPA 91 - Standard for Exhaust Systems for Air Conveying of Materials.
3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

E. Underwriters Laboratories (UL)

1. UL 555 - UL Standard for Safety Fire Dampers.

F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. All FRP duct and fittings except for accessories such as dampers, flexible connections, turning vanes, etc., shall be fabricated by a single manufacturer experienced in the fabrication and installation of systems similar to those specified.
- B. The ductwork manufacturer shall provide a full time representative from the factory for training of installers, and for field supervision, direction and inspection of the installation.
- C. Corrosion resistance data shall be based on ASTM C581.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Equipment, material and spare parts are to be shipped complete except where partial disassembly is required by transportation regulations or for protection of components. No ductwork or components shall be shipped prior to complete resin cure.
- B. Inspection of the duct and components will be made by the Engineer or other representative of the Owner after delivery. Materials shall be subject to rejection at any time on account of failure to meet any of the specification requirements. Material rejected after delivery shall be marked for identification and shall be immediately removed from the jobsite.
- C. Store all fiberglass joint kits, and resins to provide protection from fire, precipitation, dust, and salt, and to maintain product storage temperatures within the limits established by the

manufacturer's storage and handling requirements. Observe all manufacturer's storage and handling requirements and recommendations. All resin system components, not consumed by the end of their recommended shelf life, shall be removed from the jobsite.

1.7 STANDARDS OF CONSTRUCTION AND INSTALLATION

- A. The ductwork construction and installation details shown on the Drawings and specified herein represent acceptable methods of construction and are intended to define the quality of construction and installation to be furnished. Alternate details and methods may be submitted for approval together with a reason for requesting the use of an alternate.

1.8 TOOLS, SPARE PARTS AND MAINTENANCE MATERIALS

- A. The duct system shall be furnished with the following:
 - 1. All materials in kit form to make or repair three average size system joints. Materials shall be packaged for long term storage. No resin is required.
 - 2. For each joint kit provide one set of FRP applicators tools required to make the necessary minor joint repairs.
 - 3. Names and addresses of all manufacturers of: Fiberglass reinforcements, resins, hardeners and components used to repair and maintain the FRP duct system.
- B. Joint kits shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location, until transferred to the Owner at the conclusion of the Project.
- C. Material Safety Data Sheets (MSDS) for all components must be furnished.

PART 2 - PRODUCTS

2.1 DUCTWORK DESIGN CRITERIA AND STANDARDS

- A. Physical Design Criteria
 - 1. Temperature: minus 10 degrees F to 125 degrees F
 - 2. Internal Pressure: 20-in H₂O w.g. positive; 20-in H₂O w.g. negative
 - 3. Flow medium and velocity: Odor-filled air with hydrogen sulfide at 4,000 feet per minute
 - 4. Support Spacing: As shown on the drawings but not greater than 5-foot spacing on center.
 - 5. Design Tensile Strength: Laminate tensile strength of 9,000 psi maximum. Decrease ultimate tensile stress as appropriate to the laminate design.

- a. Round Ducting: The maximum allowable design tensile strength shall be the ultimate tensile stress divided by 5.
- b. Rectangular Ducting: The maximum allowable design tensile stress shall be the ultimate tensile stress divided by 10.

B. Chemical Environment

1. The following chemical/moisture/temperature conditions are expected to exist at various times in the exhaust air stream. The resins used shall be suitable for all of the following:
 - a. Hydrogen sulfide - up to 80 ppm
 - b. Water Vapor - up to 100% RH with possibility of carryover from scrubber mist eliminator
 - c. Temperature Range: 20 to 105 degrees F typical

C. Ductwork Design Standards

1. Ductwork structural analysis and design calculations shall be performed in accordance with the procedures specified in ANSI/ASME RTP-1 latest edition.
2. Where reference is made to compliance with NBS PS-15-69 requirements, those requirements shall be considered the minimum acceptable criteria and may be used only when the calculations performed according to ANSI/ASME RTP-1 procedures demonstrate that the NBS 15-69 requirements meet the specified design criteria.

2.2 FIBERGLASS REINFORCED PLASTIC (FRP) DUCTWORK

A. FRP ductwork shall be filament wound construction.

B. FRP ductwork structural layers and exterior shall have a flame spread rating of 25 or less.

C. Laminates

1. Materials of construction shall be as specified herein and shall be the same for the Above Grade Duct, Buried Pipe, Dampers and Flex connectors.
2. Minimum Corrosion Liner:
 - a. One layer of "C" or Nexus veil as specified for the service environment.
 - b. Remainder 1-1/2 oz/ft² of mat to total minimum thickness of 0.096 inches on surface exposed to the service environment.
3. Resin: Fire retardant premium vinyl ester throughout as follows unless otherwise recommended by the resin manufacturer for the service environment:
 - a. Ashland Chemical Hetron vinyl ester 992FR-SB 27 or Equal.
4. Resin for Structural Layers: Resin with sufficient antimony trioxide or pentoxide for Class I fire rating.
5. Glass: For filament winding provide continuous filament, single end (strand) Type E, Silane, glass roving; designed for filament winding, having a minimum yield 113 yd/lb. For contact molded provide 1 oz/ft² of Type E-Glass, Silane, Chopped Strand Mat with

- strand lengths of 2 inches and Spray-Up Roving Type E-Glass with a yield of 154 yd/lb. Glass to be manufactured by Owens Corning or-equal.
6. Color: A pigmented gel coating containing UV inhibitor shall be applied as the final layer to all above grade ductwork. Gel coating shall be applied during the manufacturing process and shall be sufficiently cured using Methyl Ethyl Ketone Peroxide (MEKP) catalyst. All laminated field joints on above grade ductwork shall be similarly coated by the installer. The color of the gel coating shall be selected by the ENGINEER during the submittal process. Buried FRP ductwork shall not require gel coating.
 7. Ultra Violet Stabilizer: Add to the exterior surface resin coat of fabrications intended for outside service, in the type and amount recommended by the resin manufacturer
 8. Provide fasteners, field joints, expansion joints, dampers, and supports required for complete installation of a duct system.
- D. The inner surface shall be free of cracks and crazing with a smooth finish and with an average of not over two pits per square foot, providing the pits are less than 1/8-in in diameter and not over 1/32-in deep and are covered with sufficient resin to avoid exposure of inner surface fabric. Some waviness is permissible as long as the surface is smooth and free of pits.
- E. Calculations for wall thickness determination shall be based on the structural fiberglass reinforced wall only structural calculations shall be provided by a licensed Florida PE experienced in the design of FRP duct and pipe. Long term deflection shall not exceed one percent of duct diameter or duct width for rectangular ducts. Round and rectangular FRP ductwork shall be designed using a safety factor of 10 to 1 for pressure and 5 to 1 for vacuum service or in accordance with ANSI RTP-1. Duct shall be designed by manufacturer to resist specified loadings but in no case shall FRP duct be less than the following thicknesses:

<u>Diameter (-in)*</u>	<u>Filament Wound Thickness (-in)</u>
Less than 18	0.25
20 to 36	0.375
42 – 54	0.5
60 – 72	0.625

* Where rectangular duct is used, the longest dimension shall be considered equivalent to diameter.

- F. Tolerances
1. Out-of-roundness of duct shall be limited to plus or minus 1/8-in or plus or minus one percent of duct inside diameter, whichever is greater for all duct sizes.
 2. Rectangular duct tolerances shall be plus or minus 3/16-in for duct side dimensions up to 18-in and plus or minus one percent for dimensions of over 18-in on a side.
 3. All unflanged duct shall be square on the ends in relation to the duct axis within plus or minus 1/8-in up to and including 24-in diameter and rectangular duct up thru 72-inches perimeter; and plus or minus 3/16-in for all larger sizes of both round and rectangular ducting.
- G. Reinforcing

1. Round and rectangular duct and fitting reinforcing shall be factory located and installed to avoid duct hangers, support saddles, bracing, branch take offs and entries, and plenum connections. Routine field cutting and field relocation of factory installed reinforcing is not acceptable. There shall be not less than a 1/4-in build-up of FRP over the duct at each support.

2.3 FITTINGS, FLANGES AND JOINTS

- A. All fittings such as elbows, laterals, tees, and transitions shall be of the same resin as and equal or superior in strength to the adjacent duct and shall have the same internal dimensions as the adjacent duct.
- B. Round Standard Elbows
 1. Standard elbow centerline radius shall be equal to 1.5 times the diameter.
 2. Standard elbows up to 24-in diameter shall be smooth radius molded elbows. Standard elbows 30-in diameter and greater may be mitered sections as specified herein.
 3. 0 to 45 degree elbows shall contain one mitered joint and two sections. 45 to 80 degree elbows shall have a minimum of two mitered joints and three sections. Elbows greater than 80 degrees shall have a minimum of four mitered joints and five sections even if shown on the Drawings with fewer sections.
- C. Rectangular Fittings
 1. Fittings shall be factory manufactured to meet the specified design criteria and in accordance with approved submittals. Factory install reinforcing ribs as required to meet the specified deflection requirements and to provide a system free from pulsing, warpage, sagging and undue vibration.
 2. Provide turning vanes in all mitered rectangular elbows. Rectangular elbow turning vanes shall be of FRP construction, solid wall construction with an airfoil shaped profile.
 3. Custom flanges shall be designed as required to connect to fans, coils, dampers and ductwork. Coordinate flange sizes to match approved equipment dimensions.
- D. Flanges
 1. All connections to expansion joints, butterfly dampers, multiblade dampers, tanks, or other equipment shall be flanged and constructed of the same material as the duct. Gaskets shall be hypalon. Flanges shall be hand laid up to thickness specified in PS 15-69 except that minimum thickness shall be 3/4-in. The flange shall be integral to the duct per ASTM RTP -1. Each flange face shall be ground flat, and a new 100 mil corrosion barrier shall be applied. The flange shall be anchored to a waxed table to ensure the flatness tolerance outlined above. The face shall be textured for use with full face hypalon gaskets, 1/8-in minimum thickness, 60 durometer or as recommended by the FRP system designer.
 2. Flange drilling shall be as per PS 15-69 or as required by the FRP designer. Field drilling is permitted if approved by the Engineer. All bolt holes shall be back spot faced for a washer seat. All flange bolts shall be torqued to values as recommended by the manufacturer.
 3. Fasteners: Furnish all bolts, nuts, washers and other fasteners required. Material of metallic fasteners shall be Type 316 stainless steel.

E. Fitting and Flange Tolerances

1. Fittings:

- a. The tolerance on angles of all fittings shall be plus or minus one degree, up to and including 24-in diameter and plus or minus 1/2 degree for 30-in diameter and above.

2. Flanges:

- a. Flange faces shall be perpendicular to the axis of the duct within 1/2 degree.
- b. Flange faces shall be flat to within plus or minus 1/32-in, up to and including 18 inch diameter and flat within plus or minus 1/16-in for 20-in diameter and larger.
- c. Provide custom filler pieces as required to mate flanges squarely.

F. Joints

1. Non-flanged duct joints shall be butt wrapped or bell and spigot joints. Bell and spigot joints shall be sealed with a standard butt joint overlay as per PS 15-69. The interior opening between the bell and spigot shall be sealed with a resin paste so that no glass fibers are exposed and all voids are filled. Field cut duct ends and exposed glass fibers shall be resin coated prior to joint assembly to maintain a continuous interior corrosion barrier. Coat all exterior surfaces of joints with a paraffinated resin-rich gel coat with UV inhibitors.
2. Total width of overlay for butt-wrap joints shall be not less than 6-in for diameters from 6-in up to and including 30-in, 36-in and larger shall be not less than 10-in.

G. Manufacturers

1. Qualification of Ducting Manufacturer: Manufacturer shall provide proof of having experienced personnel, specializing in the design and manufacture of FRP duct. Manufacturer shall have a facility with sufficient capacity and work force, dedicated to the design and fabrication of custom-made, corrosion resistant fiberglass reinforced plastic products of quality and size specified herein. Manufacturer shall have a minimum of 10 years of successfully operating from its facility and shall submit reference information on at least 5 wastewater treatment plants in which its FRP odor control ducting systems have been installed in the last five years and are currently in operation. Include name, address of each facility, along with phone number of contact person. Provide date and details of each installation.
2. Responsibility of Manufacturer: The manufacturer of the FRP ductwork shall be singularly responsible for the fabrication, lamination of field joints, and performance of the odor control air conveyance fiberglass ducting system. Manufacturer shall be a licensed contractor with sufficient experienced personnel typically engaged in applying FRP laminate field joints on site. Manufacturers that do not install FRP odor control ductwork systems will not be accepted. Manufacturer shall coordinate with Contractor to do all laminations on-site and upon completion, inspect and certify that the ducting system has been correctly installed and operating properly.
3. Ductwork system supplier shall be the manufacturer of the ductwork. "Packagers" of the ductwork system which are not the manufacturer shall not be accepted. The manufacturer of the FRP ductwork shall provide single-source responsibility for the ducting system including dampers and connectors.

4. Manufacturers

- a. Midwestern Fabricators, Salt Lake City, UT
- b. Daniel Mechanical, Upland CA
- c. ECS Environmental, Belton, TX
- d. Approved Equal

2.4 DRAINS AND LOW POINTS

- A. Slope bottom surfaces of rectangular ductwork and plenums to low points for collection of condensation, which may occur in the ductwork. Provide flanged FRP nozzles for attachment of field installed drain piping and valves.
- B. Provide 1-1/2-in minimum schedule 80 PVC pipe and PVC ball valve duct drains in the bottom of all main, branch and riser ducts to allow removal of condensate. Insulation and heat tracing should be applied where freeze protection is required by the environment.

2.5 FLEXIBLE CONNECTORS

- A. Furnish flexible connectors at inlet and outlet of each fan and in the duct runs where required for expansion, contraction and movement. Flexible connections shall be W-design or arch design units constructed of Hypalon rubber minimum 3/16-in thick, reinforced with a strong synthetic asbestos-free fabric suitable for corrosive service. The flexible connections shall be designed to minimize the transmission of vibration from the fans to the ductwork at the fan suction and discharge connections. Flexible joints to allow for system thermal expansion and contraction shall be designed to allow for the required movements as calculated by the FRP system designer. For flexible joints subjected to continuous vacuum service, design any required set back clearances into the joint, to avoid obstruction of the air stream by the joint material. Ends shall be flanged, with flanges matching duct or fan connection flanges. Corners on rectangular expansion joints shall be molded and free of patches or splices. The flexible connections shall be suitable for outdoor service and temperature ranges from minus 10 degrees F up to 125 degrees F, pressure to 1 psig and vacuum to 28-in water column. Furnish split Type 316 stainless steel back-up retaining bars for securing connector flanges to their mating metal or FRP flange. Fastener materials shall be as specified for flanges.

1. Manufacturer:

- a. Holz Rubber Company.
- b. Mercer Rubber Company.
- c. Proco Products, Incorporated.
- d. Daniel Mechanical
- e. ECS Environmental
- f. Approved equal

2.6 FIBERGLASS REINFORCED PLASTIC DAMPERS

- A. Manufacturers: Following or equal:

1. Daniel Company's DanELAST Model 303,ECS X03, BELCO 204, Ershigs Type B
2. Volume Control and Balancing Dampers
 - a. Zero leak Isolation Fiberglass Round Damper:
 - 1) All damper bodies shall be designed to the greater of the following values:
 - a) Not less than 50 inches of water pressure and 5 inches of water vacuum.
 - b) The damper manufacturer shall be a certified AMCA member in good standing, having had their product line tested by an AMCA certified laboratory. Damper blades may be affixed to the blade or annular corrosion resistant elastomer sealing seat shall be embedded in the damper body to achieve a bubble tight seal. Blade seals shall be a PTFE encapsulated O-ring. Non – PTFE seals or bladder-type seals molded into the body are NOT acceptable.
 - c) Damper frames shall be vinyl ester resin fabricated to ASME/ANSI RTP-1.
 - d) Damper flanges shall be per NBS PS 15-69 Table 2, hand lay- up integral to body per ASME RTP-1-2005 standard Figure 4- 11
 - e) Damper blades shall be vinyl ester resin similar to damper frame having a calculated percent deflection of L/360. Damper blades shall be of the single laminate design with corrosion liners applied to both sides and any external stiffeners. All stiffeners shall be integral to the blade. The use of coring materials shall not be allowed to thicken the blade.
 - f) Damper shaft shall be solid Type 316 stainless steel with nuts, bolts, and washers encapsulated in FRP. The shaft shall extend across the diameter of the damper. Shaft shall be completely replaceable and easily disassembled from the body and blade.
 - g) Shaft seal shall be located at the penetration of the fiberglass body. Shaft seals shall consist of hypalon packing material and “O” rings in an adjustable compression type housing, made of PVC or the same FRP material as the damper body. No other materials will be permitted for the shaft seal compression type housing. No other type of seal will be acceptable. The shaft seals shall be designed to permit external access for easy adjustment and/or replacement of packing material without having to remove the damper from the duct line. Shaft seal assemblies shall contain no metal parts.
 - h) Bearings shall be PVC or PTFE sleeve type and shall require no lubrication. Bearings shall withstand air stream temperatures of up to 140 degrees Fahrenheit.
 - i) Provide all dampers 24” diameter and larger with hand-wheel driven worm gear operators mounted to FRP stand-off plate made integral to damper body. Dampers smaller than 24” diameter shall be operating using hand lever with locking quadrant. The worm gear operators shall be sized for the pressure rating and torque required to rotate the blade from opening to closed positions. A 316 stainless steel adaptor shall be used to connect the operator with the solid shaft made of the same material. The operator shall have a hand wheel handle and shall be epoxy coated to resist corrosion. Dampers of all sizes, which are located at an elevation of 7 feet above the floor, shall be provided

with chain wheel operators. Chain wheel sprockets along with anti-gagging chain guides and corrosion resistant chain link of appropriate lengths shall be coupled with worm gear operators of the type previously specified. Worm gear operator shaft diameters shall be sized large enough to withstand pull forces of 300 pounds. Chain wheel sprockets shall be manufactured by Babbitt Company, or equal. Worm gear operators shall be Model DT-12 as manufactured by Dyna Torque, or equal.

- j) Dampers shall be designed so that all parts including shaft, blade, bearings, compression seal, handle, perimeter seal, and operator may be disassembled for maintenance and repair using simple hand tools. A list of spare parts and instructions on how to replace dampers shall be made readily available by the manufacturer as part of an operation and maintenance manual. "Throw-away" or disposable dampers will not be allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All ductwork shall be fabricated and erected as shown on the Drawings or as specified herein. Ductwork shall be rigidly supported and secured in an approved manner in accordance with this Section. Bracing and vibration isolators shall be installed, where necessary, to eliminate vibration, rattle and noise. Hangers shall be installed plumb and securely suspended from supplementary steel or inserts in concrete beams. Lower ends of hanger rods shall be sufficiently threaded to allow for adequate vertical adjustment. Building siding and metal decking shall not be used to hang ductwork.
- B. During installation the open ends of ducts shall be closed to prevent debris and dirt from entering. Work shall be installed in accordance with the overall approved progress schedule and in close cooperation with all other trades so there will be no delay to other trades.
- C. Install heating coils, flow sensors, manual dampers, silencers and other system appurtenances supplied under other sections.
- D. The Drawings of the air ducts and air risers indicate the general location for installation of the ducts and risers. Should additional offsets or changes in direction be made, these changes must be considered in the original bid and shall be installed at no additional cost to the Owner.
- E. All necessary allowances and provisions shall be made in the installation of the ducts for the structural conditions of the building. Ducts shall be transformed or divided as may be required. Wherever this is necessary, the cross-sectional area shall be maintained. All of these changes, however, must be approved and ducts installed as directed by the Engineer or as approved on shop or erection drawings.
- F. The taper of all transformations shall be not more than 15 degrees unless shown otherwise on the drawings.

- G. Do not remove or alter factory installed duct reinforcing ribs except as required to accommodate duct alterations due to unexpected field conditions. Notify the Owner's representative prior to starting any field modifications involving ductwork structural reinforcing members. The Contractor may be required to submit additional design calculations to demonstrate structural design integrity of ductwork and fittings requiring reinforcing modifications in the field.
- H. Tops of all exterior ducts shall be sloped to shed water.

3.2 HANGERS AND STRUCTURAL SUPPORTS

- A. Rectangular and Round Ductwork - Spacing and size of hangers and supports shall be as required by the ductwork manufacturer.
- B. All elevated duct supports and hanger materials shall be Type 316 stainless steel.
- C. Ducts running near ground level shall be supported in neoprene lined concrete cradles and be attached with 316SS bolts and bands.
- D. All expansion joints dampers and similar items shall be supported within 18-in of the joint unless otherwise approved.

3.3 DUCTWORK FITTINGS AND ACCESSORY ITEMS

- A. Duct Elbows - Changes in direction and offsets shall be made in a gradual manner to facilitate streamline flow of air. Unless otherwise shown all elbows shall have a centerline radius of not less than 1-1/2 times the width of the duct in the plane of the elbow.
- B. Access Manways and Inspection Ports
 - 1. Bolted access doors shall be installed where listed, where shown on the Drawings and wherever access may be required for service, maintenance and adjustment. Access manways shall be 30-in diameter except where the duct geometry requires a rectangular door; the largest door that will fit the duct will be used. Access doors shall be of the same material as the duct. Doors shall be equipped with gaskets and bolted. Access door fasteners and hardware shall be Type 316 stainless steel. FRP inspection ports are not shown on the Drawings, but shall be provided at the following locations, and shall be 12-in diameter, gasketed and bolted:

3.4 DUCTWORK AT SPECIAL OR EXISTING FLANGES

- A. Where ducts connect to or terminate at special flanges, provide any required FRP matching flanges; with EPDM or Hypalon gaskets and stainless steel fasteners.

3.5 QUALITY

- A. All ductwork shall be free from pulsation, chatter, vibration or objectionable noise. After system is in operation, should these defects appear they shall be corrected by removing, replacing or reinforcing the work. No discreet tones will be allowed. Corrosion liners shall be translucent.

- B. The Engineer reserves the right to reject delivery of any pieces of FRP equipment found upon inspection to have any of the following defects in the laminate:
1. Blisters
 2. Chips
 3. Crazing
 4. Exposed glass
 5. Cracks
 6. Burned areas
 7. Dry spots
 8. Foreign matter
 9. Surface porosity
 10. Sharp discontinuity
 11. Trapped air
 12. Any item which does not satisfy the tolerances as specified.

3.6 CLEANING OF DUCTWORK

- A. All ductwork, fans, outlets and other parts of the ductwork systems shall be maintained in a clean condition during installation.
- B. Complete ductwork systems shall be cleaned and inspected prior to testing and air balancing, and prior to making final connections to the packaged odor control system.

3.7 TEST PORTS AND INSTRUMENT NOZZLES

- A. Where shown on the Drawings and where required for testing and balancing instrument insertion ports shall be provided. Size (3/4-in FPT minimum) and location of ports shall be coordinated with the contractor performing air balancing. Ports shall be sealed with threaded PVC plugs. When the ductwork will be lagged, the port shall be extended to the face of the base insulation, and the port shall be provided with a removable lagging cover.
- B. Where flow measurement and other field installed instrumentation is shown on the Drawings or specified for installation in sections of FRP ductwork, provide flanged nozzles compatible with the instrument installation requirements. Coordinate with the installation dimensional requirements of approved instruments.

END OF SECTION 233116

This page intentionally left blank.

SECTION 260000 - ELECTRICAL WORK - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. In general, the work specified in this division of the specifications includes the furnishing of all labor, material, auxiliaries, and services necessary to install complete and properly operating electrical systems, including all fees, charges, and permits necessary.
- B. The Contractor shall furnish and install all wire, cables, conduits, wiring, wiring devices, lighting fixtures, motor controllers, safety switches, relays, control equipment, and all other apparatus and accessories indicated, specified, or required for complete lighting, power, control and instrumentation systems for the project facilities.
- C. The Contractor shall refer to every section of these specifications for installation and coordination requirements applicable to the work specified in this division. The Contractor shall furnish and install all wiring and connections to all electrical equipment furnished under other sections of these specifications, except where specified or indicated otherwise.
- D. The Contractor shall coordinate all electrical work with other project construction trades, installation requirements, sequence of construction schedule, etc., including coordination and installation of required conduit sleeves and supporting devices.
- E. The Contractor shall be required to coordinate all electrical system connections with each appropriate utility company and shall furnish and install all equipment or material necessary to provide complete electrical and communication services in accordance with all utility company requirements.
- F. Unless otherwise indicated, the basic materials and methods included in this section of the specifications shall be applicable throughout the project.

1.2 GENERAL REQUIREMENTS

- A. Design drawings are diagrammatic and intended to show approximate installation and equipment locations. All dimensions shall be verified in the field and coordinated with shop drawings issued. Equipment schedules are intended to serve as a guide only and do not relieve the Contractor of the responsibility for the complete furnishing and installation of all wiring, cable, conduits, or additional apparatus required.
- B. The Contractor shall furnish, install, maintain, and remove upon completion of the project, all temporary service required for construction and testing. The service shall be for general power and lighting and shall include distribution system, panelboards, grounding, branch circuits, general lighting, and receptacles as required.
- C. The Contractor shall furnish and install reinforced concrete pads, for electrical equipment, of size as shown on the drawings or required. Unless noted otherwise, pads for indoor equipment

shall be 4 inches high and exceed the equipment dimensions by 6 inches on all sides not flush to a wall; pads for outdoor equipment shall be a minimum of 12 inches thick and exceed the equipment dimensions by 2-1/2 feet on sides equipped with door access and 6 inches on all remaining sides. Motor control centers, switchboards, etc., located indoors and equipped with a wireway at the base, shall be centered on a continuous reinforced concrete curb, minimum 6 inches high and 8 inches wide.

- D. The Contractor shall furnish a covered, weather-protected facility, providing a clean, dry, non-corrosive environment for storage of all electrical and instrumentation equipment incorporated into this project in accordance with the provisions of the General Conditions.
- E. The Contractor shall furnish and install a system of engraved, laminated nameplates (black lettering on a white background), designed to identify each major piece of equipment.
- F. Motors will be furnished with the equipment they drive unless indicated otherwise. Motors shall be premium efficiency design. Motors located outdoors or within corrosive environments shall be severe duty construction.
- G. The Contractor shall remove all existing electrical equipment within areas to be demolished and shall return all reusable material to the Owner. Equipment feeder conductors shall be removed up to the first remaining circuit disconnect.
- H. Existing receptacles, light switches, lighting fixtures, etc., which become inaccessible or nonfunctional as a result of the new construction, shall be relocated to become accessible and functional. Replace or reroute the existing branch circuits as required to accommodate the relocated devices.
- I. All electrical apparatus and lighting equipment shall be in compliance with the Florida Building Code Fifth Edition (2014) Energy Conservation, and the Federal Energy Policy Act of 2005, including all subsequent updates, revisions, and replacements.
- J. All electrical equipment exposed in wet wells, on treatment structures, in direct exposure to process, chlorine, or chemical atmospheres, or otherwise subject to accelerated corrosion, shall be furnished as specified for "corrosive atmospheres".
- K. All electrical equipment and installation within hazardous areas shall comply with the requirements of the National Electrical Code for Class I, Division 1, Hazardous Locations.

1.3 SUBMITTALS

- A. For each individual section of this division, there shall be submitted for approval a single, complete shop drawing submission. All elementary and schematic diagrams shall be provided with indication of system coordination and complete description of sequence of operation. Deviations from the contract documents shall be clearly identified. One copy of each shop drawing submittal shall be provided in PDF format.
- B. Complete operation and maintenance instruction manuals, including system schematics which reflect "as-built" modifications, shall be provided. All wire terminations shall be numbered and identified on as-built drawings included as part of the operations and maintenance manuals.

All drawings included within the operation and maintenance manuals shall be reduced to a maximum dimension of 17 inches x 11 inches and shall be legible and reproducible. Special maintenance requirements particular to the system shall be clearly defined along with special calibration and test procedures. One copy of each operation and maintenance manual submittal shall be provided in PDF format.

- C. Following approval of the operation and maintenance instruction manual submittals, an electronic copy of all as-built electrical apparatus drawings, schematic diagrams, control wiring diagrams, instrumentation drawings, etc. shall be provided. A drawing index, identifying each electronic drawing file name and a description of the contents, shall be included within the operation and maintenance instruction manuals.
 - 1. Unless otherwise approved prior to submittal, all electronic drawings shall be provided on compact disk in both PDF and AutoCAD 2017 format.
- D. One complete set of design drawings shall be neatly marked daily as a record of job progression and "as-built" installation. The drawings shall reflect the actual installed locations of all equipment and indicate the exact routing and elevations of all concealed conduits. Upon completion of the project, the drawings shall be coordinated with the as-built drawings and submitted to the Engineer. One copy of the final as-built drawings shall be provided in PDF format.
- E. The Contractor shall maintain a record of all construction documentation including construction survey data, inspection reports, test reports, startup logs, etc. Upon completion of the project, copies of all construction documentation shall be submitted to the engineer. One copy of the final construction documentation shall be provided in PDF format.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All material shall be new and shall conform with the standards of the Underwriter's Laboratories, Inc., American National Standards Institute, National Electrical Manufacturers' Association, Insulated Power Cable Engineers Association, and Institute of Electrical and Electronic Engineers in every case where such a standard has been established for the particular type of materials in question.
- B. The use of a manufacturer's trade name and catalog number is not intended to indicate preference but only the type and quality of the product desired. Products of reputable manufacturers of equal quality and functional type will be acceptable. Substitutes which tend to lower the quality of the work will not be permitted.
- C. Acceptance of alternate equipment does not relieve the Contractor of the responsibility of compliance with the performance and accuracy requirements of these specifications. Where such substitutions alter the design or space requirements indicated on the Contract Drawings, detailed drawings shall be prepared and submitted by the Contractor delineating any changes in or additions to the work shown on the Contract Drawings, and such drawings and changes or additions to the work shall be made by the Contractor at no additional expense to the Owner.

In all cases, the burden of proof that the material or equipment offered for substitution is equal in construction, efficiency, and service to that named on the Contract Drawings, and in these Contract Documents, shall rest on the Contractor and, unless the proof is satisfactory to the Engineer, the substitution will not be approved.

- D. Wherever possible, equipment items having the same or similar rated capacity or function shall be identical.
- E. All equipment and apparatus shall be the manufacturer's latest proven design, neither presently scheduled for obsolescence nor developmental prototype.

2.2 RACEWAYS

- A. **Metallic Conduit (Aluminum):** All conduit shall be heavy wall rigid aluminum of standard pipe weight unless noted otherwise.
 - 1. Couplings, conduit unions, conduit fittings, etc., shall be aluminum, shall have conventional trade dimensions, and shall be internally threaded with a tapered thread at each end to fit the tapered thread specified for the corresponding size conduit. Conduit outlet body covers shall be cast construction.
 - 2. All conduits, couplings, and fittings run exposed to corrosive atmospheres, and all conduit elbows and risers within concrete encasement shall have a gray or black factory-applied PVC coating, or field applied heat shrink jacket, of not less than 20 mils thickness. Damaged PVC coatings shall be repaired with an approved compound. Conduit supports, channels, and mounting apparatus shall be type 316 stainless steel.
- B. **Flexible Conduit:** All flexible conduit shall be Type LTA liquid-tight flexible aluminum conduit made with flexible aluminum core covered with an extruded PVC jacket, unless noted otherwise. Fittings shall be the type specifically designed for flexible conduit use and shall form watertight connections. Flexible conduit fittings shall be aluminum construction.
 - 1. Flexible conduit shall only be used for connections from conduits, junction boxes, or motor controllers to mechanical equipment or where the location of the connection is such that it is impractical to make a rigid conduit connection, where vibration isolation is required, or where specifically called for on the drawings. Flexible conduit shall be used for connection to all motors.
- C. **Non-Metallic Conduit:** Non-metallic conduit, couplings, and fittings shall be Schedule 40 PVC unless noted otherwise. All PVC conduit joints shall be solvent-welded in accordance with the manufacturer's recommendations.
 - 1. Underground conduits and conduit embedded within slabs on grade shall be non-metallic; however, conversion shall be made to rigid metallic conduit before conduit runs exit encasement. Conversion elbows, fittings and risers within the concrete encasement shall be PVC coated rigid metallic conduit.
 - 2. Underground conduits shall be installed not less than 24 inches below grade.
 - 3. Underground pull boxes shall be provided for all miscellaneous underground conduit runs over 200 feet long.

4. A minimum 3-inch wide polyethylene warning tape, yellow for electrical and orange for telephone, with imprinted legend, shall be installed in the backfill above all underground conduits. Warning Tape shall be Allen Terra Tape, or equal and shall be guaranteed not to discolor. Unless indicated otherwise, the tape shall be 12 inches below the finished ground grade.

2.3 WIRES AND CABLE

- A. Low Voltage Cable: Low voltage wire and cable shall be 600 volt, single-conductor copper, rated 90 degrees C dry and 75 degrees C wet. Unless indicated otherwise, low voltage building wire shall have XHHW-2 insulation.
 1. Low voltage multi-conductor power and control cable shall be 600 volt, Type XHHW copper conductors with an overall neoprene jacket, rated 90 degrees C dry and 75 degrees C wet and shall be suitable for cable tray installation.
- B. VFD Cable: VFD power cables shall be shielded, flexible motor supply cable for variable speed drives subject to non-linear power distortions. VFD cable shall be used to interconnect AC variable frequency drives or control systems, to compatible AC motors. VFD cables shall be 1000V rated UL flexible motor supply cable, 3 stranded tinned copper circuit conductors with XLPE insulation, 1 stranded tinned copper ground wire with PVC insulation, overall combination tinned copper braid and foil shield, and black PVC jacket; Belden VFD cable, or equal.
 1. VFD cables are subject to a harsh operating environment characterized by high voltage spikes, high noise levels and adverse environmental conditions. VFD cables shall be specifically designed to overcome the shortcomings of single conductor lead wire installed in conduit, unshielded tray cables, or continuously welded armored cable typically used for this application.
- C. Instrumentation Cable: Instrumentation cable shall be single twisted pair, 600 volt, stranded, tinned copper conductors with cross-linked polyethylene primary insulation, overall foil shield with tinned copper braid, and chlorinated polyethylene jacket; Belden 3072F.
- D. Inner Panel Wiring: Wiring for instrumentation and control panels shall be single conductor, 600 volt, 125 °C rated UL Type AWM stranded tinned copper conductors with cross-linked polyethylene insulation, Belden 356 series.
- E. Fiber Optic Cable: Unless otherwise indicated or required to meet the specific installation requirements, fiber optic cables shall be UL listed, OFNR-rated, UV, water and fungus resistant, all dielectric, tight buffered construction, consisting of tight buffered optical fibers with acrylate fiber coating, central strength member, aramid yarn strength member, ripcord, and PVC outer jacket.
 1. Single-Mode optical fibers shall be minimum 9 micron core, 125 micron clad, 900 micron buffer glass fiber conductors. Fiber optic cables shall be Optical Cable Corporation DX-DSLX9YR.

2. Multi-mode optical fibers shall be minimum 62.5 micron core, 125 micron clad, 900 micron buffer glass fiber conductors. Fiber optic cables shall be Optical Cable Corporation DX-DWLX9OR.
3. Fiber optic cable termination interface patch panels shall be provided at all termination points.
4. Each cable fiber shall be terminated with connector type as required by the utilization equipment.
5. Fiber optic jumper cables shall be provided from patch panels to the utilization equipment.
6. Fiber optic cable test report shall be provided following installation.

2.4 TERMINAL BLOCKS AND WIRE MARKING

- A. Terminal blocks for power conductors shall be 600 volt, three pole unit construction type with high pressure solderless connectors, headless socket screws, and ampere rating equal to or greater than the ampacity of the maximum conductor size to be terminated; Square D Type LBC, or equal.
- B. Terminal blocks for control and instrumentation conductors shall be 600 volt, sectional rail mounted terminal blocks with plastic pre-printed terminal numbering markers on both the inside and outside tracks, and provisions for center terminal bridge jumper cross connections with no loss of space on terminal or rail; Siemens 8WA1 011-1DF11, or equal. Terminal blocks for general control connections shall be feed-through terminal blocks; terminal blocks for instrumentation signal circuits shall be knife type test/disconnect terminal blocks; and terminal blocks for cable shield termination and grounding shall be ground blocks.
- C. Cable and conductor markers shall be heat shrinkable sleeve markers with permanent legible machine printed markings.

2.5 BOXES

- A. General: Boxes shall be installed at all locations necessary to facilitate proper installation and equipment connection, including each conduit/cable transition.
 1. Minimum dimensions of boxes shall not be less than NEC requirements and shall be increased if necessary, for practical reasons or where required to suit job condition.
 2. Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.
 3. All boxes shall be rigidly secured in position. All boxes, except on unfinished ceilings and walls, and where conduit is run exposed, shall be so set that the front edge of box shall be flush with or recessed not more than 1/4-inch behind the finished wall or ceiling line.
- B. Outlet Boxes: The location of outlets as shown on the drawings will be considered as approximate only. It shall be the work of this section to study all plans with relation to spaces surrounding each outlet in order that the work may fit and that when fixtures or other fittings are installed, they shall be symmetrically located to best suit each condition. All outlets shall

be coordinated with the work of other sections of these specifications to prevent outlets or fixtures from being covered by pipe, duct, etc.

1. Where conduit is concealed, outlet boxes shall be steel, 1 piece standard gang boxes.
 - a. Wiring device boxes shall be minimum 4 inches x 4 inches x 1-1/2 inches deep with covers of proper size and configuration.
 - b. Ceiling fixture boxes shall be minimum 4-inch octagonal by 1-1/2 inches deep and shall be equipped with fixture studs.
 - c. Wall fixture boxes shall be minimum 4-inch octagonal by 2-1/8 inches deep.
 2. Where conduit is exposed, outlet boxes shall be cast aluminum one piece hub type standard gang boxes with rubber gaskets.
 - a. Wiring device boxes shall be equipped with cast screw-type covers; Crouse-Hinds Series FS or equal.
 - b. Fixture boxes shall be of sufficient diameter to provide a seat for the fixture canopy; Crouse-Hinds Series GRF or equal.
 3. Unless indicated otherwise, receptacle boxes shall be centered 1 foot 6 inches; wall switch boxes shall be centered 4 feet; and wall fixture boxes shall be centered 7 feet 6 inches above finished floor.
 - a. Where shown at door locations, wall switch boxes shall be installed on lock side of door.
 - b. Where shown on columns or over doors, wall fixture boxes shall be installed symmetrically.
- C. Pull Boxes: Pull boxes, including junction boxes and terminal boxes, shall be installed at all necessary points, whether indicated or not, to prevent injury to the insulation or other damage that might result from pulling resistance or other reasons during installation.
1. Unless indicated otherwise, pull boxes shall be NEMA 12 construction with gasketed screw covers and gray baked enamel over a rust-inhibiting primer finish. Pull boxes installed outdoors or in corrosive atmospheres shall be NEMA 4X aluminum or 316 stainless.
 2. Pull boxes in excess of 36 inches x 36 inches x 12 inches shall be fabricated from code gauge aluminum or 316 stainless steel, suitably reinforced to provide a rigid, self-supporting construction. Each large pull box shall be equipped with a gasketed hinged cover fastened with screws on three sides. Dimension and installation details, for each large pull box, shall be approved prior to fabrication.
 3. Pull boxes in hazardous areas shall be explosion proof, cast aluminum construction with hinged, threaded, screw-on covers. Explosion proof pull boxes shall be equipped with threaded conduit openings as required for the initial installation, all identified future connections, and a minimum of one spare conduit opening sized to match the largest otherwise required conduit opening.
 4. Branch circuit pull boxes shall be appropriate outlet boxes with blank covers.
- D. Wireways: Wireways, as indicated on the drawings or approved for installation, shall be NEMA 12 construction with gasketed screw covers and gray baked enamel over a rust-

inhibiting primer finish. Wireways installed outdoors or in corrosive atmospheres shall be NEMA 4X aluminum or type 316 stainless steel.

1. Wireways shall be furnished and installed with required conduit knockouts only.
- E. Underground Pull Boxes: Underground pull boxes shall be minimum 30-inch x 17-inch x 18-inch deep compositelike service boxes constructed of reinforced polymer concrete suitable for light traffic loading, with locking cover and molded logo; Quazite Compositelike, or equal.
1. Unless otherwise indicated underground pull boxes shall have solid bottoms. Where open bottom pull boxes are indicated or approved for installation, a bed of gravel, minimum 12" thick and exceeding the pull box footprint by 6" on all sides, shall be placed beneath each open bottom pull box.

2.6 WIRING DEVICES

- A. Wall Switches: Wall switches shall be specification grade, totally-enclosed, toggle switches rated 20 ampere, 120/277 volt. Switches shall be single pole, double-pole, 3-way, or 4-way as indicated; GE-5951 through 5954, Hubbell 1221 through 1224, Leviton 1221 through 1224, or equal.
1. Wall switches shall be furnished with suitable plates. The material, colors, and finishes of switch plates shall be as directed to harmonize with the surroundings. In general, standard switches shall be brown with stainless steel plates. Indoor FS switch box covers shall be aluminum; Appleton FSK-1TS-A, or equal.
 2. Unless specified otherwise, wall switches installed outdoors or in corrosive atmospheres shall be weatherproof and vapor-tight. Weatherproof and vapor-tight switches shall consist of standard wall switches as previously specified, enclosed in Series FS condulets equipped with vapor-tight gasketed covers; Appleton Series FSK-1VTS-A, or equal.
- B. Receptacles: Receptacles shall be specification grade, grounding type, totally-enclosed, duplex receptacles rated 20 ampere, 125 volt; GE 8300-9, Hubbell 5362-GRY, Leviton 5362-GY, or equal.
1. Each receptacle shall be provided with a single gang plate for flush mounting. The materials, colors, and finishes of the plates shall be as directed to harmonize with the surroundings. In general, receptacles shall be gray with stainless steel plates. Indoor FS receptacle box covers shall be aluminum; Appleton FSK-1DR-A, or equal.
 2. Unless specified otherwise, receptacles installed outdoors or in corrosive atmospheres shall be weatherproof. Weatherproof receptacles shall each consist of standard duplex receptacles as previously specified, enclosed in Series FS conduit equipped with a weatherproof cover; Crouse-Hinds WLRD or equal. Outdoor receptacle covers shall be aluminum in-use covers; Crouse-Hinds WIUMV, or equal. Outdoor receptacles installed on circuits without ground fault protection shall be type GFCI.
 3. Special purpose outlets shall be black melamine locking receptacles with voltage, phase, and current ratings in accordance with the connected service and intended duty. Special purpose outlets shall be grounding type with permanent rating identification following installation; GE NEMA-Line, Hubbell Twist-Lock, Leviton Spec-Master, or equal, equipped with plates, boxes, etc., as indicated for standard receptacles.

4. The Contractor shall connect the grounding terminal in each receptacle to the inside of the metal enclosure.

2.7 MOTOR STARTERS

- A. Manual Motor Starters: Manual motor starters shall be 600 volt, toggle-type suitable for installation within standard outlet boxes. Enclosures for all starters not installed in outlet boxes, and all starters located outdoors, or in corrosive atmospheres, shall be NEMA 4X aluminum or type 316 stainless steel.
 1. Where required, starters shall be equipped with overload protection on each pole.
 2. Each starter for automatic control shall be equipped with an H-O-A selector switch.
- B. Magnetic Motor Starters: Unless indicated or required otherwise, each motor starter shall be of the combination type complete with molded case motor circuit protector; full-voltage magnetic starter; manual resetting, 3-pole, bimetallic thermal overload relay; individual 120 volt control power transformer; enclosure door-mounted pilot control devices; and all required accessory control components.
 1. Motor starter enclosures shall have oil-resistant gasket and external operating handle. Unless otherwise indicated, motor starter enclosures located indoors shall be NEMA 12 construction. Motor starter enclosures located outdoors, or in corrosive atmospheres, shall be NEMA 4X type 316 stainless steel.
 2. Motor starters for submersible motors shall be equipped with ambient-compensated, bimetallic, quick-trip type overloads.
 3. Unless indicated otherwise, motor starters for all motors 25 hp and above shall be of the solid state reduced voltage type.

2.8 DISCONNECT SWITCHES

- A. Disconnect switches shall be 600 volt rated heavy-duty safety switches with full cover interlocks and quick-make, quick-break mechanisms. Switches shall be fused or non-fused, of capacities noted; Square-D Type HD or equal.
 1. Unless indicated otherwise, disconnect switches located indoors shall have NEMA 12 enclosures with gray baked enamel over a rust-inhibiting primer finish. Disconnect switches located outdoors, or in corrosive atmospheres, shall have NEMA 4X type 316 stainless steel enclosures.
 2. Unless indicated otherwise, fuses shall be Mersen type TRS-R Class RK5 current limiting time-delay fuses.

2.9 CIRCUIT BREAKERS

- A. Circuit breakers shall be 600 volt thermal magnetic, quick-make, quick-break molded case air circuit breakers, with trip-free operation, incorporating an internal trip bar and a single external handle. Circuit breaker ratings shall be coordinated with the installed service and loads

supplied. Unless indicated otherwise, circuit breakers shall be rated not less than 25,000 amperes RMS symmetrical.

1. Unless indicated otherwise, enclosed circuit breakers located indoors shall have NEMA 12 enclosures with gray baked enamel over a rust-inhibiting primer finish. Enclosed circuit breakers located outdoors, or in corrosive atmospheres, shall have NEMA 4X type 316 stainless steel enclosures.
2. Circuit breakers used as a service disconnecting device shall be 100% rated and UL service entrance rated; shall be equipped with long time, short-time, instantaneous and ground fault adjustments for system selectivity; and shall be fully rated for the maximum fault current, without the use of current limiters.

2.10 SUPPORT SYSTEMS

- A. Groups of two or more conduits, and all boxes and equipment, shall be mounted on a system of minimum 1-5/8-inch x 1-5/8-inch heavy wall aluminum or 316 stainless steel channel with a minimum of 25% unused capacity.
- B. Overhead conduits shall be supported on trapeze hangers from approved concrete inserts and shall be grouped with pipes wherever possible.
- C. Support system hardware, including hanger rods, shall be aluminum or stainless steel.

2.11 LIGHTING FIXTURES

- A. Lighting fixtures shall be of specification grade and listed or labeled by Underwriters Laboratories (UL) or an approved Nationally Recognized Testing Laboratory (NRTL).
- B. LED fixtures shall comply with the following:
 1. UL Standard 8750 "Light Emitting Diode Equipment for Use in Lighting Products"
 2. IES Standard LM-79 "Electrical and Photometric Measurements of Solid-State Lighting Products"
 3. IES Standard LM-80 "Measuring Lumen Maintenance of LED Light Sources"
 4. IES Standard TM-21 "Projecting Long Term Lumen Maintenance of LED Light Sources".
 5. ANSI C78.377 "Specifications for the Chromaticity of Solid State Lighting Products" with LEDs binned within a maximum three-step MacAdam Ellipse to ensure color consistency amongst luminaries of the same type.
- C. For LED fixtures, lamps, drivers, and components, provide a complete warranty for parts and labor for a minimum of five years from the date of Substantial Completion.
- D. Provide only LED fixtures with a Design Lights Consortium (DLC) listing, a U.S. Department of Energy (DOE) "LED Lighting Facts" label, or a U.S. Environmental Protection Agency (EPA) ENERGY STAR label, which have demonstrated third-party testing verification.
- E. Recessed lighting fixtures shall be thermally protected.

- F. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.
- G. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50%-100%) line voltage, two switch controlled dimming driver, as shown on the drawings.
- H. Unless otherwise indicated, LED lamps shall have a color temperature of 3500 degrees K, a CRI of 80 minimum, and a lumen maintenance L70 rating of 50,000 hours minimum.
- I. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.
- J. Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.
- K. Battery-backed LED emergency lighting fixtures shall consist of a normal LED fixture with some or all of the LEDs connected to a battery and charger. The battery shall be nickel cadmium and sized for a minimum of 90 minutes of fixture operation. The charger shall be solid-state and provide overload, short circuit, brownout and low battery voltage protection. The battery and charger shall include self-diagnostic and self-exercising circuitry to exercise and test itself for 5 minutes every month and for 30 minutes every 6 months. The fixture shall include a test/monitor module with LED status indicating lights mounted so as to be visible to the public. The fixture shall not contain an audible alarm.
- L. Lighting contactors shall be electrically-operated, mechanically-held, suitable for panelboard mounting, and fully rated as indicated for tungsten and ballast lighting; Square D Type L and S, ASCO 917 and 920, or equal.
 - 1. Contactors shall be provided with fused control circuits and 120 volt operating coils. Contactors shall be furnished with control power transformers where required.
 - 2. Contactors shall be panelboard-mounted, or mounted in separate enclosures, as indicated. Contactor enclosures for interior locations shall be NEMA 1 code-gauge steel with gray baked enamel over a rust-inhibiting primer finish. Enclosures for exterior locations shall be NEMA 4 seam-welded aluminum. Enclosures located in corrosive atmospheres shall be type 316 stainless steel.

PART 3 - EXECUTION

3.1 CODES, PERMITS, AND INSPECTIONS

- A. The installations shall be in accordance with the regulations of the latest editions of the National Electrical Code, National Electrical Safety Code, applicable city, state, and local codes and regulations and other applicable codes, including utility company codes.

- B. All permits required by state or local ordinances shall be obtained and after completion of the work, a certificate of final inspection and approval from the electrical inspector shall be furnished to the Owner. All permits for installation, inspections, connections, etc., shall be taken out and paid for as part of the work under this section.

3.2 CONDUIT INSTALLATION

- A. Conduit Installation: All conduits shall be run in such a manner as to cause the least interference with other trades. Conduits shall be joined by means of couplings or 3-piece coupling type conduit unions. Joints shall be set up tight. Runs shall be straight and true; elbows, offsets, and bends shall be uniform and symmetrical. Installation workmanship shall be of the best quality and skill.
- B. Conduits shall be of sizes required to accommodate the number of conductors in accordance with the tables given in the current edition of National Electrical Code or as noted on the drawings. The minimum size of conduit shall be 3/4-inch.
- C. Conduit runs shall terminate below the particular section of the motor control center or equipment to which their respective circuits run. Concealed conduits shall be run in as direct a line as possible. Exposed conduits shall be run parallel to or at right angles with the lines of the building. All bends shall be made with standard conduit ells, conduit bent to not less than the same radius, or aluminum conduit outlet bodies with gasketed cast iron covers. Adjacent conduit runs shall be installed with concentric bends. All bends shall be free from dents or flattenings. Not more than the equivalent of four quarter bends shall be used in any one run between terminals at cabinets, outlets, and junction or pull boxes. Boxes shall be located in accessible locations.
- D. Conduit shall be continuous from outlet to outlet and from outlets to cabinets, junctions, or pull boxes and shall enter and be secured to all boxes in such a manner that each system shall be electrically continuous from point of service to all outlets. Insulated grounding bushings shall be used on all metallic conduit. Terminals of all conduits shall be plugged with an approved cap to prevent the entrance of foreign materials when exposed during construction.
- E. As far as practicable, all exposed conduits shall be run without traps. Where dips are unavoidable, a pull box or approved conduit outlet body shall be placed at each low point. Conduit systems shall be completed before conductors are drawn in. Where conduits must be run exposed, except as indicated in the drawings, locations of the runs shall be subject to approval.
- F. Where exposed conduit needs clamping to the structures, clamps shall consist of aluminum 1-hole pipe straps and pipe spacers, stainless steel bolts of appropriate size to fill the holes in the straps and spacers, and approved expansion shields. Clamps used with aluminum conduit, and clamps located outdoors or in "corrosive atmospheres", shall be PVC coated, aluminum or type 316 stainless steel. Clamps shall be bolted to the structure or where necessary to intermediate type 316 stainless steel brackets. Spacing between conduit supports shall not exceed the recommendations published by the National Electrical Code. No deformed, split, or otherwise defective conduit or fitting shall be installed. Conduit shall be installed with a minimum number of joints.

- G. Aluminum Myers hubs shall be used for all threaded conduit connections to enclosures that do not contain integral threaded conduit hubs. Conduit connections to enclosures located outdoors shall only enter the bottom of the enclosure.
- H. Where conduit has been cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The use of pipe cutters with cutter wheels will not be permitted. The cut ends of the field-cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory-cut threads on conduit. Conduits installed in the work with threads not complying with these requirements shall be removed and replaced.
- I. Where conduit installed in concrete or masonry extends across building joints, expansion joints with approved type grounding straps and clamps shall be installed. Expansion joints shall be Type XJ as manufactured by Crouse-Hinds, Appleton, or equal. Where conduit enters a building through the concrete foundation, below final grade, approved type FSK entrance seals shall be used.
- J. All conduit shall be cleaned, prior to pulling in wire and cable, by pulling a stiff wire brush of the size of the conduit through it. This cleaning shall remove all foreign matter, including water, from the conduit. All boxes in which the conduit terminates shall be cleaned of all concrete, mortar, or other foreign matter and all threads in boxes shall be left clean and true upon completion of the work.
- K. All spare, future, or empty conduits shall be equipped with a pull wire prior to capping.
- L. All conduits, fittings, and electrical equipment used within hazardous areas shall comply with requirements of the National Electrical Code for the type of hazardous location encountered and shall be furnished as specified for "corrosive atmospheres".
 - 1. In such hazardous locations, conduits terminating at boxes enclosing electric switching, or circuit opening equipment, shall be sealed at the entrance to the enclosure with approved, compound-filled, sealing fittings to prevent passage of explosive or combustible gases through the conduits.
 - 2. All conduits exiting from such hazardous locations or entering said locations shall be similarly sealed at point of exit or entrance.

3.3 WIRE AND CABLE INSTALLATION

- A. The installation of wires and cables includes all splicing of these wires and cables to each other and connecting them to receptacles, switches, control boxes, lighting fixtures, motors, and all other electrical apparatus installed under this Contract. All cable installation methods shall correspond to manufacturer's recommendations.
- B. Wire and cable shall be suitably protected from weather or damage during storage and handling and it shall be first-class condition when installed.
- C. The minimum size of wire or cable conductor shall be No. 12, unless indicated otherwise on the drawings. Wire sizes No. 8 and larger, and all wire sizes utilized for control or instrumentation,

shall be stranded. All sizes called for in the specifications or shown on the drawings are American Wire Gauge sizes.

1. No wire smaller than No. 12 shall be used for any branch circuit unless noted otherwise on the drawings. Larger sizes shall be used where required or indicated on the drawings. If the single distance from the panelboard to the first device exceeds 50 feet, the minimum size for this run shall be No. 10 AWG with the minimum between devices as No. 12 AWG.
- D. All sizes of wire and cable furnished and installed under these specifications shall be color-coded with a separate color for each phase and neutral used consistently throughout. Each conductor shall have factory color-coded insulation. As an alternative, wire sizes No.8 and larger shall have black insulation and shall be color-coded with waterproof phasing tape at each termination, junction box, pull box, etc. All 277/480 volt wiring shall be color-coded yellow, brown, and orange for hot legs (Phase A, B, and C, respectively). All 120/208-240 volt wiring shall be color-coded black, blue, and red for hot legs (Phase A, B, and C, respectively). The grounded neutral conductor of each circuit shall be color-coded white. Grounding conductors shall be color-coded green.
- E. All wires and cables shall, as far as practicable in the judgment of the Engineer, be continuous from origin to destination without running splices in intermediate pull boxes, junction boxes, or wireways. At the ends of these wires and cables, only sufficient slack shall be left as may be required for making proper connections. There shall be no unnecessary slack.
- F. In connecting wires and cables to apparatus, various methods shall be used depending upon the local conditions as detailed on the drawings. In general, solderless pressure connectors shall be used for terminals, taps, and splices for all wires and cables. Solderless pressure connectors or vinyl-covered steel spring-type connectors shall be securely fastened and shall not loosen under vibration or normal strain. All connections shall be in accordance with manufacturer's recommendations and shall be with connectors approved for the particular connection conditions.
- G. Where wires and cables are connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the mechanical connector. The lacquer coating of the conduits shall be removed where a ground clamp is to be installed.
- H. All soldered joints shall be made mechanically strong before soldering and shall be carefully soldered without the use of acid and shall be taped with insulating tape to a thickness equal to that of the insulation.
- I. The installation of wires and cables shall include the furnishing and installing of all hangers, racks, cable cleats, and supports that may be necessary to make a neat and substantial wiring installation in all pull boxes, wireways, cable channels, and in such other locations as may be required. Plastic ties shall be used to hold the wires and cables together and to the racks or supports.
- J. Each junction box, terminal box, control cabinet, or other terminal location containing a total of 4 or more conductor terminations or splices, shall be equipped with 1 or more terminal boards, as required, for connecting each wire including the spare wires. Each wire terminal shall be permanently marked throughout the entire system using, wherever possible, the notation of the

wires given on the manufacturer's wiring diagrams. Sufficient terminal blocks shall be provided to terminate all wires routed to the enclosure including all spare conductors. In addition, the greater of 20 percent or four unused spare terminals shall be provided. All connections for future functions shall be wired to numbered terminal blocks, grouped separate from the terminal blocks in use. Terminal blocks shall be grouped to isolate power conductors from control conductors and to separate AC circuits from DC circuits.

- K. Each control, instrumentation, and power cable and conductor shall be marked with the proper feeder symbol or termination number in each manhole, handhole, pull box, wireway, terminal cabinet, panelboard, switchboard and all additional locations required to provide positive identification. Each conductor shall be marked at each point of termination following final installation.
- L. The electrical installation shall maintain suitable isolation between power, control and instrumentation conductors. Approved isolation barriers shall be provided within each pull box, terminal box, wireway, cable tray, handhole, manhole, etc.

3.4 TESTING

- A. Upon completion, the Contractor shall provide all necessary instruments and special apparatus to thoroughly test the complete installation and shall conduct all tests that may be required to insure system is free of all improper grounds and short circuits, and that all the feeders are properly balanced. All electrical equipment shall be tested to determine proper polarity, phasing, relay settings, and operation. System shall be checked for quality and completeness in accordance with the provisions of the General Conditions. Any objectionable noise, heating, voltage drop, or excessive current draw, after in operation, shall be identified and corrected.
- B. Prior to energization, the electrical system ground resistance shall be tested. Additionally, the insulation resistance of all electrical gear, power feeders, and electric motors shall be measured. Upon completion of all corrective measures required, certified acceptance reports, including tabulations of all initial and final resistance measurements, shall be submitted for approval in accordance with the provisions of the General Conditions.
- C. Each motor starter overload element, and each motor circuit protector, shall be selected and adjusted to coordinate with the nameplate full-load current and service factor of the actual motors installed. Improper units shall be replaced. Upon completion of all corrective measures required, certified compliance reports, including tabulation of the actual full load current and voltage measurements for each phase of each motor, together with the nameplate current rating, overload element rating, and motor circuit protector setting, shall be submitted for approval in accordance with the provisions of the General Conditions.
- D. System testing shall include complete circuit breaker tests for each power circuit breaker and complete thermal surveys of all new and existing electrical apparatus. Upon completion of all corrective measures required, certified acceptance reports, including satisfactory infrared photographs, shall be submitted for approval.

3.5 SPARE PARTS

- A. The Contractor shall furnish, upon completion of the project, one year's supply of all consumable parts utilized within the electrical system.
- B. Spare parts shall include pilot lights (minimum 12 of each part number), fuses (minimum 12 of each part number below 100 amps and 6 of each part number 100 amps and above).

3.6 GUARANTEES

- A. All materials and workmanship shall be guaranteed to be free from defects. Any part of the system considered defective by the Engineer within the guarantee period shall be immediately replaced or corrected to the Engineer's satisfaction without further expense to the Owner.
- B. Upon final completion, the Contractor shall furnish certification from each equipment manufacturer that all equipment has been installed in accordance with the requirements of these specifications, is ready for permanent operation, and that nothing in the installation shall render the warranty null and void.

END OF SECTION 260000

SECTION 260100 - ELECTRICAL SYSTEMS ANALYSIS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Provide both a preliminary and a final short circuit, device evaluation, protective device coordination, and arc flash study of the complete electrical distribution system as specified herein and as shown on the Drawings. The study shall include motor starting/running calculations.
- B. Provide both a preliminary and final harmonic study of the complete electrical distribution system as specified herein and as shown on the drawings.
- C. Obtain and pay for the services of an independent engineering specialty firm, subject to the approval of the Engineer, to provide a complete fault current, device evaluation, protective devices selective coordination, arc flash study, harmonic study and motor starting study. The selective coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective devices down to and including the largest feeder circuit breaker and motor starter in the low voltage motor control centers and power distribution panelboards. The study shall also include variable frequency drives, harmonic filters, Uninterruptible Power Supplies (UPS), power factor correction equipment, transformers and protective devices associated with emergency and standby generators, and the associated paralleling equipment and distribution switchgear. The arc flash study shall begin with the utility company's feeder protective device and include all of the electrical distribution equipment down to and including low voltage motor control centers and power distribution panelboards and lighting panels. All information required to perform the study shall be obtained by the entity performing the study.
- D. Submit the preliminary short circuit, protective device coordination and motor starting/running study prior to submittal of medium voltage switchgear, the 480-Volt switchgear, and motor control centers shop drawings. The aforementioned shop drawings will not be reviewed until the preliminary power system study is approved by the Engineer. No exceptions will be allowed. The preliminary study shall include but not limited to:
 1. Short circuit, device evaluation, protective device coordination, arc flash study, harmonic study and motor starting studies shall be performed on SKM PowerTools ®. No exceptions permitted.
 2. Obtain and verify with the utility company all information needed to conduct the study. Obtain and verify with the Owner ratings of existing electrical equipment that shall be included in the study.
 3. Current transformer ratio and burden calculations shall be based on a 10 percent maximum ratio error per ANSI C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable ANSI error margins and recommend corrective action.
 4. The preliminary study shall verify equipment is being applied within their design ratings and electrical protective devices will coordinate.

5. Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments, and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the Contractor at no additional cost to the Owner.
- E. After release of electrical equipment by the manufacturer, but prior to energizing the electrical equipment, submit the final short circuit and selective coordination study including all calculations, tabulations, protective devices coordination graphs, etc. as specified herein.
1. Provide a complete short circuit study and protective device selective coordination study for both the utility power distribution system and the emergency/standby power distribution system under the scope of this study. The study shall include but shall not be limited to:
 - a. Full compliance with applicable ANSI and IEEE Standards.
 - b. Performed on SKM PowerTools[®] No exceptions permitted.
 2. Provide a report summarizing the selective coordination and motor starting/running study including: one-line diagram of the system, relay and breaker setting tabulation, coordination curves, relay curves, circuit breaker curves, motor starting/running curves, protective device coordination and short circuit calculation, all prepared by the specialty firm.
 3. Recommend changes and/or additions to equipment as required providing adequate protection and coordination based on the actual equipment supplied and the results of the short circuit and protective device selective coordination studies. Submit any such changes and additions as a part of the study. Field settings of devices, adjustments and minor modifications to equipment that are required to accomplish conformance with the approved short circuit and protective device selective coordination studies shall be carried out by the Contractor at no additional cost to the Owner.

1.2 SUBMITTALS

A. Submit, the following:

1. The number of years the specialty firm has been in the business of performing power system studies.
2. Identification of each of the three qualifying projects for each of the past three years including:
 - a. A brief description of each study.
 - b. Name of owner of installation on which study was performed with address, telephone number, and contact person.
 - c. Date of study.
 - d. Any other information indicating the firm's experiences and ability to perform the work and business status.

B. Preliminary Short Circuit and Coordination Study Report shall include but not limited to:

1. The coordination study report shall be bound in a standard 8-1/2-in by 11-in size report.
2. Electrical distribution system one-line diagram. One line diagrams shall be legible on printed paper and shall not exceed 11 x 17-in in size unless required to clearly illustrate the system and related data.
3. Provide detailed "Input Data" report that identifies all input parameters associated with the equipment depicted on the system one line diagrams including but not limited to Utility data, conductor sizes and lengths, protective device sizes and rating, transformer sizes and ratings, motor types and sizes, etc.
4. Provide current transformers' ratio and burden calculations to confirm that the current transformers will not saturate prior to operation of the protective relays and confirming the current transformers used with differential protection will not saturate under any fault condition.
5. Tabulation of each protective device, its short circuit rating, the available fault current available at the device and an indication whether or not the device is adequately rated for the available fault current and voltage at which it is applied.
6. Preliminary graphic time-current curves showing how the protective devices proposed by the equipment suppliers will coordinate as being applied. TCC's shall be produced and printed in color to assist the reviewing engineer in the graphical analysis of the protective device coordination. Each device on a TCC shall be a different color and where devices are shown on multiple TCCs the color for the device shall be constant on each TCC that the devices are shown on.

C. Final Short Circuit and Protective Device Coordination Study Report shall include but not limited to:

1. The coordination study report shall be bound in a standard 8-1/2-in by 11-in size report. The selection of all protective relays types, current transformers, fuse types and ratings shall be the responsibility of the manufacturer and shall be based on the preliminary coordination study, which shall be submitted prior to the equipment shop drawings in accordance with Section 01300. The complete study shall be approved by the Engineer before any equipment is shipped. The report shall include the following sections and information:
 - a. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report, statement of the adequacy of the distribution equipment to safely clear any fault currents, the adequacy of the distribution equipment to close in on a fault, identify any problem areas with recommendations for resolving the problem.
 - b. Electrical distribution system one-line diagram. One line diagrams shall be legible on printed paper and shall not exceed 11 x 17-in in size unless required to clearly illustrate the system and related data.
 - c. Provide detailed "Input Data" report that identifies all input parameters associated with the equipment depicted on the system one line diagrams including but not limited to Utility data, conductor sizes and lengths, protective device sizes and rating, transformer sizes and ratings, motor types and sizes, etc.
 - d. Provide current transformers' ratio and burden calculations to confirm that the current transformers will not saturate prior to operation of the protective relays

- and to confirm the current transformers used with differential protection will not saturate under any fault condition.
- e. Transformer differential protection calculations including current transformer mismatch relay setting and charts. Provide differential current transformer wiring schematics including polarity and wiring connections based on the winding configuration of the actual power transformers being supplied.
 - f. Tabulation of all protective devices, circuit breakers, fuses, current transformers, etc. The tabulation shall indicate the device, manufacturer, catalog number, recommended setting, etc.
 - g. Industry standard graphic time current, protective relay and protective device curves, showing equipment and material damage curves, relay, circuit breaker, fuse curves, available fault currents at the equipment, transformer inrush currents, etc, for each piece of equipment. TCC's shall be produced and printed in color to assist the reviewing engineer in the graphical analysis of the protective device coordination. Each device on a TCC shall be a different color and where devices are shown on multiple TCCs the color for the device shall be constant on each TCC that the devices are shown on.
 - h. Tabulation of each protective device, its short circuit rating the available fault current at the device and an indication whether or not the device is adequately rated for the available fault current and voltage at which it is applied.
 - i. Calculations and required documentation including copies of correspondence with involved entities such as utility fault contribution coordination.
- D. Preliminary Arc Flash Study shall be performed as detailed in the "Guidelines for Performing and Reporting Results of Arc Flash Studies" issued by SJCUD dated March 2013. It is the contractor's responsibility for obtaining this guideline from the Owner and complying with the requirement therein. The arc flash study report shall include but not be limited to:
1. The report shall be structured as indicated in the guidelines and in the "Sample Report" appended to the guideline.
 2. The Arc Flash study report shall be bound in a standard 8-1/2-in by 11-in size report.
 3. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.
 4. Specific recommendations to reduce the arc flash incident energy levels in the plant. The recommendations shall not propose general and widely applied arc flash mitigation measure such as arc resistant gear but shall detail specific equipment or setting adjustments of new or existing equipment that could be applied to the system and the mitigation that could be realized from such an application.
- E. The Final Arc Flash Study report shall be bound in a standard 8-1/2-in by 11-in size report. The report shall be structured as specified in the Guideline and shall include the following sections and information:
1. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report and recommendations to reduce the arc flash values.
 2. Provide a single detailed, customized bus label for each fault location. Each label shall include a listing of the protective device settings and incident energy at several different working distances. Sample label acceptable to SJCUD is included in the Guideline.

Multiple labels depicting different hazard risk categories as a result of arc flash mitigation devices shall not be acceptable. Labels shall contain all information required by NFPA 70E for arc flash hazard and shock protection calculations.

3. Where arc flash reduction maintenance settings are available and utilized on protective devices to reduce incident energy levels while operating at temporary set points the report shall include an additional table that provides the Owner with detailed information resulting from the reduced arc flash hazard category. The table should include all of the information required by NFPA 70E on a standard arc flash label for both the normal operating protection settings and with the maintenance mode engaged on the device.
4. Provide a customized NFPA 70 E work permit form for the client and specific installation.
5. PPE Table – Provide a PPE table that defines the Personnel Protective Equipment classes and clothing descriptions identified in the reports and labels.

F. Preliminary Harmonic Study Report shall include but not limited to:

1. The harmonic study report shall be bound in a standard 8-1/2-in by 11-in size report.
2. Electrical distribution system one-line diagram.
3. Provide the minimum available fault current available from the utility and show the calculations of plant load vs. available fault current to determine the appropriate THD threshold as defined in IEEE 519.
4. Provide the harmonic parameters assumed for use in the study for the harmonic generating equipment, i.e., VFD units, UPS units, static inverters, Ozone units, etc.

G. Final Harmonic Study Report shall include but not limited to:

1. The harmonic study report shall be bound in a standard 8-1/2-in by 11-in size report. The selection of the harmonic mitigation equipment shall be the responsibility of the manufacturer and shall be based on the preliminary harmonic study, which shall be submitted prior to the equipment shop drawings in accordance with Section 013300. The complete study shall be approved by the Engineer before any equipment is shipped. The report shall include the following sections and information:
2. An executive summary outlining the distribution system, the information received from the power company, assumptions made to complete the report, document harmonic profile for all harmonic producing equipment.
3. Electrical distribution system one-line diagram.
4. Recommended parameters for harmonic mitigation equipment, if required. Recommendations shall detail the projected effects of the mitigation effects and shall prove them via a revised harmonic study.
5. Calculations and documentation indicated.

1.3 REFERENCED STANDARDS

A. Institute of Electrical and Electronic Engineers, Inc. (IEEE):

1. IEEE Std 141 - Recommended Practice for Electrical Power Distribution for Industrial Plants, Latest Edition
2. IEEE Std 241 - Recommended Practice for Electrical Power Systems in Commercial Buildings, Latest Edition

3. IEEE Std 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Systems, Latest Edition
4. IEEE Std 399 - Recommended Practice for Industrial and Commercial Power System Analysis, Latest Edition
5. IEEE Std. 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, Latest Edition
6. IEEE Std. 1584 - IEEE Guide for Arc Flash Hazard Calculations, Latest Edition
7. NFPA 70E, Latest Edition
8. IEEE Std. 242- IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems, Latest Edition

B. American National Standards Institute (ANSI):

1. Standard C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
2. Standard C37.91, IEEE Guide for Protective Relay Applications to Power Transformers
3. Standard C37.95, IEEE Guide for Protective Relaying of Utility-Consumer Interconnections
4. Standard C37.96, IEEE Guide for AC Motor Protection
5. Standard C57.12.59, IEEE Guide for Dry-Type Transformer Through-Fault Current Duration
6. Standard C57.13, IEEE Standard Requirements for Instrumentation Transformers
7. Standard C57.109, IEEE Guide for Liquid-Immersed Transformer Through-Fault-Current Duration

1.4 QUALITY ASSURANCE

A. Independent Engineering Specialty Firm's Experience

B. Specialty firm shall have been in the business of the type of work specified, for at least the past five years.

1. The specialty firm shall have a minimum of three projects of equal or greater size, service, with the type of equipment specified for each of the past three years.
2. Specialty firm shall be incorporated in the State of Florida and shall have a licensed professional engineer as a full time employee, to supervise and seal the report.

C. The specialty firm shall be an independent organization, which can function as an unbiased authority, professionally independent of the manufacturers, suppliers and installers of equipment or systems evaluated by the specialty firm.

D. All electrical studies shall be stamped and signed by a professional electrical engineer licensed in the State of Florida.

1.5 SHORT CIRCUIT STUDY AND DEVICE EVALUATION

A. Perform a short circuit study in accordance with ANSI Standards C37.010 and C37.13 to check the adequacy and to verify the correct application of circuit protective devices and other system

components within the construction package. The study shall address the case when the system is being powered from the utility source as well as from the on-site generating facilities, normal and alternate (bus tie closed) modes of operation. Minimum and maximum possible fault conditions shall be covered in the study. It shall be the responsibility of the Contractor performing the study to determine the operating parameters of the system and to derive the worst case fault conditions. Assumptions of plant operation shall not be allowed.

- B. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.
- C. Calculate short-circuit momentary duties and interrupting duties on the basis of an assumed bolted 3 phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. The short circuit tabulations shall include X/R ratios, asymmetry factors, KVA and symmetrical fault-current. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.
- D. The studies shall include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.
- E. Provide the following:
 - 1. The available fault current at each bus within the limits of the study shall be identified and listed.
 - 2. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available fault current available at each element shall be calculated
 - 3. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. The results shall be tabulated in the form of a PASS/FAIL device evaluation table Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the Engineer.
 - 4. The short circuit portion of the report shall include:
 - a. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information, identify all assumptions made in the preparation of the study, identify any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.
 - b. Computer printout of the input data.
 - c. Computer printouts for the three phase and ground fault studies. Printouts shall indicate the fault current available at each major equipment, distribution bus within the high, medium and low voltage distribution systems.

- d. Table listing all the electrical distribution and utilization equipment (including VFDs), the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment and the ability of the equipment to interrupt and/or withstand the fault.
- e. The short circuit study shall be prepared using approved computer software and must include complete fault calculations as specified herein for each proposed and ultimate source combination. Source combinations may include present and future Power Company supply circuits, large motors, or generators.

F. Automatic Load Transfer

- 1. Provide a detailed study demonstrating the interrupting capacity of automatic transfer bus ties and switches, as well as the fault withstand capabilities. The following shall be considered:
 - a. X/R ratio fault-current of circuit at point of transfer.
 - b. X/R ratio and fault-current rating of the transfer device.
 - c. Length of time fault may persist prior to protective device opening.
 - d. Magnetic stress withstand rating.
 - e. I²t withstand rating.
 - f. Transfer device maximum interrupting duty compared to load interrupting duty.

1.6 PROTECTIVE DEVICE COORDINATION

- A. Provide a protective device time-current coordination study in accordance with ANSI/IEEE Std. 242, with coordination plots of protective devices plus tabulated data, including ratings and settings selected. In the study, balance shall be achieved between the competing objectives of protection and continuity of service for the system specified, taking into account the basic factors of sensitivity, selectivity and speed.
- B. Provide separate plots for each mode of operation: (1) "double-ended mode" (double-ended substation with bus tie open); (2) "singled ended mode" (single incoming utility feeder energized all switchgears single ended with bus ties closed); (3) "stand-by mode" (on-site generation solely providing power to the system); (4) "peak shaving modes" (a.) (double-ended substation with bus tie open with on-site generation paralleled) and (b) (single-ended with bus ties closed with on-site generation paralleled). Show maximum and minimum fault values in each case. Multiple power sources shown in one plot is not acceptable.
- C. Each primary protective device required for a delta-to-wye-connected transformer shall be selected so the characteristic or operating band is within the transformer parameters, which, where feasible, shall include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults. Separate the protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity. The protective device characteristics or operating bands shall be terminated to reflect the actual symmetrical and asymmetrical fault-currents sensed by the device. Provide the coordination plots for 3 phase and phase-to-ground faults on a system basis. Include at least all devices down to largest branch circuit and largest feeder circuit

breaker in-each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

- D. Select relay types (i.e., inverse, very inverse, extremely inverse, over current with or without voltage restraint, timers, etc), current transformer ratings and types, fuse, residually or zero sequence connected ground faults protection, etc, that will allow the system to be protected to within the equipment fault ratings and provide the maximum possible coordination between the protective devices.
- E. Multifunction Solid State Relays
1. Where multifunction solid state relays are already installed, it shall be the responsibility of the Contractor to obtain the current and complete list of software setpoints programmed into the device. These setpoints shall be evaluated for potential impacts on the protective device coordination.
 2. Where multifunction solid state relays are being installed, it shall be the responsibility of the Contractor to provide all setpoints needed for the specified operation of the relay. These settings include but are not limited to:
 - a. The complete pickup settings of all protective elements specified by the designer and shall not be limited to only the overcurrent pickup settings. Settings for protective elements such as reverse power, synchronization, frequency and voltage control, etc. shall be provided in full.
 - b. Differential pickup and zone settings necessary for the relay to operate as specified and designed and to protect the zone it is intended for. Zone of protection calculations and balance equations shall be completed entirely by the Contractor based on the equipment as furnished and designed.
 - c. The complete protective relay logic map and logic equations. The relay logic is responsible for translating the pickups of the protective elements into relay output events and device trips. All logic necessary to create the specified output of the relay based on the specified protective elements shall be furnished with the protective device coordination report.
 - d. Any and all miscellaneous settings necessary for the relay to communicate with the installation systems and the mirroring of data to other installation systems as specified or designed.
 3. Contractor shall be responsible for the programming of relays prior to the field testing and start up requirements of this contract. The Contractor shall be responsible for all time needed to complete the relay settings in order to furnish a completely functional system as specified and required by the approved protection device settings.
- F. Arc Flash Mitigation and Reduction Modes
1. Where devices are furnished with alternative trip settings intended to mitigate arc flash hazards, the Contractor shall coordinate these alternative pickup settings and provide representation of their tripping characteristics via TCC's. The alternative pickup settings shall be coordinated with the associated load and shall be set to provide the fastest device response time while avoiding nuisance trips during normal plant operation.

G. Generator Protective Devices

1. The study shall address all of the protective devices provided for generator protection.
2. Protective relays requiring settings shall be included.
3. The Electrical Contractor shall obtain all necessary generator information to perform this study.

H. Motor Protection and Coordination

1. Provide a complete and independent set of current-time characteristic curves for all motors 50 Hp and above indicating coordination between the protective relays and the thermal and starting characteristics of the motor.
2. The Contractor shall obtain from the motor supplier the necessary information to perform the study. Certified curves for "Safe Time vs. Current at 100% Voltage" and "Accelerating Time vs. Current at 100% Voltage" are necessary and shall become part of the final report.

I. Call discrepancies to the attention of the Engineer in the conclusions and recommendations of the report.

J. The Time current Characteristic Curves shall include:

1. The coordination plots shall graphically indicate the coordination proposed for the several systems centered on full-scale log forms. The coordination plots shall include complete titles, representative one-line diagrams and legends, associated upstream power system relays, fuse or system characteristics, significant motor starting characteristics, significant generator characteristics, complete parameters for power, and substation transformers, complete operating bands for low voltage circuit breaker trip devices, fuses, and the associated system load protective devices. The coordination plots shall define the types of protective devices selected, together with the proposed coil taps, time-dial settings and pick-up settings required. The short-time region shall indicate the relay instantaneous elements, the magnetizing inrush, and ANSI transformer damage curves, the low voltage circuit breaker and instantaneous trip devices, fuse manufacturing tolerance bands, and significant symmetrical and asymmetrical fault-currents.
2. No more than six devices shall be shown on one coordination plot. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots in order to provide cross-reference. Give each curve in the study a study-unique number or letter identifier to permit cross-reference between plots.
3. The coordinating time interval between primary and back-up protective devices shall be as per Table 15-3, Section 15.6, IEEE Std. 242-2001.
4. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings. A tabulation shall include settings for every overcurrent protective device, timer, power system relays (e.g., ANSI 25, 27, 32, 67, 87, etc), circuit breaker, recommended fuse and current transformer ratings, etc. Include C.T. ratio, burden and all other calculations required for the determination of settings. Provide recommended settings for all protective devices furnished under

Division 16 and furnished with Variable Frequency Drives and associated transformers, generators and associated paralleling and distribution switchgear.

1.7 ARC FLASH

- A. Provide an arc flash study that utilizes the fault current values calculated in the short circuit study and the minimum clear times of the upstream protective device selected in the coordination study to calculate the incident energy at each fault location.
- B. The Arc Flash study shall be in accordance with the procedure outlined in IEEE Standard 1584 and NFPA 70E.
- C. Calculate the incident energy levels at each faulted bus for each mode of operation: (1) "double-ended mode" (double-ended substation with bus tie open); (2) "singled ended mode" (single incoming utility feeder energized all switchgears single ended with bus ties closed); (3) "stand-by mode" (on-site generation solely providing power to the system; (4) "peak shaving modes" (a.) (double-ended substation with bus tie open with on-site generation paralleled) and (b) (single-ended with bus ties closed with on-site generation paralleled). Determine arc flash incident energy values for both maximum and minimum fault values in each case.
- D. Extent of Study
 - 1. The arc flash study shall include analysis for all equipment that would normally be serviced while energized and cannot be easily shut down during maintenance periods. The contractor shall coordinate with the owner to ensure that all equipment that is expected to be analyzed is included in the study. The extent of the analysis includes but is not limited to:
 - a. Switchgear, MCC's and distribution equipment
 - b. Low voltage lighting panels, even those covered by certain calculation exceptions must be modeled and provided with a unique device label
 - c. Low voltage control equipment such as 120-600V control panels.
- E. Arc Flash Labels
 - 1. The arc flash study shall produce a single set of label templates that shall not be printed until the final arc flash study has been approved.
 - 2. A single set of labels shall be printed and affixed to the equipment analyzed if the equipment is continuous. Double ended equipment shall have individual labels for each side of the gear. Equipment that is not continuous shall have a single label placed on each piece of continuous gear.
 - 3. Where applicable, LINE and LOAD labels shall be produced for equipment. Examples of equipment that require these labels include the main breakers of switchgear and MCC's. In these cases, the LINE side labels shall be affixed to indicate the hazard associated with the line side of the equipment and the LOAD side label shall be affixed to indicate the hazard associated with the rest of the gear.
 - 4. Labels shall be affixed where they are clearly identifiable with the equipment they depict. Labels shall not obscure any other signage on the equipment unless they are used to completely cover a previous arc flash label.

5. Labels shall meet the following requirements:
 - a. Labels shall be indoor/outdoor rated weather resistant vinyl or polyester with a UV resistant overlamine. The label shall have a minimum thickness of 5 mil. Labels shall be backed with pressure sensitive permanent cold temperature adhesive rated for a minimum 5 year life in the environment in which they are installed.
 - b. All lettering shall be black and printed via thermal transfer. Backgrounds shall be orange for hazard risk categories 1-4 and red for "Dangerous" areas.
 - c. Where subjected to degrading or corrosive environments, the labels shall be provided with a tinted fiber glass cover.
 - d. The label shall match any pre-existing facility or client specified formatting. The contractor shall be responsible for obtaining this formatting information prior to submitting label templates.
 - e. A single label for equipment is acceptable where equipment is continuous. In the event of split busses or equipment not arranged in a continuous fashion, multiple labels shall be provided.
 - f. Line side labels for equipment main breakers shall be included in addition to load side labels.
 - g. Labels shall be DANGER/WARNING type conforming to the NFPA 70E and ANSI Z534.4 standards. Labels are required to have the minimum information specified by these standards printed on them. Labels shall be legible and standard throughout the plant.
 - h. Labels templates shall be provided to the engineer and client for final approval and shall be printed and affixed by the contractor. Contractor shall be responsible for all work required to print and affix the labels to the equipment. Labels shall be affixed in accordance with the direction of the client.
6. Contractor shall produce all arc flash labels and coordinate affixing them onto all equipment.

F. Arc Flash Mitigation and Reduction Devices

1. Where devices are furnished with alternative trip settings intended to mitigate arc flash hazards, the Contractor shall provide an alternative arc flash lookup table associated with these alternative settings.
2. Labels shall have only the worst case hazard risk category (without the arc flash reduction settings) depicted. Multiple labels for different device settings shall not be accepted.
3. Devices such as differential protection relays which limit incident energy by limiting the magnitude of the available fault and/or minimizing the fault clearing time may be used to calculate hazard risk categories. The use of these devices in the calculations shall only be permitted where permitted by the standards and code guidelines used to complete the arc flash analysis. If not explicitly stated by the standard as an acceptable method for calculating arc flash hazard, it shall not be permitted.

G. Arc Flash Hazard Mitigation

1. Acceptable hazard risk categories shall be coordinated by the contractor between the owner and engineer. Where there are no guidelines determining acceptable arc flash

- levels, the Contractor shall actively attempt to reduce all hazard risk categories greater than 2. Contractor shall list all areas greater than category 2 in the conclusion of the report and shall give reasons for the high incident energy.
2. The Contractor shall be responsible for proposing and evaluating arc flash mitigation measures including but not limited to:
 - a. Adjustment of protective devices in an attempt to better balance the system coordination and the incident energy available to an arcing fault.
 - b. Equipment that could be used to physically remove the operator from the arc flash hazard boundary (mimic panels, remote switching/racking).
 - c. Equipment that could be used to limit the amount of incident energy or reduce the protective device pickup time (maintenance mode bypass, differential relaying).
 3. Proposing and evaluating these arc flash mitigation measures shall include evaluating the cost and implementation of the options as well as reevaluating and reporting the hazard risk category associated with their installation.

1.8 MOTOR STARTING/RUNNING

- A. Provide a motor starting study for all electric motors rated above 500 HP to determine voltage dip or power inrush limitations at selected locations due to starting of motors. Include in the study problems created by reclosing of Power Company feeders in 20 cycles with a dead time of 15 cycles. Provide relay protection on breakers as the study recommends.
- B. The motor starting/running study shall provide a voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, each switchgear/switchboard bus, and each motor control center and at the terminals of each motor identified in Paragraph 1.09A.
- C. A complete voltage profile shall be provided for each of the following operating conditions:
 1. All tie circuit breakers open with electrical distribution system operating double-ended.
 - a. One profile for all equipment running (steady state condition)
 - b. One profile for each motor starting scenario as identified in Paragraph 1.09A.
 2. All tie circuit breakers closed with the electrical distribution system operating single-ended.
 - a. One profile for all equipment running (steady state condition)
 - b. One profile for each motor starting scenario as identified in Paragraph 1.09A.
- D. The Contractor shall obtain from the motor supplier the necessary information to perform the study. Certified curves for "Safe Time vs. Current at 100% Voltage" and "Accelerating Time vs. Current at 100% Voltage" are absolutely necessary and shall become part of the final report.
- E. Multifunction Solid State Motor Protection/Management Relays
 1. Following a starting study, the Contractor shall produce all settings necessary for the programming of any and all motor protection and/or management relays. Generation of

these settings shall take into account the motor starting parameters assessed during the motor starting study and shall incorporate all parameters coordinated with the motor manufacturer.

2. Contractor shall develop all settings necessary to safely start and run any motor evaluated in the study and controlled by a motor protection/management relay. Settings generated shall include but shall not be limited to:
 - a. Starting parameters including start and stall times, torque settings and transition timing where applicable.
 - b. Motor protection settings coordinated with the motor manufacturer such as the number of starts per hour, safe stall times, overcurrent protection and mechanical jams.
 - c. Logic required for the motor to start, transition and run as specified and designed.

1.9 HARMONIC STUDY

- A. Provide a harmonic study for all harmonic producing equipment to determine the harmonic currents and voltages of the electrical distribution system.
- B. The harmonic study shall provide a harmonic current and voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, each switchgear/switchboard and motor control center bus.
- C. A complete Harmonic current and voltage profile shall be provided for the minimum anticipated fault current available from the utility and the standby generator for each of the following operating conditions:
 1. All tie circuit breakers open with electrical distribution system operating double-ended.
 - a. One profile for all equipment running (Full speed condition for VFD units)
 - b. One profile for all equipment running (70% of full speed condition for VFD units).
 2. All tie circuit breakers closed with the electrical distribution system operating single-ended.
 - a. One profile for all equipment running (Full speed condition for VFD units)
 - b. One profile for all equipment running (70% of full speed condition for VFD units).
- D. The Contractor shall obtain from the harmonic generating equipment suppliers the necessary information to perform the study. Certified harmonic information is absolutely necessary and shall become part of the final report.
- E. The harmonic study shall contain, as a minimum, the following:
 1. Explanation of method used to perform the study.
 2. Explanation of study results with specific recommendations on filters and/or other measures that will be implemented to meet the specified limits.
 3. All calculations and/or computer printouts used to arrive at the recommendations.

4. Individual drive voltage and current harmonic content up to the fiftieth harmonic, and the combined total of all the drive harmonic contents reflected in the system source supply voltage and current as a percent of the 60 Hz fundamental under actual load conditions from 0 to 60 Hz at 10 Hz increments.
- F. If the harmonic distortion for voltage and current distortion levels and line notching do not meet the requirements of IEEE 519. The contractor shall specify the appropriate filter traps that provide the filtering required to meet the requirements of IEEE 519 as specified herein.
- G. The manufacturer shall be responsible to provide all data necessary to perform the study. This includes nonlinear load producing equipment signature, feeder cable sizes, approximate feeder length, motor data, switchgear data, utility data, alternate source data, existing field data (if required) and any other information relevant to the study.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

- A. Adjust relay and protective device settings according to values established by coordination study. Setting shall be made in accordance with Section 260800.
- B. Make minor modifications to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.
- C. Notify Consulting Engineer in writing of any required major equipment modifications.

END OF SECTION 260100

This page intentionally left blank.

SECTION 260400 - ELECTRICAL APPARATUS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. In general, the work specified in this section of the specifications includes the furnishing of all labor, material, and services necessary to install the following material, including all fees, charges, and permits necessary.

1.2 SYSTEM RESPONSIBILITY

- A. All major components of the electrical system shall be the product of one manufacturer. To insure coordination, compatibility, and the maximum interchangeability of equipment items, the remaining components shall be provided by the major equipment manufacturer.
- B. The manufacturer shall maintain a recognized engineering, servicing, and repair facility in the project locality.

1.3 SUBMITTALS

- A. Complete wiring diagrams including coordination with instrumentation systems, generation systems, auxiliary control systems, etc., shall be approved prior to manufacture. Drawings shall be clear and carefully prepared to facilitate interconnections with other equipment. Standard drawings revised to indicate applicability shall not be acceptable.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All factory wiring shall be permanently numbered every 12".
- B. The electrical apparatus shall be manufactured by Eaton, or pre-approved equal.

2.2 MOTOR CONTROL CENTERS

- A. Unless indicated otherwise motor control centers (MCC) shall be NEMA Class II, Type B, provided in NEMA 12 enclosures with open bottom panels and shall be UL-approved for use as service entrance equipment. Units located outdoors shall be NEMA 3R. Each lineup shall consist of vertical sections nominally 90" high, 20" deep, and 20" wide. Each lineup shall be equipped with 120/1/60 space heaters and shall be provided with starter units, feeder units, main breakers, transfer switches, transformers, panelboards, control equipment, etc., as

indicated on the drawings. Control equipment shall be provided as specified in the section of these specifications entitled ELECTRICAL CONTROL EQUIPMENT.

- B. Each vertical section shall be fabricated of code gauge steel, reinforced and bolted together to form a rigid, free-standing, completely enclosed assembly. Each section shall have a gray baked enamel final coat over a rust-inhibiting prime coat. Enclosure finish shall be suitably touched up, following installation, with a manufacturer's supplied spray. Unless approved otherwise, the final coat shall be ANSI 61 Light Gray.
- C. Each vertical section shall be provided with a separate vertical wire trough door, a 12" horizontal wireway at the bottom, and a 6" horizontal wireway at the top. Each section shall have flange-formed covers on the rear and flange-formed doors with concealed hinges and quick release quarter-turn latches in the front. Unless approved otherwise, each vertical section shall be front-mounted only, completely front-accessible, and suitable for mounting against the wall. Each lineup shall be provided with continuous lifting angle and floor sills.
- D. Power shall be distributed throughout the lineup by means of a 3-conductor, bolt-connected, edgewise-mounted, tin-plated copper bus bar system. Cable shall not be used on the load side of the main. Each lineup shall be provided with a continuous ground bus and, if indicated, a continuous neutral bus. Each bus shall be braced, and the entire motor control center rated, for the maximum available short-circuit fault current, minimum 42,000 amperes RMS symmetrical. The main horizontal bus shall be enclosed in an isolating compartment at the top of each vertical section. The main bus shall be rated as indicated on the drawings and shall not be rated less than 600 amperes. The vertical bus sections shall be sized for the total connected load and shall not be rated less than 300 amperes. The main horizontal bus, transfer switch bus, cable lugs, etc., and the full height of the vertical bus shall be isolated providing a complete, dead-front installation with glass-reinforced polyester barriers equipped with shutter mechanisms for stab openings. Each ground bus shall be rated for the total capacity of the lineup and shall not be rated less than 300 amperes. When provided, each neutral bus shall have 50% of the full capacity of the main horizontal bus and shall be connected to the ground bus by a removable link.
- E. A separate control power source, independent of any single control circuit, starter unit, etc., shall be provided for all control components (control relays, annunciators, level controllers, etc.), integral to multiple control circuits or system operations, or actuated by remote field devices. Where practical, all control components connected to the separate control power source shall be located in a common compartment. For split bus applications, the separate control power source shall be continuously energized from either bus through an appropriately sized mechanically-held automatic reversing contactor.
- F. Each unit compartment shall be provided with an individual front door, interlocked mechanically with the unit disconnect device to prevent opening the door with the unit energized, or energizing the unit with the door open. Unit disconnect device handles shall indicate the ON, OFF, TRIPPED, and RESET positions and shall be provided with means for padlocking in the OFF or ON positions. Each unit compartment, including door, shall be individually removable without disturbing adjacent units. Unless approved otherwise, all units shall be of drawout construction with a positive guidance system to insure positive stabbing into the vertical bus. Unit stabs shall be tin-plated copper. Each unit compartment shall be provided with a door-mounted engraved nameplate attached with removable fasteners.

- G. Each motor starter unit shall be the combination type complete with molded case motor circuit protector; magnetic starter; manual resetting, 3-pole, bi-metallic thermal overload relay; individual 120 volt control power transformer; door-mounted pilot control devices, indicators, and instruments; and required accessory control relays, alternators, etc.
1. Each motor starter or contactor coil shall be equipped with a transient suppressor to limit high voltage transients.
 2. Overload element ratings shall be individually selected and adjusted in the field to coordinate with the equipment connected.
 3. Motor starters for submersible motors shall be equipped with ambient-compensated, bi-metallic, quick-trip type overloads.
 4. Control power transformers shall be fused on both primary leads and one secondary lead with the remaining lead grounded and shall be sized for the entire control circuit, including motor space heaters and all additional remote auxiliary devices.
 5. Motor circuit protectors shall be quick-make, quick-break, molded case air circuit breakers with adjustable instantaneous trip. Instantaneous trip settings shall be individually adjusted in the field to coordinate with the equipment connected.
 6. Each unit shall be provided with 2-piece drawout terminal boards, for load and control terminals. The field terminal board component shall be mounted adjacent to the wiring trough.
 7. As indicated on the drawings, starters shall be full voltage, across-the-line type, or reduced voltage autotransformer closed transition type, connected on the 65% tap, unless noted otherwise. Starters shall be reversing, or non-reversing as indicated.
 8. Multi-speed starters shall have compelling relays which require starting at lowest speed and prevent instantaneous transition between speeds.
 9. Starter unit size and ratings shall be coordinated with the equipment supplied. Units of the same size shall be interchangeable.
 10. In addition to contacts required, all starter units shall be provided with 2 spare N.O. and N.C. auxiliary contacts.
- H. Solid-state reduced voltage motor starters shall consist of three sets of two inverse-parallel connected SCR's with a complete microprocessor based electronics package to provide soft start and smooth stepless acceleration to full speed. Unless otherwise indicated, or required by the application, each solid-state reduced voltage starter shall provide individually adjustable acceleration and deceleration control (0 - 120 seconds). Each starter shall be equipped with voltage transient protection (thermostat, MOV, and RC protection of each pole), shorted SCR protection, and single phase protection. Each starter shall be equipped with a 3 phase temperature-compensated solid-state motor overload protection relay. Each starter shall be fan-cooled and shall be rated 115% FLA continuous duty and 300% FLA for a minimum of 30 seconds. Each starter shall be equipped with a fault indication pilot light and auxiliary contact for remote indication of fault condition. Unless indicated otherwise, each solid-state motor starter shall include fully rated isolation contactor and bypass shorting contactor. Each solid-state motor starter shall automatically resume normal operation following a power outage.
- I. Feeder units shall be equipped with molded case air circuit breakers, unless indicated otherwise. Breakers shall be quick-make, quick-break, with trip-free operation, incorporating an internal trip bar and a single external handle. Breakers shall be thermal magnetic type rated not less than 35,000 amperes RMS symmetrical. Breakers rated above 150 amperes shall be provided with interchangeable trips. Breakers shall be provided with control accessories, such

as shunt trip, auxiliary contacts, etc., as indicated or required for proper interlocking and operation.

- J. Unless specified otherwise, main breakers shall be as specified for feeder breakers; however, main breakers shall be 100% rated, UL-approved for use as service entrance equipment, and shall be fully rated for the maximum fault current, without the use of current limiters. Each main breaker shall be equipped with a completely self-contained temperature insensitive automatic trip unit with selective tripping characteristics including adjustable long time setting, adjustable long time delay setting, adjustable short time setting, adjustable short time delay setting, adjustable instantaneous setting, and ground fault protection systems. Each main breaker shall be equipped with auxiliary contacts for remote indication of breaker status and overcurrent trip.
- K. Power monitoring units shall be complete microprocessor-based circuit monitors for each incoming line, and selected feeders as indicated. Power circuit monitors shall be equipped with data communications port, communications interface modules, protocol converters, etc. as required for remote monitoring from the Owner's standard monitoring system. Power circuit monitors shall continuously monitor and display 3 phase current, voltage, power factor, frequency, wathours, varhours, demand current, and demand power, and shall store historical maximum and minimum data for each parameter monitored.

2.3 VARIABLE FREQUENCY DRIVES

- A. To ensure coordination, compatibility, and maximum interchangeability with the Owner's existing standardized equipment, all variable frequency drive equipment shall be Eaton SVX9000 with minimum 3% input line reactor, or pre-approved equal.
- B. Each variable frequency drive shall control the speed of a standard squirrel-cage induction motor by controlling the frequency applied to the motor and shall be designed to operate from a local manual speed potentiometer or remote automatic speed reference signal. The variable frequency drive shall convert incoming 3 phase AC power to a variable potential DC and then to variable frequency AC by use of a full-wave diode bridge converter with line power factor in excess of 0.95 regardless of speed and load, and a 3 phase insulated gate bipolar transistor power module inverter with sine-coded pulse width modulated output.
- C. Variable frequency drives shall have a 110% continuous full nameplate current overload rating, and 150% for 60 seconds. Variable frequency drives shall be oversized where necessary to meet these current overload rating requirements.
- D. Each drive shall be contained within a gasketed, force-ventilated, free-standing motor control center style enclosure. Enclosures shall be equipped with replaceable filters.
- E. Each drive shall be equipped with input circuit breaker, output contactor, 3 phase temperature-compensated solid-state motor overload protection, and fault protection and indication as follows:
 - 1. Softstall
 - 2. Current limit
 - 3. Overcurrent

4. Overvoltage
 5. Short-circuit at load
 6. Load-side ground fault
 7. Undervoltage
 8. Momentary power failure
 9. Electronic thermal overload protection
 10. Overtemperature
 11. Overfrequency
- F. Each drive shall be equipped with the following system interfaces:
1. Auxiliary dry contacts for indication of drive operation
 2. Auxiliary dry contacts for indication of drive fault
 3. Isolated process control speed reference signal
 4. Digital diagnostic display for indication of drive diagnostic information
 5. Addressable serial communications link to allow drive programming, monitoring, and control
- G. Each drive shall provide independently adjustable acceleration (6-75 seconds), deceleration (6-75 seconds), minimum speed (70%-90%), maximum speed (75%-100%), and current limit (100%-120% FLA). All programmable parameters shall be adjustable from a door-mounted digital operator keypad.
- H. Each drive shall automatically restart and resume normal operation following a power outage.
- I. Instrumentation Signal Controlled Systems: Each variable speed pump control system to be controlled by a remote instrumentation signal shall be equipped with all necessary logic and control apparatus to provide the intended automatic mode of operation:
- J. All VFDs shall be equipped with drive output line conditioning as required to protect the connected motors from reflected wave high voltage impulses.
- K. All VFDs while operating at rated load shall limit harmonic current and voltage distortion in accordance with the recommendations of the latest edition of IEEE 519 for general systems during operation from the utility source and for dedicated systems during operation from the standby generator source. The VFD manufacturer shall provide harmonic filtering equipment required to meet this distortion limit and shall submit calculations to demonstrate compliance for drives operating from both sources.
- L. Before shipment, each VFD shall undergo a minimum 24-hour factory burn-in test. Each VFD shall be burned in at 100% inductive or motor load for 24 hours without an unscheduled shutdown. Copies of factory test reports shall be submitted with final drawings.

PART 3 - EXECUTION

3.1 SERVICE AND TRAINING

- A. The major equipment manufacturer shall provide support and technical direction of installation, energization, and operation of the electrical equipment. Experienced field service engineering personnel shall be available at the job site, as needed, to provide the following factory service:
1. Recommended procedures for checks and tests.
 2. Assist in solving erection problems by making critical checks and necessary adjustments.
 3. Supervise necessary operational tests, verify, and document test results.
 4. Perform final inspection of installed equipment.
 5. Participate in initial energization.
 6. Check and test all relays for proper operation. Contractor shall set relays as directed by the Engineer and shall submit a list of "as-left" settings.
 7. Provide revised factory drawings on an "as-built" basis.
 8. Conduct complete operation and maintenance training program (minimum 2-1/2 days' duration) at the job site for a minimum of 4 Owner-selected operating personnel, prior to startup.
- B. Upon completion, final approved as-built wiring diagrams shall be permanently fastened inside the enclosure doors of each SWB section, MCC cubicle, etc. Wiring diagrams shall include all local and remote interconnections, in detail.
- C. Prior to startup, the variable speed drive manufacturer shall conduct a complete training program (minimum 2-1/2 days duration) at the job site for a minimum of 4 Owner-selected operating personnel. The training program shall include operation, preventive maintenance, and troubleshooting instructions relative to all aspects of each variable speed drive system provided.
- D. Each variable speed drive manufacturer shall provide complete drive operation and maintenance manuals.
- E. Each training program shall be scheduled a minimum of 14 days in advance. Proposed dates shall be submitted in writing for approval. The Owner may exercise the option to audio- or video-tape each entire training program without restriction.

END OF SECTION 260400

SECTION 260600 - GROUNDING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. In general, the work specified in this section of the specifications includes the furnishing of all labor, material, and services necessary to install the following materials, including all fees, charges and permits necessary.

1.2 GENERAL REQUIREMENTS

- A. The project's grounding system shall consist of a grounding electrode system in accordance with NEC specifications, bonded to a main ground bus interconnecting all power distribution equipment. Ground rods shall be located at each service connection, transformer pad, generator pad, outdoor electrical equipment pad, and as indicated or required, and shall be bonded to the main ground bus. Ground rod sections shall be coupled and driven to establish a maximum resistance to ground of 5 ohms throughout the grounding system.

1.3 SURGE PROTECTION

- A. The Contractor shall furnish and install UL 1449 (latest edition) listed surge protection devices (SPD) for the protection of all AC electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally-generated transients from inductive and/or capacitive load switching. Surge protection devices shall be provided for all switchgear, switchboards, motor control centers, power distribution panels, lighting panels, control panels, instrumentation panels, etc.
- B. Each SPD unit shall be marked with a short circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating.
- C. Complete UL 1449 performance ratings, including the fault current rating and VPR rating, shall be posted on the UL label of each SPD.
- D. Submit copies of the UL Standard 1449 Listing documentation for each proposed SPD.

PART 2 - PRODUCTS

2.1 GROUNDING

- A. Ground rods shall be minimum 10 feet long, 5/8-inch diameter, copper-clad steel sections.

- B. Main ground bus cable shall be minimum No. 4/0 (19 strand, tinned copper). Bonding jumpers shall be minimum No. 2. Unless noted otherwise, all grounding conductors shall be insulated and shall have green colored insulation.
- C. All grounding hardware such as clamps, connectors, couplings, lugs, bolts, nuts, and washers shall be of silicone bronze.

2.2 SURGE PROTECTION

- A. AC power surge protection devices (SPD), formally transient voltage surge suppressors (TVSS), shall utilize heavy duty 'large block' MOVs, each exceeding 30mm diameter, with redundant modules per phase. SPD equipment shall provide suppression elements between all phases and each phase conductor and the system neutral. AC power surge protection equipment shall be APT, or equal.
- B. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls. SPDs relying upon external or supplementary installed safety disconnectors do not meet the intent of this specification.
- C. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per NEC 285.6.
- D. SPD shall be UL labeled with 20kA I nominal (I-n) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.
- E. Minimum surge current capability (single pulse rated) per phase shall be:

Service Entrance Equipment:	300kA
Power Distribution Equipment:	200kA
Panelboards & Control Panels:	100kA

- F. SPD shall provide surge current paths for all modes of protection: L-N, L-G, and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.
- G. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V

Numerically lower is allowed/preferred; old-style Suppressed Voltage Ratings (SVRs) shall not be submitted, nor evaluated due to outdated less-strenuous testing)

H. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	Allowable Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277	15%	320V

I. SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.

J. SPD shall include visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED. SPD shall include an audible alarm with on/off silence function and diagnostic test function (excluding branch).

K. Warranty – Each SPD shall have a warranty period of not less than 10 years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

PART 3 - EXECUTION

3.1 GROUNDING

A. The concrete-encased steel reinforcement within the foundation of each structure shall be grounded, with a minimum of one 20-foot ground rod, at each corner column and at intermediate columns at distances not to exceed 60 feet. The main ground bus shall be interconnected to each ground rod throughout the structural grounding system with a continuous tinned copper cable loop, minimum No. 4/0 (19 strand), buried 30 inches below grade and 24 inches outside the structural footing.

B. A minimum of one 20-foot ground rod shall be located within each manhole and handhole. The main ground bus shall be interconnected to each ground rod throughout the underground ductbank system with a continuous tinned copper cable, minimum No. 4/0 (19 strand), encased within the ductbank concrete envelope.

C. All grounding connections shall be made in the same manner as current carrying connections are made with bolted clamps and solderless connectors. All underground grounding system connections, cable-to-cable, cable-to-ground rod, etc., shall be made with exothermic-fused connections. Contact surfaces shall be equal in area to those of current carrying connectors. All contact surfaces shall be thoroughly cleaned before connections are made.

D. All ground connections shall be made with connectors or lugs approved for the specific type of connection.

E. Insulated-type grounding bushings shall be used for all metallic conduit terminations.

F. Permanent and effective ground connections shall be provided for transformer secondary neutrals.

G. The metallic frame of each motor, generator, transformer, panelboard, lighting fixture, outlet box, control equipment enclosure, etc. shall be grounded to the ground bus of the power

distribution equipment with an insulated grounding conductor included in the feeder or branch circuit conduit.

- H. The base of each street or area lighting standard shall be grounded to a ground rod driven into the ground near the base of the standard and to a separate ground wire run with the feeder. Ground rods shall be driven so that the top is 6 inches below finished ground grade. When the foundation is placed, a suitable ground wire shall be embedded in the concrete to facilitate connection to the base on the inside.
- I. Installed ground cables shall be protected from subsequent mechanical damage. Sleeves shall be provided in foundation walls and in floors to facilitate installation of ground cables. Where ground cables enter buildings through sleeves, the sleeves shall be sealed with jute packing and approved sealing compound.

3.2 SURGE PROTECTION

- A. Surge protection devices (SPD) shall be provided for all switchgear, switchboards, motor control centers, power distribution panels, lighting panels, control panels, instrumentation panels, etc.
- B. Service Entrance - Each SPD installed on service entrance equipment shall be replaceable modular construction. A UL approved disconnect switch shall be provided as a means of servicing disconnect if a 60A breaker is not available.
- C. Power Distribution - Each SPD installed on switchboards or motor control centers shall be replaceable modular construction. Each SPD shall have an independent means of servicing disconnect such that the protected power distribution equipment remains energized. A 30A breaker (or larger) may serve this function.
- D. Sub Panels - Each SPD installed on power distribution panelboards, lighting panelboards, control panels, unit equipment, etc. shall be encapsulated construction.
- E. SPD equipment shall be installed per manufacturer's installation instructions with lead lengths as short (less than 24") and straight as possible. Gently twist conductors together.
- F. Installer may reasonably rearrange breaker locations to ensure short & straightest possible leads to SPDs.
- G. SPD shall be installed on the load side of the main service disconnect.
- H. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers per NEC.
- I. Status indication pilot lights for each SPD shall be remote mounted and shall be visible from the front of the protected equipment enclosure.

END OF SECTION 260600

SECTION 260800 - ELECTRICAL CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. In general, the work specified in this section of the specifications includes the furnishing of all labor, material, and services necessary to install the following material, including all fees, charges, and permits necessary.
- B. As specified in the section of these specifications entitled ELECTRICAL WORK - GENERAL, the Contractor shall furnish and install conduit, wiring, and connections for equipment and devices furnished under other sections of the specifications or under other contracts. The Contractor shall also install motor starters, switches, and other electrical equipment furnished under other sections or under other contracts.
- C. The Contractor should refer to the heating, ventilating, and air conditioning specifications and drawings for locations of thermostats, damper motors, small transformers, relays, and other devices requiring wiring.
- D. The Contractor should also refer to the mechanical specifications and drawings for locations of pressure-operated control switches, float switches, solenoid-operated valves, limit switches, alarm actuating contacts, and other devices requiring wiring.

PART 2 - PRODUCTS

2.1 CONTROL DEVICES

- A. Control Stations - Control stations shall be 30 mm, heavy-duty, corrosion resistant, water-tight and oil-tight, complete with NEMA 13 cast aluminum enclosures; Eaton Type E34, Square-D Type SK, or equal.
 - 1. Safety lockout stations (SAFE-OFF) shall be equipped with 316 stainless steel padlock devices for padlocking in the de-energized position; Eaton 10250A63, Square-D Type K5, or equal.
 - 2. Unless specified otherwise, control stations installed outdoors, or in corrosive atmospheres, shall have watertight, NEMA 4X cast aluminum enclosures.
 - 3. Control stations within hazardous locations shall be explosion-proof and shall have galvanized cast iron enclosures; Crouse-Hinds Type EFS, Appleton, or equal.
- B. Float Switches - Where required for control system operation, float switches consisting of a SPDT mechanical micro switch, rated 15 amps at 120 VAC, in a chemical-resistant casing, complete with chemical-resistant flexible cord, shall be provided; Flygt ENM-10 standard version for non-classified area applications (water), Ex version for classified area applications (wastewater).

- C. Electrode Level Controls - Where required for control system operation, industrial-type, conductance actuated, 120 volt primary, single or differential liquid level controls shall be provided; Warrick Controls Series 1, 2, or 17 (as required) or equal. Unless indicated otherwise or required for the specific application, each electrode control system shall consist of PVC-coated 316 stainless steel electrodes with a NEMA 4X cast aluminum holder with 316 stainless steel body and a 3-pole transformer/relay combination with a NEMA 4X cast aluminum enclosure.
- D. Liquid Flow Switches - Where required for control system operation, magnetic sleeve, flow disc actuated, mercury switch type flow switches shall be provided; Magnetrol Model F-503 or equal. Switches shall be adjustable rate with sensitivity to low flow and large flow-through capacity. Switches shall be all 316 stainless steel construction with body taped for direct installation and a NEMA 4X watertight switch enclosure. Switch mechanism shall be DPDT rated 5 amps at 120 VAC.
- E. Pressure Switches - Where required for control system operation, adjustable deadband, industrial pressure switches shall be provided; ASCO Tri-Point, Square D 9012-G, or equal. Pressure switches shall be watertight (or explosion-proof as required), die-cast copper-free aluminum construction, with 316 stainless steel wetted parts. Contacts shall be DPDT rated 5 amps at 120 VAC. Each pressure switch shall be equipped with a 316 stainless steel, adjustable, self-cleaning pulsation dampener and a 316 stainless steel diaphragm isolation sleeve, Red Valve Series 42 or equal.
- F. Temperature Switches - Where required for control system operation, adjustable deadband, industrial temperature switches shall be provided; ASCO Tri-Point or equal. Temperature switches shall be watertight (or explosion-proof as required), die-cast copper-free aluminum construction with 316 stainless steel sensing probe. Contacts shall be DPDT rated at 5 amps at 120 VAC.
- G. Limit Switches (Leverless) - Where required for control system operation, magnetic target sensing, leverless limit switches shall be provided; GO Switch Model 81. Limit switches shall be NEMA 4X, hermetically sealed, 316 stainless steel construction. Limit switches shall be equipped with 72 inch potted leads. Unless otherwise required by the application and installation, limit switch outlet shall be located at the bottom of the enclosure. Limit switches shall not require input power for operation. Limit switch contacts shall be DPDT rated 10 amps at 120 VAC. Limit switches located in hazardous locations shall be explosion proof and intrinsically safe
- H. Alarm Horns - Alarm horns shall be piezoelectric audible signal devices; Mallory Sonalert, or equal. Each alarm horn shall be equipped with an enable/disable control switch. Unless indicated otherwise, alarm horns shall be installed within the associated control equipment enclosure. Exterior alarm horns shall be weatherproof semi-flush mounted.

2.2 CONTROL COMPONENTS

- A. General - Where indicated on the drawings, or required by the functions specified, control components shall be furnished and installed with-in control panels, motor control center, or other approved locations. Suitable nameplates shall be provided for all panel door or surface-

mounted control devices. All component terminals, including auxiliary contacts, shall be wired to master terminal boards.

- B. Instruments - Instruments shall be of standard size not less than 5-1/2" in width and they shall present a uniform appearance when mounted upon the panels. Instruments shall have scales 5" in length and shall be accurate within 1% of full scale. Instrument scales shall be selected with full-load readings at 75% of the scale range, unless specified otherwise or approved.
- C. Pilot Devices - Selector switches, pushbuttons, indicating pilot lights, and additional pilot devices as required, shall be 600 volt rated heavy-duty, oil-tight, 30mm pilot devices as manufactured by General Electric, Cutler-Hammer, or equal.
 - 1. Pushbuttons shall be standard type with anodized aluminum rings and colored buttons.
 - 2. Selector switches shall be standard handle type with anodized aluminum rings and handles.
 - 3. Pilot lights shall be full brightness LED type.
 - 4. All pilot devices shall have appropriate nameplates and locking means for locking in the de-energized mode, and shall be color coded (red - start, on, open, up; green - stop, off, close, down; black - test, silence, miscellaneous).
- D. Running Time Meters - Hour meters shall be non-reset type with register to indicate hours and tenths of hours up to 99,999.9 hours. Each meter shall be a 2-1/2" round panel mounting type, suitable for operation on 120 volt control circuits; Engler Model 10NG1 or equal.
- E. Timers - Where required for control system operation, multifunction programmable timing modules shall be provided. Timers shall have timing modes and cycle times as indicated, shall be provided for operation at voltage indicated, and shall have DPDT contacts; Potter & Brumfield CNS-35-96, or equal.
- F. Automatic Alternators - Where required for control system operation, duplex DPDT plug-in automatic alternators shall be provided; Diversified Electric Model ARA-120-ADA or equal. Alternators shall be installed with hold-down springs, and a lead selector switch (1-AUTO-2) to permit manual and automatic selection of the lead sequence. For triplex systems, 3 input 3 output triplex alternators shall be provided. Triplex alternators shall be installed with plug-in base, hold down springs, and a lead selector switch (AUTO-1-2-3).
- G. Control Relays - Where required for control system operation, control relays shall be 3P3T, 11 pin octal type, with 10 amp contacts, internal LED, test button, and large ice cube style case; Cutler-Hammer D3PF3AA, D3PF3AT1, or equal.
 - 1. Time delay relays shall be potentiometer adjustable time setting, 1.0% repeatability, 2PDT plug-in type time delay relays with, 10 amp contacts, 8-pin square sockets and hold-down springs. Delay on de-energize mode shall not require input power during the timing; Potter & Brumfield CK Series, or equal.
- H. Shock Relays - Where required for control system operation, electronic sensor shock relays that detect overloads and unexpected shock loads shall be provided; Tsubaki TSB-SS Shock Relay.
- I. Power Monitors - Where required for control system operation, 3 phase power monitors shall be provided. Power monitors shall be surface-mounted type consisting of a phase angle sensing

circuit driving a DPDT electromechanical relay. Power monitors shall sense loss of any phase, low volt-age on any or all phases, and phase sequence reversal. Power monitors shall be field-adjustable, provided with fault indication, and adjustable time delay (0-20 seconds); Diversified Electronics Series SLD or equal.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Electrical control equipment, starters, contactors, etc., shall be full NEMA rated.
- B. All contacts for control of electrically-operated equipment shall be rated not less than 10 amperes on 120 volts.
- C. All electrical components of the control system shall operate on 120 volt, single phase, 60 hertz power, except as noted otherwise in the specifications. Unless indicated otherwise, control circuits for components which are located in hazardous areas shall be 24 volt.
- D. Where control equipment is not within sight of the motor, a safety lockout station with position indication, which shall prevent application of current to the motor, shall be located near the motor. Where the driven equipment is located on a different level than their driving motors, a safety lockout station shall be provided on each level.
- E. For each automatically operating field control device (float switch, pressure switch, etc.), an adjustable time delay module shall be furnished and installed within the control panel, motor control center, or other approved control equipment location. Timing modules shall be 2-wire, 0-1,000-second, delay on make, solid-state units; SSAC TDU3000A or equal.
- F. Programmable controllers shall be utilized for standard relay and control functions within motor control centers, control panels, etc., only where specifically approved. In general, conventional control equipment shall be provided.

3.2 CONTROL PANELS

- A. Where indicated on the drawings, specified, or required by the functions specified, control panels, including all necessary accessories, shall be provided for power distribution and control of the associated equipment. Each control panel shall be equipped with an incoming line main circuit breaker and an incoming line surge protection device (SPD). Each three phase control panel shall be equipped with a three phase power monitor.
- B. Control panel components shall be inner-panel or door-mounted, wired to terminal boards with identifying numbers. All contacts, including spare auxiliaries, shall be wired to terminal boards. All wiring shall be neatly bundled with wire ties, or in wireways, and all wiring shall be identified by color coding and numbering. Wiring shall be coded: black - primary power; red - AC control wiring; blue - DC control wiring; white - neutral; and green - ground.
- C. Unless indicated otherwise, each control panel shall be furnished with red (running) and green LED pilot lights, H-O-A selector switch, circuit breaker type combination motor starter,

running time meter and control circuit equipment for each motor controlled. Motor starters for all motors 25 hp and above shall be the solid state reduced voltage type. Multiplex control panels shall be furnished with an automatic alternator and lead selector switch. Each control panel shall be equipped with an independent control power system including all required control power transformers, protective fusing, and separate control power main breaker. Control panels shall be equipped with power monitors, an exterior red flashing alarm light, alarm horn, alarm test switch, and a 120 volt convenience outlet.

- D. Control panels shall be furnished with a thermostatically controlled condensation heater and all additional accessories as indicated. Control operation shall be as specified or as required for proper operation of the equipment controlled. In general, for each associated alarm condition, control panels shall be furnished with amber pilot lights and auxiliary contacts for remote indication.
- E. Unless indicated otherwise or required for the specific installation, panels for interior use shall be NEMA 12 construction with oil-resistant gasketing and full-sized single door. Door shall have slotted flush latch and door-mounted control devices. Exterior panels shall be NEMA 12/3R with oil-resistant gasketing and full-sized door-in-door construction. Inner door shall have door-mounted control devices and slotted flush latch. Blank outer door shall have three-point latching handle with padlocking provisions.
- F. Variable speed control panels shall be equipped with VFD in accordance with the section of these specifications entitled ELECTRICAL Apparatus. The VFDs shall be flange mounted with the heat sinks located outside the enclosure. The enclosures shall be equipped with sun shields on all surfaces. A compact cooling fan shall be installed inside the enclosure to provide air circulation and eliminate hot spots within the enclosure. The fan shall provide 50,000 hours of continuous operation without lubrication or service. Finger guards shall be mounted on each side of fan for safety. The enclosure shall be oversized as required to eliminate the need for an enclosure air conditioning system.
- G. Control panel enclosures and inner panels shall be seam-welded aluminum, 0.125" minimum, with all stainless steel hardware.

END OF SECTION 260800

This page intentionally left blank.

SECTION 310515 - SOILS AND AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Soils: Soil materials and topsoil materials.
- 2. Aggregates: Coarse aggregate materials and fine aggregate materials.

- B. Related Sections:

- 1. Section 312000 "Earthwork."
- 2. Section 312333 "Trenching and Backfilling"
- 3. Section 312500 "Erosion and Sedimentation Control."
- 4. Section 329119 "Landscape Grading."
- 5. Section 329200 "Turfs and Grasses."

1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures" for requirements of submittals.
- B. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 2000 cubic yards or change in material.

1.4 INFORMATIONAL SUBMITTALS

- A. Materials Source: Submit name and location of imported materials suppliers.
- B. Source's Certificate: Certify materials meet or exceed specified requirements.
- C. Material Test Reports: For each on-site soil and aggregate material proposed for fill and backfill as follows:
 - 1. Test Reports: Submit any test reports required by this Section to the Engineer.

1.5 QUALITY ASSURANCE

- A. Furnish each subsoil and topsoil material from single source throughout the Work, unless an alternate source is approved by the Engineer.
- B. Furnish each coarse and fine aggregate material from single source throughout the Work, unless an alternate source is approved by the Engineer.
- C. Perform Work according to St. Johns County Utility Department standards.
- D. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.
 - 1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Tree and Plant Protection Zones: Comply with requirements and measures specified in Section 015639 "Temporary Tree and Plant Protection."

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Common Fill - Common fill shall be approved on site excavated material or imported fill material that is composed of durable soil free of debris, organic matter, or other deleterious materials. Common fill shall not contain stones larger than 6 inches in largest diameter, a maximum of 50 percent passing the No. 200 sieve, and a maximum dry density of at least 85 pounds per cubic foot (pcf) as determined by ASTM D698. Common fill shall not contain granite blocks, broken concrete, masonry rubble, or other similar materials and shall have physical properties such that it can be readily spread and compacted during filling.
- B. Select Common Fill – Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than 2 inches in largest diameter.
- C. Structural Fill – Structural fill shall consist of mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted. Structural fill should consist of materials with the following gradation:

Sieve Size Percent Finer by Weight

3-in	100
No. 4	20 to 70
No. 40	5 to 35
No. 200	0 to 10

Structural fill should be non-plastic, inorganic, and have a maximum dry density of at least 95 pcf as determined by ASTM D1557.

2.2 TOPSOIL MATERIALS

- A. Topsoil (Type S3): Conforming to State of Florida Department of Transportation (FDOT) and St. Johns County Utility Department Manual of Water, Wastewater and Reuse Design Standards and Specifications.
- B. Topsoil (Type S4):
 - 1. Excavated and reused material.
 - 2. Graded.
 - 3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.

2.3 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate - Crushed Stone: Natural stone; washed, free of clay, shale, organic matter; conforming to State of Florida Department of Transportation (FDOT) and St. Johns County Utility Department Manual of Water, Wastewater and Reuse Design Standards and Specifications.
 - 1. Coarse Aggregate Designation: No. 57
- B. Coarse Aggregate - Screened Gravel: Natural stone; washed, hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials; to the following limits:
 - 1. Percent Passing per Sieve Size:
 - a. 5/8- inch: 100 percent.
 - b. 1/2-inch: 40 to 100 percent.
 - c. 3/8-inch: 15 to 45 percent.
 - d. No. 10: 0 to 5 percent.
- C. Coarse Aggregate – Limerock base for pavement: the limerock base course shall have a minimum Limerock Bearing Ratio (LBR) of 100.

2.4 FINE AGGREGATE MATERIALS

- A. Fine Aggregate - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded according to ASTM C 33; within the following limits:
 - 1. Percent Passing per Sieve Size:
 - a. No. 4: 95 to 100.
 - b. No. 8: 80 to 100.
 - c. No. 16: 50 to 85.
 - d. No. 30: 25 to 60.
 - e. No. 50: 10 to 30.
 - f. No. 100: 2 to 10.

2.5 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing and inspection services. Submit test result reports to the Engineer.
- B. Subsoil Material - Testing and Analysis: Perform in accordance with ASTM D 1557.
- C. Topsoil Material - Testing and Analysis: Perform in accordance with ASTM D 1557.
- D. Coarse Aggregate Material - Testing and Analysis: Perform according to ASTM D 1557.
- E. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM D 1557.
- F. When tests indicate materials do not meet specified requirements, change material and retest.
- G. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION - SOILS

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations indicated on Drawings.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.
- D. Stockpile topsoil **8** feet high maximum.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

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 310515

This page intentionally left blank.

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and removing site utilities.
8. Temporary erosion and sedimentation control.

- B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing vegetation.
2. Section 312500 "Erosion and Sedimentation Controls" for temporary protection of erosion and sedimentation.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings and as indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface electrical and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Conform to the St. Johns County Land Development Code (Article VI) for clearing.
- B. Perform Work in accordance with St. Johns County Utility Department standard.

1.7 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed roadways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- C. Utility Locator Service: Notify Sunshine 811 for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earthwork."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.
- D. Call Local Utility Line Information service not less than one working day before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than **two** days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 1. Limit height of topsoil stockpiles to 72 inches.
 2. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other project work.

END OF SECTION 311000

This page intentionally left blank.

SECTION 312000 – EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. General: Earthwork includes clearing and stripping, procurement of on-site and imported fill material, excavating, placing, and compacting fill and backfill, structural excavating and backfilling, transportation and storage of excess earthwork materials; disposal of unsuitable, waste, and surplus materials; restoration of excavation and trench surfaces; and subsidiary work necessary to complete the grading of developed areas to conform with required lines, grades, and slopes.
- B. Work includes but is not necessarily limited to; excavation for structures, tanks, foundations, manholes, vaults, electrical manholes, conduits, cables, raceways and ducts, pipes, paving; embankments; grading; and related work such as sheeting, bracing and dewatering.
- C. Provide services of a licensed Professional Engineer to prepare temporary excavation support system, dewatering system designs, and submittals.
- D. Provide temporary excavation support systems, including sheeting, shoring, and bracing, to ensure the safety of personnel and protect adjacent structures, piping, and other materials in accordance with Federal, State and local laws, regulations, and requirements. Temporary excavation support systems are specified in Section 315000 “Excavation Support and Protection.”
- E. Provide temporary dewatering, surface water control systems, and operate to dewater and maintain excavations in a dry condition. Control drainage into excavations and remove seepage water and rainwater. Dewatering and surface water control are specified in Section 312319 “Dewatering.”
- F. Examine site and review available geotechnical report prior to submitting a proposal, taking into consideration project conditions that may affect the work. Owner and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time investigations were made.
- G. Do not initiate extra work without written notification to Owner and Engineer and receiving Owner’s written approval in response.
- H. Protect existing structures and utilities that remain.
- I. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for recording pre-excavation and earthwork progress.
2. Section 310515 "Soils and Aggregates for Earthwork" for fill materials.
3. Section 311000 "Site Clearing" for site preparation work, including stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 312333 "Trenching and Backfilling" for stated work.
5. Section 312319 "Dewatering" for controlling surface and groundwater and disposing of water during construction.
6. Section 312500 "Erosion and Sedimentation Controls" for temporary stated work.
7. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
8. Section 321216 "Asphalt Paving" for flexible paving system.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 2. Unauthorized Additional Excavation: Excavation as directed by Engineer to correct Contractor's work not in compliance with Contract Documents, which will be performed without additional compensation.
 3. Bulk Excavation: Excavation more than 10 feet width and more than 30 feet in length.
 4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be provided without additional compensation.
- E. Finished Grade: Required final grade elevation indicated on Drawings. Spot elevations take precedent over proposed contours.
- F. In-the-Dry: An excavation subgrade where groundwater level: has been lowered to at least 2 feet below lowest level of excavation; is stable with no ponded water, mud, or muck; is able to support construction equipment without rutting or disturbance; and is suitable for placement and compaction of fill material, pipe, or concrete foundations.

- G. **Objectionable Material:** Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, and rocks or lumps of cemented soils over 6 inches in maximum dimension.
- H. **Optimum Moisture Content:** Moisture content (percent by dry weight) corresponding to maximum dry density of the same material as determined by ASTM Test Method D 1557.
- I. **Overexcavation:** Removal of unsuitable soil or objectionable material at or below the normal grade of excavation or subgrade as indicated on Drawings.
- J. **Percent Compaction:** Required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by ASTM Test Method D 1557.
- K. **Structures:** Buildings, wet wells, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes and vaults, or other man-made stationary features constructed above or below the ground surface.
- L. **Subgrade:** Required surface of subsoil, borrow fill, or compacted fill that is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.
- M. **Unsuitable Soil:** Includes existing fill materials, organic soils, weak native soils, or clays with a plasticity index of greater than 30, and any materials that cannot be properly placed and compacted as specified.
- N. **Utilities:** On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- O. **Zone of Influence:** A line extending at least 2 feet beyond foundation or pipeline edge, then outward and downward at a slope of 1 horizontal to 1 vertical. Do no excavation below foundation of existing structures or pipeline.
- P. **Professional Engineer:** Registered Professional Engineer meeting project qualifications and who is hired by Contractor.
- Q. **The Engineer:** The Engineer or designated representative hired by Owner.
 - 1. Approval given by the Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 ACTION SUBMITTALS

- A. Coordinate various submittal types required by this Section with requirements of dewatering and support of excavation submittals specified in other Sections.
- B. **Samples:** Submit a representative sample weighing approximately 50 pounds of each fill material, filter sand, and crushed stone contained in sealed 5 gallon containers, at least 30 calendar days prior to date of anticipated use of each material.

- C. Submit laboratory test results for fill materials that include maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria, at least 72 hours prior to importing or placing fill.
- D. Prepare excavation support system designs by a licensed Professional Engineer, registered in State of Florida and having a minimum of 5 years of professional experience in design and construction of excavation support systems.
 - 1. Submit an original and three copies of licensed Professional Engineer's certification, on PE form specified in Section 013300, stating excavation support systems designs have been prepared by Professional Engineer who is responsible for their execution.

1.5 INFORMATIONAL SUBMITTALS

- A. Construction and Operations Plan: Submit proposed methods of construction, including earthwork operations, excavation limits, slopes, fill material moisture conditioning and handling, compaction equipment, excavation support systems designs, backfilling and filling and compaction, and material sources.
 - 1. Submit excavation support system plan as prepared by registered Professional Engineer complying with requirements stated in previous Article.
- B. Upon completion of earthwork and grading operations, submit an as-graded map showing density test numbers and locations, a table of density test results and depths, and a certification of compliance by geotechnical engineer in charge.
- C. Qualification Data: For qualified testing agency to conduct geotechnical observation, testing and documentation, include qualifications of firm, resumes of soil technicians assigned to the project, and licensed geotechnical engineer in charge.
 - 1. Firm Qualifications: Meet ASTM D 3740.
 - 2. Soil Technicians: Have minimum three years demonstrated experience in earthwork and grading operations and satisfy certification requirements of agency having local jurisdiction.
 - a. The Engineer reserves right to request substitution of soil technicians assigned to field work. Do not substitute assigned soil technicians without prior approval of the Engineer.
- D. Pre-excavation Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.6 QUALITY ASSURANCE

- A. Excavation, trenching, sheeting, bracing, and similar work shall comply with requirements of the Florida "Trench Safety Act", CS/SB 2626, which incorporates by reference, OSHA excavation safety standards, 29 CFR 1926 Subpart P.

- B. At least three working days prior to starting any excavation, notify the appropriate regional notification center for underground utilities and underground utility owners who are not members of notification center. To obtain area specific information for project site, refer to [www.call 811.com](http://www.call811.com).

1.7 FIELD CONDITIONS

- A. Be responsible for construction layout and reference staking necessary for proper control and satisfactory completion of structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and other appurtenances.
- B. Perform construction layout and staking by a Professional Surveyor or Professional Engineer registered in State of Florida, experienced and skilled in construction layout and staking requirements.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- D. Utility Locator Service: Notify Sunshine 811 for area where Project is located before beginning earthwork operations.
- E. Do not commence earthwork operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 311000 "Site Clearing" are in place.
- F. Do not commence earthwork operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- G. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- H. Do not direct vehicle or equipment exhaust towards protection zones.
- I. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Fill materials designated for use in this Section are specified in Section 310515 “Soils and Aggregates for Earthwork.”
- B. On-Site Fill Material: Earth and rock material obtained at project site during excavation, following clearing and stripping, from which any Unsuitable Soil or Objectionable Material has been removed.
- C. General: Provide imported fill materials when sufficient satisfactory soil materials are not available from excavations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, fencing, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - 1. If necessary, remove and restore or replace curbing, driveway aprons, and fencing after performing backfilling work.
 - 2. Replace existing facilities damaged by construction with new material fully equal to existing without additional compensation.
- B. Prior to and During Earthwork Operations:
 - 1. Protect and maintain erosion and sedimentation controls; coordinate with Section 312500 “Erosion and Sedimentation Controls.”
 - 2. Provide, monitor, and maintain excavation support; coordinate with Section 315000 “Excavation Support and Protection.”
 - a. Use excavation support system for excavations within the zone of influence for existing structures or utilities.
 - b. Do not permit excavations below base level of adjacent foundations or retaining walls, unless excavation design and bracing includes an analysis of structure’s stability supported by the foundation. When necessary due to project conditions, incorporate required bracing and foundation underpinning.
 - 3. Provide, monitor, and maintain dewatering and drainage systems; coordinate with Section 312319 “Dewatering.”
- C. Test Pits:
 - 1. Perform exploratory excavation work, test pits, for purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.

2. As earthwork progresses, perform test pits for the purpose of compaction testing. Pause operations and provide safe access for testing personnel.
 3. Backfill and compact test pits as soon as desired information has been obtained. Stabilize backfilled surfaces in accordance with approved erosion and sedimentation control plans.
- D. Clearing and Stripping. Initially clear and strip ground surfaces beneath planned structures and in areas requiring excavation or filling of organic material and debris. Do not use those materials as On-Site Fill Material; remove from the site and properly disposed.
1. Stripping Depth Variance: From about six inches to twelve inches, or as directed by the Engineer's representative.
- E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- F. Saw cut existing pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

3.2 DEWATERING AND DRAINAGE

- A. Provide dewatering and drainage in accordance with Section 312319 "Dewatering". This Article supplements those requirements.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff and groundwater seepage away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Prior to excavation, verify groundwater will be at required level indicated on approved dewatering and drainage submittal.
- E. Accomplish dewatering by methods that preserve undisturbed state of subgrade soils. Dewater in a manner to prevent boiling, detrimental under-seepage, or disturbance at excavation base.

3.3 SUPPORT OF EXCAVATION

- A. Provide excavation support in accordance with Section 315000 "Excavation Support and Protection". This Article supplements those requirements.
- B. Install excavation support in accordance with reviewed Shop Drawings prior to beginning excavation work. Maintain excavation supports that are required to remain in place, if applicable, as indicated on Drawings or as required by approved Shop Drawings.
- C. Owner or Engineer may direct that certain excavation supports remain in place or be cut off at any specific elevation. Supports directed by Owner or Engineer to be left in place and not so

designated on Contract Documents will be paid for according to Contract provisions for changes in the Work.

- D. The right of Owner or Engineer to direct that certain excavation supports remain in place shall not be construed as creating any obligation on Owner or Engineer to give such direction, nor shall failure to give such direction relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.
- E. Construct temporary excavation slopes in accordance with the requirements of OSHA excavation safety standards and approved Shop Drawings.
- F. Where allowed, carefully remove excavation supports in a manner without endangering the Work or other adjacent structures, utilities, or property. Immediately fill voids left or caused by withdrawal of supports with sand and compact.

3.4 EXCAVATION

- A. Include material of every description and of whatever substance encountered as an unclassified excavation.
- B. General: Excavate on-site soils using standard earthmoving equipment. Excavation in dense soil or rock may require special equipment. Do not plough, scrape, or dig earth with machinery so near to finished subgrade to result in excavation of or disturbance of below grade material.
- C. Make excavations to grades indicated on Drawings and in widths sufficient for laying of pipe, construction of the structure, installing bracing, excavation supports, dewatering and drainage facilities, and working clearances.
- D. Perform excavation in-the-dry and accomplished by methods which preserve the natural undisturbed condition of subgrade soils.
- E. Moisture Sensitive Soils: Use a smooth-edge bucket to excavate last one foot of depth when excavation is to end in such soils.
- F. If excavation bottom is removed below the limits shown on Drawings, specified, or directed by the Engineer, refill with structural fill satisfactory to the Engineer without additional compensation.
- G. When excavation has reached prescribed depths, notify the Engineer who will observe the conditions. If materials and conditions are not satisfactory, the Engineer will issue instructions for corrective procedures. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.
- H. Subgrade soils that have become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods in the opinion of the Engineer, remove existing soil and replaced with structural fill as acceptable to the Engineer at Contractor's expense.

- I. Exposed subgrades for foundations and pavement footprint shall be proof rolled with at least two overlapping coverages of a vibratory drum roller with a minimum static drum weight of 10 ton. Conduct proof-rolling in presence of the Engineer. The Engineer will waive this requirement, if in its opinion the subgrade will be rendered unsuitable by such proof-rolling.
 - 1. Confined Areas: Proof-roll with hand operated vibratory equipment that is approved by the Engineer.
- J. Perform overexcavation at the Engineer's request to remove unsuitable soil, objectionable material, or other materials as determined by the Engineer and to such depth and width as directed. Replace with suitable material as directed by the Engineer.
 - 1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- K. Perform excavation for pipe lines beneath structures and excavation for footings with excavating equipment operating from the subgrade for the structure, while in-the-dry and in a manner preserving the undisturbed state of subgrade soils.
- L. When excavations have reached the required subgrade, including any allowances for working mats or base materials and prior to their placement, notify soils testing laboratory to verify suitability of existing subgrade soils for anticipated foundation and structural loadings.
 - 1. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
 - 2. Notify the Engineer if the revised work scope would modify Contractor's cost and thereby entitle a change to the Contract Sum. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.
- M. Replace overexcavation beyond the limits and depths required by Contract Documents using structural fill satisfactory to the Engineer without additional compensation.

3.5 SUBGRADE PREPARATION

- A. Notify Engineer when excavations have reached required subgrade.
- B. Maintain excavated subgrade in-the-dry condition.
- C. Prior to fill placement, remove objectionable material which includes, but not be limited to, pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, and rocks or lumps of cemented soils over 6 inches in maximum dimension.
- D. For subgrades consisting of granular soils, proof roll the final subgrade using at least four coverages of a vibrator plate compactor.
 - 1. Exposed subgrade beneath structures shall be compacted to 95% maximum dry density for ASTM D1557 within the upper 24 inches of compacted natural soils.
 - 2. Exposed subgrade beneath pavement areas shall have a minimum Limerock Bearing Ratio (LBR) or 40, and be compacted to 98% maximum dry density for ASTM D1557.

3. Clayey sand (SC) or sandy clay (CL) materials (as classified per ASTM D2487) within 24 inches of the proposed footing, slab, or pavement base shall be removed and replaced with compacted structural fill material.
- E. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove loose or soft material from the subgrade immediately prior to placing lean concrete working mat.
- F. Remove and replace soft subgrades or unusable material with structural fill
- G. During wet or freezing weather, or in areas where exposed subgrade consists of moisture-sensitive soils, take measures to protect foundation excavations once they have been approved by the Engineer. Protective measures include, but are not limited to, placing insulation blankets, placing a layer of fill, pea gravel, crushed rock, or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tent.
 1. If additional overexcavation is required due to the subgrade not being protected against wet or freezing weather, perform additional work without additional compensation.
- H. Notify the Engineer to observe conditions following subgrade preparation and prior to fill placement. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
 1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

3.6 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Protect from precipitation.
 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.7 FILL PLACEMENT AND COMPACTION PROCEDURES

- A. Fill and Backfill: Place materials in lifts to suit specified compaction requirements to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil or sod. Correct soft spots or uncompacted areas.
- B. Do not place or compact fill and backfill when materials are too wet to properly compact.
 1. In-place Soil Moisture Content: Maximum of two percentage points above optimum moisture content of soil, as determined by laboratory test of moisture-density relation appropriate to specified level of compaction.

- C. Structural Fill and Embankment Fill: Construct to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil and sod. Correct soft spots or uncompacted areas.
- D. Fill material shall be free of snow, ice, frost, and frozen earth. Do not place fill materials on frozen surfaces or surfaces covered by snow, ice, or frost.
- E. If subgrade slopes more than 10 percent, step subgrade to produce a stable, horizontal surface for placement of fill materials. Scarify existing subgrade slope to a depth of at least 6 inches.
- F. Compact filled slopes by slope rolling and trimming, or overfill and trim back to plan grade to expose a firm, smooth surface free of loose material.
- G. Do not allow fill lifts to contain stones with a dimension larger than $\frac{2}{3}$ the specified loose measure lift thickness.
- H. Confined Compaction: Perform compaction in confined areas, including areas within a 45-degree angle extending upward and outward from the base of a wall, and in areas where the use of large equipment is impractical, using hand-operated vibratory equipment or mechanical tampers.
 - 1. Do not exceed lift thickness of 6 inches or $\frac{1}{2}$ the specified lift thickness (whichever is less), measured before compaction, when using hand operated equipment.
- I. Moisture condition on-site fill material prior to placement, unless Contractor demonstrates to the Engineer in-place moisture conditioning methods can achieve the required moisture content.
- J. Conduct compaction of each specified lift of fill materials by a minimum of four complete coverages with acceptable compaction equipment to a specified density as a percentage of maximum dry density as determined by ASTM D 1557, unless otherwise specified.
- K. Use structural fill required beneath foundations, slabs on grade, or pavement areas. Place and compact structural fill in even lifts having a maximum thickness of 8 inches, measured before compaction.
- L. Use select fill and backfill material placed within 10 feet of all structures. Uniformly place and compact select fill around the structure in even lifts having a maximum thickness of 8 inches, measured before compaction.
- M. Use common fill in areas beyond those designated for structural fill or select fill, unless shown or otherwise specified. Place in even lifts having a maximum thickness of 12 inches, measured before compaction.

3.8 COMPACTION REQUIREMENTS

- A. Perform in-place testing of compacted fill lifts to measure in-place density and water content according to ASTM D 6938 and ASTM D 1557.
- B. Beneath Foundations and Slabs-on-Grade, except sidewalks: Compact top 24 inches of existing subgrade and each layer of fill, if applicable to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D 1557.
 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 2 percent.
- C. Area Around Structures: Within 10 feet, compact each fill or backfill layer to:
1. Maximum Dry Density: Minimum of 95 percent for ASTM D 1557.
 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 2 percent.
- D. Embankments, Lawn, or Unimproved Areas: Does not include embankments under roadways and earth dam structures. Compact each fill or backfill layer to:
1. Maximum Dry Density: Minimum of 90 percent for ASTM D 1557.
 2. Moisture Content: At or near its optimum moisture content of minus 1 percent to plus 4 percent.
- E. Sidewalks: Compact each fill layer to:
1. Maximum Dry Density: Minimum of 95 percent for ASTM D 1557.
 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.
- F. Roads, Paved Areas, and Roadway Embankments: Compact each layer of fill or backfill to:
1. Fill beneath the base course: Minimum of 98 percent for ASTM D 1557.
 2. Limerock base course: shall have a minimum Limerock Bearing Ratio(LBR) of 100, and be compacted to 100 percent of maximum dry density for ASTM D1557.
 3. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 2 percent.

3.9 DISPOSAL OF UNSUITABLE, WASTE, AND SURPLUS EXCAVATED MATERIALS

- A. Unsuitable soil, objectionable material, waste, and surplus excavated material shall be removed and disposed of off-site. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restricts access to work site.
- B. Topsoil or loam excavated under this Section may be salvaged for use as specified under Section 329200 "Turf and Grasses", as approved by the Engineer.

3.10 GRADING

- A. Perform grading to lines and grades shown on Drawings. Remove objectionable materials encountered within the limits indicated and disposed of off-site. Completely and continuously drained and dewatered subgrades throughout the grading process. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the execution or condition of grading work.

- B. If it is not possible at the time of grading to place material in its proper section of the Work, stockpile it in approved areas for later use. No additional compensation will be made for stockpiling or double handling of excavated materials.
- C. In cut areas, remove loose or protruding rocks in slopes to line or finished grade of the slope. Uniformly dress, cut, and fill slopes to slope cross-section and alignment shown on Drawings, unless otherwise directed by the Engineer.

3.11 FIELD QUALITY CONTROL

- A. Test and observe materials as described in this Article. Cooperate by allowing free access to work for selection of test materials and observations.
- B. General Testing Requirements:
 - 1. At Structures: Prior to placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with CDM Smith's Geotechnical Services Division, Project Geotechnical Engineer or Soils Testing Laboratory to verify suitability of existing subgrade soil.
 - 2. Backfill and Fill: Prior to and during the placement of backfill and fill coordinate with CDM Smith's Geotechnical Services Division, Project Geotechnical Engineer or Soils Testing Laboratory to perform in-place soil density tests to verify that backfill and fill material has been placed and compacted in accordance with specified compaction requirements.
 - a. Provide minimum 48 hours' notice prior to placement of backfill and fill.
 - 3. Subgrade: Do not cover with fill without observation, testing, and approval by CDM Smith's Geotechnical Services Division, Project Geotechnical Engineer or Soils Testing Laboratory.
 - a. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.
- C. Test materials by a certified independent laboratory, engaged by Contractor and acceptable to the Engineer, demonstrating conformance with project requirements. Deliver test reports and material certifications to the Engineer before using any material in the work.
 - 1. If field test results are not in conformance with project requirements, costs involved in correcting deficiencies in compacted materials to satisfaction of the Engineer without additional compensation.
- D. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.
- E. Testing methods shall comply with latest ASTM or equivalent AASHTO Standards applicable during bidding.

- F. During placement of bedding, backfill, and fill, perform in-place soil density testing to confirm that fill material has been compacted in accordance with project requirements. The Engineer may designate areas to be tested. Notify the Engineer at least 72 hours in advance of scheduled compaction testing. In place soil density tests on backfill and fill material shall be as required by authorities having jurisdiction, project geotechnical report, but in no instance, shall less than those listed:
1. Structures and Embankments: At least one density and moisture content test for each 2,500 square feet of surface area for each lift of fill at embankment, structure and manhole locations.
 2. Column Footing: At least one density and moisture content test for 25% of the column footing locations.
 3. Wall/ring Footing: At least one density and moisture content test for 100 linear feet of the wall or ring footings.
 4. Pavement Areas: At least one density and moisture content test for each 5,000 square feet of surface area for each lift of fill at pavement area.
 5. Trench Excavations: At least one nuclear density and one moisture content test at a maximum of 300 feet intervals for each lift of fill placed or as directed by the Engineer.
 6. The Engineer may designate supplemental areas to be tested at additional compensation.
- G. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected, if it is determined that results do not conform to project requirements. Immediately remove rejected materials when directed by the Engineer, notwithstanding results of previous testing.
- H. The Engineer or Owner may conduct additional soil testing. Cooperate fully in allowing additional test to be made, including free access to the work.
- I. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

3.12 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Protecting existing structures: vibratory roller equipment shall not be used within 50 feet from existing structures. Within this zone, use of a track-mounted bulldozer, or a vibratory roller operating in static mode is recommended.
- C. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.
- D. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

This page intentionally left blank.

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes construction dewatering and surface water control and incorporates the design, equipment, materials, installation, operation, protection, monitoring and removal of dewatering and drainage system. Provide dewatering system sufficient to lower groundwater and collect surface water, regardless of groundwater level or rainfall at any time during the work.
- B. Obtain and pay for permits required for dewatering and drainage systems. Implement measurements to comply with dewatering and discharge permits requirements.
- C. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
 - 2. Section 310515 "Soils and Aggregates for Earthwork" for filter sand.
 - 3. Section 312000 "Earthwork" for excavating, backfilling.
 - 4. Section 312333 "Trenching and Backfilling" for trenching, backfilling, and compaction.
 - 5. Section 312500 "Erosion and Sedimentation Controls" for controlling surface-water runoff and ponding.
 - 6. Section 315000 "Excavation Support and Protection" for support of excavations.
 - 7. Division 32 "Exterior Improvements" for various Sections relating to civil and landscape related work.

1.3 DEFINITIONS

- A. In-the-Dry: An excavation subgrade where all of the following are met:
 - 1. Groundwater level has been lowered to at least 2 feet below lowest excavation level.
 - 2. Subgrade is stable with no ponded water, mud, or muck.
 - 3. Subgrade is able to support construction equipment without rutting or disturbance.
 - 4. Subgrade is suitable for placement and compaction of fill material, pipe, or concrete foundations.
- B. Professional Engineer: Registered Professional Engineer meeting project qualifications and who is hired by Contractor.
- C. The Engineer: Engineer hired by Owner.

1. Approvals given by The Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 ACTION SUBMITTALS

- A. Design Plan: Submit written dewatering and drainage system design plan, prepared by a qualified Professional Engineer, that includes:
 1. Description of proposed dewatering system and installation methods to be used for system elements and observation wells.
 2. Description of equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, number and location of dewatering points and observations wells.
 3. Dewatering system design calculations demonstrating that the proposed system meets all requirements herein and elsewhere.
 4. Sequence of well and well-point placement coordinated with support of excavation system installation and control procedures to be adopted, if dewatering problems arise.
 5. Identification of anticipated area influenced by dewatering system and address impacts to adjacent existing and proposed structures.
 - a. Include detailed plans for pre-construction surveys of existing structures in vicinity of dewatering system, settlement monitoring of existing structures during construction, and provisions to address settlement of existing structures resulting from dewatering activities.
 6. Coordinate dewatering and drainage submittals with excavation and support of excavation submittals.
- B. Shop Drawings: For dewatering system, prepared by a qualified Professional Engineer.
 1. Include plans, elevations, sections, and details.
 2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 3. Include pump capacity and anticipated discharge rate.
 4. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 5. Show areas and depths of excavation to be dewatered and adjacent structures or facilities within the anticipated area influence.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Professional Engineer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that has specialized in installation of dewatering systems and dewatering work and having a minimum of 5 years' experience.
- B. Professional Engineer Qualifications: Licensed Professional Engineer registered in the State of Florida; having a minimum of 5 years' experience in design and construction of dewatering and drainage systems; and having completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that required for the work.
- C. Comply with authorities having jurisdiction for the following:
 - 1. Drilling and abandoning of wells used for dewatering systems.
 - 2. Water discharge and disposal from dewatering operations.
- D. Obtain permit from EPA under National Pollutant Discharge Elimination System (NPDES), for storm water discharge from construction sites.

1.7 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. Owner is not responsible for interpretations or conclusions drawn from this report.
 - 1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 - 2. Groundwater levels may vary during the work and should not be assumed to be accurately represented by groundwater level readings reported in the geotechnical report.
- B. Survey Work: Engage a qualified land surveyor or Professional Engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of surface and ground water and permit excavation and construction to proceed in-the-dry in accordance with the requirements herein and elsewhere.
 - 1. Design dewatering system, including comprehensive engineering analysis by the Contractor's Design Engineer.

2. Continuously monitor and maintain dewatering operations to ensure required groundwater lowering, erosion control, stability of excavations, excavation support, and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
 5. Remove dewatering system when no longer required for construction.
- B. Primary Purpose of Work: Preserve natural undisturbed condition of subgrade soils in areas of proposed excavations.
1. Prior to excavation, lower groundwater to at least 2 feet below lowest excavation subgrade elevation.
 2. Additional groundwater lowering may be necessary beyond 2 feet requirement, depending on construction methods, equipment used, and prevailing groundwater and soil conditions. Lower groundwater as necessary to complete construction in accordance with Contract Documents without additional compensation
- C. Design deep wells, well points and sumps, and other groundwater control system components to prevent loss of fines from surrounding soils. Use sand filters with dewatering installations, unless screens are properly sized by Contractor's design engineer to prevent passage of fines from surrounding soils.
- D. Maintain standby pumping systems and sources of standby power at various sites.
- E. Design dewatering system to prevent damage to adjacent properties, buildings, structures, utilities, and facilities from dewatering operations. Be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements, and work that may result from dewatering or surface water control operations.
- F. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

2.2 MATERIALS

- A. Equipment: Piping, pumping, and other equipment and materials to provide control of surface water and groundwater in excavations.
- B. Grout: Mixture of Portland cement and bentonite clay or sand suitable for sealing abandoned wells and piping.

PART 3 - EXECUTION

3.1 GENERAL

- A. Control surface water and groundwater such that:

1. Excavation to final grade is made in-the-dry.
 2. Natural undisturbed conditions of subgrade soils are maintained.
 3. Softening, instability, or disturbance due to presence or seepage of water does not occur.
 4. Construction and backfilling proceeds in-the-dry.
 5. Floation of completed portions of work shall be prohibited.
- B. Methods of groundwater control may include but are not limited to trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells, or any combination.
- C. Where groundwater levels are above proposed bottom of excavation level, provide a pumped dewatering system for pre-drainage of soils prior to excavation and for maintaining lowered groundwater level until construction has been completed such that structure, pipeline, or fill will not be floated or otherwise damaged.
- D. Vary type of system, spacing of dewatering units, and other details of the work depending on soil and water conditions at each location.
- E. Do work in a manner to protect adjacent structures and utilities without causing loss of ground or disturbance to pipe bearing soils or soils supporting overlying or adjacent structures.
- F. Install, monitor, and report data from observation wells. Evaluate collected data relative to groundwater control system performance and modify systems necessary to dewater site.
- G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with installation and monitoring of geotechnical instrumentation including observation wells. Do not make excavations for sumps or drainage ditches within or below 1H:1V slopes extending downward and out from edges of existing or proposed foundation elements or from downward vertical footprint of pipe without approval by the Engineer.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways, if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.

- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 311000 "Site Clearing" during dewatering operations.

3.3 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 - 1. Space well points or wells at intervals required to provide sufficient dewatering.
 - 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.4 SURFACE WATER CONTROL

- A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent flow of surface water into excavations and to allow construction to proceed without delay.
- B. Grade excavation to divert surface water and seepage water within excavation areas into sumps and dewatering wells.

3.5 EXCAVATION DEWATERING

- A. Provide and maintain equipment and facilities to promptly remove and properly dispose of water entering excavations. Maintain excavations in-the-dry.
- B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and be in operation until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.
- C. Do not place pipe and concrete in water or submerge within 24 hours after being installed. Prevent water from flow over new concrete within four days after placement.
- D. Prevent water from rising to cause unbalanced pressure on structures until concrete or mortar has set at least 24 hours. Prevent pipe flotation by promptly placing backfill.
- E. Conduct dewatering to preserve natural undisturbed condition of subgrade soils at bottom of excavation.

- F. If trench subgrade or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Engineer and refill with structural fill, screened gravel, or other material as approved by the Engineer without additional compensation.
- G. It is expected that initial dewatering plan may be modified to suit variable soil and water conditions encountered. Dewater and excavate in a manner without causing loss of ground or disturbance to pipe bearing soil or soil that supports overlying or adjacent structures.
- H. If methods do not properly dewater excavation, install additional groundwater observation wells as directed by the Engineer. Do not place pipe or structure until readings obtained from observation wells indicate that groundwater has been lowered to specified minimum of below bottom of final excavation.
- I. Surround dewatering units with suitable filter sand with no fines being removed by pumping. Pump continuously from dewatering system until pipe or structure is adequately backfilled. Provide stand-by pumps.
- J. Collect water entering excavations from precipitation or surface runoff in shallow ditches around excavation perimeter, drained to a sump, and pump from excavation to maintain a bottom free from standing water.
- K. Dispose of drainage to an approved area Do not use existing or new sanitary sewers to dispose of drainage.

3.6 WELL-POINT SYSTEMS

- A. Where necessary, install a vacuum well-point system around excavation for dewatering purposes. Surround each well-point and riser pipe by a sand or gravel filter. Use sand of gradation that after initial development of well-points, quantity and size of soil particles discharged shall be negligible. Provide well-point systems capable of operating continuously under highest possible vacuum. Include sufficient valves and gauges to accurately monitor and control the system. Develop and redevelop well-points to provide reliable performance throughout the duration of the work.
- B. Install well point systems in the Engineer's presence according with approved submittal.

3.7 REMOVAL OF SYSTEMS

- A. At completion of excavation and backfilling work and when approved by the Engineer, remove from site various pipe, deep wells, well-points, pumps, generators, observation wells, other equipment, and accessories used for groundwater and surface water control systems.
 - 1. Removed materials and equipment become property of Contractor.
- B. Restore areas disturbed by installation and removal of groundwater control systems and observation wells to their original condition.
- C. Leave in place deep wells casings, well-points, and observation wells located:

1. Within plan limits of structures or pipelines.
 2. Within zone below 1H:1V planes extending downward and out from edges of foundation elements or from downward vertical footprint of pipe.
 3. Where removal would result in ground movements causing adverse settlement to adjacent ground surface, utilities, or existing structures.
- D. Fill pulled casings holes with sand. Where left in place, fill casings with cement grout and cut off a minimum of 3 feet below finished ground level or 1 foot below foundation level to prevent interference with finished structures or pipelines.
- E. When directed by the Engineer, leave observation wells in place for continued monitoring. Cut casings flush with final ground level when directed and provide protective lockable boxes with locking devices. Provide protective boxes suitable for traffic and other conditions to which observation wells will be exposed.

END OF SECTION 312319

SECTION 312333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes trench excavation, backfilling, and compaction.
- B. Related Requirements:
 - 1. Section 310515 "Soils and Aggregates for Earthwork" for materials used as backfill.
 - 2. Section 312000 "Earthwork" for related earthwork activities.
 - 3. Section 312319 "Dewatering" for dewatering and drainage.
 - 4. Section 312500 "Erosion and Sedimentation Controls" to prevent erosion, sedimentation, and contamination of adjacent properties.

1.3 DEFINITIONS

- A. Percent Compaction: Means at least the stated percentage of maximum density as determined by ASTM D 1557, Method D.

1.4 ACTION SUBMITTALS

- A. Submit proposed method of backfilling and compaction prior to start of Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For material excavated from trench for re-use as backfill, by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Comply with following regulations:
 - 1. Florida "TrenchSafety Act" (CS/SB 2626).
 - 2. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926 Subpart P.

- B. Provide excavation, trenching, related sheeting, bracing, and related materials to comply with requirements of the Florida "Trench Safety Act" (CS/SB 2626) which incorporates, by reference, OSHA's excavation safety standards, 29 CFR 1926 Subpart P.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store excavated materials according to Section 312500 "Erosion and Sedimentation Control" to prevent erosion of soil type materials and contamination of adjacent water sources.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine that erosion and sedimentation controls are in place and comply with project requirements and authorities having jurisdiction.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where excavation activities occur across active vehicular or pedestrian circulation paths, use temporary controls specified in Division 01 to maintain circulation during operations required by this Section. Maintain temporary controls for each day circulation paths are restricted.
- B. Coordinate work of this Section with materials specified in other Sections of Division 31.
- C. Identify required lines, levels, contours, and datum locations.
- D. Protect features to remain-in-place including bench marks, existing structures, fences, sidewalks, paving, curbs, etc. from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCH EXCAVATION

- A. Trench excavation includes material of every description and substance encountered, except rock and boulders.
- B. Cut rigid and flexible pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.
- C. Strip and stockpile topsoil from grassed areas crossed by trenches.

1. At Contractor's option when required, topsoil may be disposed of and replaced with approved topsoil of equal quality.
- D. While excavating and backfilling is in progress, maintain traffic and protect utilities and other property.
- E. Excavate trenches to indicated depths and in widths sufficient and of practical minimum for pipe laying, bracing, and pumping and drainage facilities.
- F. Accomplish excavation and dewatering by methods preserving undisturbed state of subgrade soils. Excavate trench by machinery to or just below designated subgrade, if material remaining in trench bottom is no more than slightly disturbed.
 1. Remove subgrade soils that become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods and replace with screened gravel fill acceptable to the Engineer at Contractor's expense.
- G. Use care when working in clay and organic silt soils, which are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 12 inches of depth.
- H. Where pipe is to be laid in screened gravel bedding, excavate trench by machinery to normal depth of pipe, provided material remaining in trench bottom is no more than slightly disturbed.
- I. Where pipe is to be laid directly on trench bottom, manually perform final excavation, providing a flat-bottom, true to grade upon undisturbed material. Make bell holes required by project conditions.

3.4 DISPOSAL OF MATERIALS

- A. Stack excavated material without excessive surcharge on trench bank or obstructing free access to hydrants and gate valves. Avoid inconvenience to traffic and abutters. Segregated excavated material for use in backfilling as specified below.
- B. Do not remove excavated material from work site, except as directed by the Engineer. When removal of surplus materials is approved by the Engineer, dispose of such surplus material in approved designated areas.
- C. Should conditions make it impracticable or unsafe to stack material adjacent to trench, haul and store material at a location provided. When required, re-handled and use it in backfilling trench.

3.5 SHEETING AND BRACING

- A. Provide and maintain sheeting and bracing required by Federal, State, or local safety requirements to support sides of excavation and prevent loss of ground which could endanger personnel, damage, adjacent structures, or delay the work.
 1. Engineer may order additional supports placed at Contractor's expense if it is determined that at any point sufficient or proper supports have not been provided. Compliance with such order shall not relieve Contractor from their responsibility for sufficiency of such

supports. Take care to prevent voids outside of sheeting; if voids are formed, immediately fill and ram them.

- B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support trench sides, take care in placing and moving the boxes or supporting bracing to prevent pipe movement, disturbance of pipe bedding, or screened gravel backfill.
 - 1. Rigid Pipe Installation (such as R.C., V.C., A.C.): Raise that portion of box extending below mid-diameter above this point prior to moving box ahead to install next pipe. Perform to prevent separation of installed pipe joints due to box movement.
 - 2. Flexible Pipe Installation (such as PVC): Do not allow trench boxes, moveable sheeting, shoring, or plates to extend below mid-diameter of pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, place screened gravel to fill voids created. Re-compact screened gravel and backfill to provide uniform side support for pipe.
- C. Engineer may give permission to use steel sheeting in lieu of wood sheeting for entire job wherever sheeting use is necessary. Include cost for use of sheeting in bid items for pipe, including full compensation for driving, bracing, and later removal of sheeting.
- D. Carefully remove sheeting and bracing in manner to not endanger construction of other structures, utilities, or property, whether public or private. Immediately refill voids left after withdrawal of sheeting using sand by ramming with tools especially adapted to that purpose and watering or otherwise directed by the Engineer.
- E. No payment will be given for sheeting, bracing, or other support during progress of the work. No payment will be given for sheeting left in trench for Contractor's convenience.
- F. Leave sheeting driven below mid-diameter of pipe in place from driven elevation to at least 12 inches above top of pipe.

3.6 TEST PITS

- A. Excavation of test pits may be required for purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Backfill test pits as soon as desired information has been obtained. Maintain backfilled surface appropriate for travel until resurfaced.

3.7 EXCAVATION BELOW GRADE AND REFILL

- A. Drain trench completely and effectively be in-the-dry, whatever the nature of unstable material encountered or groundwater conditions.
- B. If Contractor excavates below grade through error or for their own convenience, through failure to properly dewater the trench, or disturbs subgrade before dewatering is sufficiently complete, the Engineer may direct Contractor to excavate below grade as set forth in following Paragraph, where work shall be performed at its own expense.

- C. If material at trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel, even with effective drainage, remove subgrade material to extent directed. Refill excavation with a 6-inch layer of coarse sand or a mixture graded from coarse sand to fine pea stone to form a filter layer preserving voids in pipe gravel bed. Composition and gradation of gravel shall be approved by the Engineer prior to placement. Place screened gravel in 6-inch layers thoroughly compacted up to normal grade of pipe. If directed by the Engineer, use bank-run gravel for refill of excavation below grade.

3.8 BACKFILLING

- A. Begin backfilling as soon as practicable after laying and jointing pipe and continue expeditiously. Place bedding gravel of specified type for pipe installed up to 12 inches over the pipe.
- B. Construct an impervious dam or bulkhead cutoff of clay or other impervious material in the trench, as directed by the Engineer, to interrupt unnatural flow of groundwater after construction is completed. Key dam into trench bottom and sidewalls. Provide at least one clay or other impervious material dam in pipe bedding between each manhole where directed or every 300 feet, whichever is less.
- C. Where pipes are laid cross-country, fill remainder of trench with common fill material in layers not to exceed 12 inches and mounded 6 inches above existing grade or as directed by the Engineer. Where a loam or gravel surface exists prior to cross-country excavations, remove, conserve and replace it to full original depth as part of the work under pipe items. Where necessary, remove excess material during clean-up process, so that ground may be restored to its original level and condition.
- D. Where pipes are laid in streets, backfill remainder of trench up to a depth of 12 inches below bottom of specified permanent paving with select common fill material in layers not to exceed 12 inches and thoroughly compacted. Use bank-run gravel for subbase layer of paving and compact in 6 inches layers.
- E. To prevent longitudinal pipe movement, do not dump backfill material into trench and then spread, until selected material or screened gravel has been placed and compacted to a level at least 12 inches over the pipe.
- F. Bring backfill up evenly on all sides. Thoroughly compact each layer of backfill material by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping to 95 percent compaction according to ASTM D 1557 or 98 percent according to ASTM D 698. If rolling, use a suitable roller or tractor being careful to compact fill throughout full width of trench. Compaction testing shall be performed a minimum of every 100-feet.
- G. Do not compact by puddling or water jetting.
- H. Use hand or pneumatic ramming with tools weighing at least 20 pounds for compacting in confined areas. Spread and compact material in layers not exceeding 6 inches thick, an uncompacted loose measurement.
- I. Use granular fill material as backfill around structures. Spread and compact specified backfill under and over pipes connected to structures.

- J. Do not place bituminous paving in backfill. Do not use frozen material under any circumstances.
- K. Broom and hose-clean road surfaces immediately after backfilling. Employ dust control measures throughout construction period.

3.9 RESTORING TRENCH SURFACE

- A. Where trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate backfill and maintain surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore ground level.
- B. In and adjacent to streets, 12 inches of trench backfill below specified initial pavement shall consist of compacted bank-run gravel. If Contractor wants to use material excavated from trench as gravel subbase for pavement replacement, take samples at intervals not to exceed 500 feet of material and test by an independent testing laboratory at Contractor's expense. Use only materials approved by the Engineer.
- C. Restore surface of driveways or other areas which are disturbed by trench excavation to a condition at least equal to that existing before work began.
- D. In areas where pipeline passes through grassed areas, remove and replace sod or loam and seed surface at Contractor's own expense.

END OF SECTION 312333

SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Silt Fence
- 2. Construction Entrances

- B. Related Sections:

- 1. Section 031000 - Concrete Forming and Accessories
- 2. Section 032000 - Concrete Reinforcing
- 3. Section 033000 - Cast-In-Place Concrete
- 4. Section 055000 - Metal Fabrications
- 5. Section 310515 "Soils and Aggregates for Earthwork"
- 6. Section 311000 - Site Clearing
- 7. Section 312316 - Excavation
- 8. Section 329119 - Landscape Grading
- 9. Section 329200 - Turf and Grasses

1.3 REFERENCE STANDARD

- A. EPA document titled: "Stormwater Management for Construction Activities – Developing Pollution Prevention Plans and Best Management Practices" document number EPA 832-R-92-005, dated 1992, or most recent edition.

1.4 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.

- 1. Submit, within 10 days after award of Contract, technical product literature for all commercial products.
- 2. The CONTRACTOR shall submit to the ENGINEER an erosion and sedimentation control plan for approval. The silt fence and erosion and sedimentation control plan shown on the Contract Documents is for guidance only.

- B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements

1.5 INFORMATIONAL SUBMITTALS

- A. Stormwater Pollution Prevention Plan (SWPPP) as specified in “Quality Assurance” article.
- B. Copy of EPA NPDES Notice of Intent to Discharge submitted to the EPA as specified in “Quality Assurance” article.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for submittals.

1.7 QUALITY ASSURANCE

- A. Prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the U.S. Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) General Permit applicable to this work) document number EPA 832-R-92-005, dated 1992, or most recent edition.
- B. Prepare and submit the EPA NPDES Notice of Intent to Discharge to the applicable EPA office in accordance with EPA regulations.
- C. Perform Work in accordance with requirements of Section 310515, Section 312333, Section 311000, Section 312319, Section 321313, Section 329119, Section 329200, Section 031000, Section 032000, and Section 033000.
- D. Perform Work according to St. Johns County Utility Department standards.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Crushed stone for sediment filtration devices, access ways and staging areas shall conform to Florida Department of Transportation Specifications.
- B. Rip-rap shall be sound, durable rock which is roughly rectangular shape and of suitable quality to insure permanence in the condition in which it is to be used. Rounded stones, boulders, sandstone or similar soft stone will not be acceptable. Material shall be free from overburden, spoil, shale and organic material, meet the ENGINEER’S approval, and meet the gradation, thickness, and physical property requirements presented in FDOT Standard Specifications Section 530:

<u>Weight of Stone</u>	<u>Percent Finer by Weight</u>
------------------------	--------------------------------

40 lb	100
12 lb	50
3 lb	0

C. Sediment Fence

1. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as ADS Geosynthetic 3302W AASHTO Grade-Woven Geotextile”, “Polypropylene Silt Fence by Tenax” or approved equal.

D. 1/4-in woven wire mesh for filter boxes shall be galvanized steel or hardware cloth.

- E. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

- F. Latex acrylic copolymer, or organic tackifier shall be a commercial product specifically manufactured for use as straw mulch tackifier.

- G. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the ENGINEER.

- H. Erosion control blanket shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the ENGINEER. Erosion control blanket shall be 100 percent agricultural straw matrix stitch bonded with degradable thread between two photodegradable polypropylene nettings, such as Model S150 Double Net Short-Term Blanket (10 months) by North American Green, Evansville, IN or approved equal.

PART 3 - EXECUTION

3.1 SILT FENCE

- A. Position sediment fences as indicated on the Drawings and to prevent off site movement of sediment produced by construction activities as directed by the Engineer. Areas beyond limits of silt fence shall be undisturbed or stabilized.
- B. Dig trench approximately 6-inch-wide and 8-inch-deep along proposed fence lines.
- C. Drive stakes, 6 feet on center (maximum) at back edge of trenches. Drive stakes 2 feet (minimum) into ground.
- D. Hang filter fabric on posts carrying to bottom of trench with about 4 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.
- E. Backfill trench with excavated material and tamp.

- F. Install pre-fabricated silt fence according to manufacturer's instructions.

3.2 CONSTRUCTION ENTRANCE

- A. Construct entrance with minimum of 6 inch of course aggregate at all points of ingress/egress.
- B. Width: Minimum 20 feet, increased as needed for typical construction vehicles.
- C. Minimum Length: 50 feet
- D. Install filter fabric below aggregate.
- E. Maintain entrance throughout construction, adding more aggregate or increasing length as needed.

3.3 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2:1 or flatter.
- D. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading. Straw mulch shall be applied at rate of 100 lbs/1000 sq ft and tackified with latex acrylic copolymer at a rate and diluted in a ratio per manufacturer's instructions.
- E. Install erosion control blankets in all seeded drainage swales and ditches as shown on the Drawings and as directed by the ENGINEER in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. Apply blankets in the direction of water flow and stapled. Place blankets a minimum of three rows (of 4 ft) wide (total approx. 12 ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Overlap sides 4 in minimum. Provide staples made of wire, .091 in in diameter or greater, "U" shaped with legs 10 in in length and a 1 1/2 in crown. Commercial biodegradable stakes may also be used with prior approval by the ENGINEER. Drive staples vertically into the ground, spaced approximately two linear feet apart, on each side, and one row in the center alternately spaced between each size. Bury upper and lower ends of the matting to a depth of 4 in in a trench. Create erosion stops every 25-ft by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. Fold the bottom 4 in below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4 in. Overlap lower end of upstream roll 4 in past edge of downstream roll and staple.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements and 017300 - Execution: Field inspecting, testing, adjusting, and balancing.
- B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas, promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly. Stormwater inspections and monitoring shall be performed in accordance with the NPDES General Permit.

3.5 CLEANING

- A. Section 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- C. Do not damage structure or device during cleaning operations.
- D. Do not permit sediment to erode into construction or site areas or natural waterways.
- E. Clean channels when depth of sediment reaches approximately one half channel depth.

END OF SECTION 312500

This page intentionally left blank.

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation and trench support and protection systems.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 014000 "Quality Requirements" for testing and laboratory services.
 - 3. Section 312000 "Earthwork" for excavating and backfilling.
 - 4. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 5.
 - 6. Section 312319 "Dewatering" for lowering and disposing of ground water during construction and dewatering excavations.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer, meeting the minimum performance requirements in Part 2 of this Section.
 - 1. Include overall system plan, indicating clearances, dimensions, material properties, member sizes, locations, spacing and member penetrations depths, and locations of various types of lateral supports.
 - 2. Show details, layout, arrangement, equipment requirements, and method of construction of proposed excavation support system.
 - 3. Indicate existing and proposed utilities, structures or other obstructions.
 - 4. Show wall elevations and locations of bracing.
 - 5. Show overall installation sequence and removal of bracing. Indicate work levels to be performed before bracing is installed or removed.
 - 6. Method of preloading bracing, if required, including preload for each member, and method of locking-off the preload. Submit detailed drawings of connections, jacking supports, and method of shimming.
Include procedures for resolving difficulties arising from misalignment of members exposed during excavation and criteria for implementing those procedures. n.

- B. Design Calculations: For excavation support and protection system. Include analysis data prepared, signed, and sealed by professional engineer responsible for their preparation.
 - 1. Include loads on excavation support system for all stages of excavation, bracing removal, and concrete placement, including material and equipment loads on adjacent ground during construction.
 - 2. Include design of wall and bracing members including details for all construction stages.
 - a. Design: Account for water pressures associated with flood conditions.
 - 3. Include theoretical deflections of excavation support system and deformation of structures, pipelines, and other improvements located within areas influencing excavations.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit quality control measures to ensure that performance of excavation support system complies with project requirements.
- B. Submit welder qualifications and weld procedures in accordance with AWS D1.1.
- C. Qualification Data: For land surveyor.
- D. Maintain at least one copy of design at job site during excavation that includes a plan indicating sizes, types, and configurations of the materials to be used in protective system. Identify registered Contractor's design engineer who stamped the design.
- E. Do not proceed with excavation support or protection activities until submittals have been approved by the Engineer.
- F. Submit inspection documentation:
 - 1. On-site inspections of excavation support system as the systems are constructed.
 - 2. Review of quality control measures and performance data.
 - 3. Certification that excavation support system is constructed per applicable design following completion of each support system and following Contractor modifications during construction.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications: Minimum 5 years' experience compatible to indicated Work, and who employs labor and supervisory personnel similarly experienced in Work of this Section.
- B. Contractor's Design Engineer: Registered Professional Engineer in Florida where the work is located with at least 5 years' professional experience in design and construction of support of excavation systems and having completed a minimum of 5 successful excavation support projects of equal type, size, and complexity to specified work.

- C. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.
- D. Regulatory Requirements: Comply with authorities having jurisdiction, including OSHA requirements.
- E. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Contact utility companies and other responsible authorities to locate and mark underground utilities.
 - 2. Notify the Engineer and Owner no fewer than two days in advance of proposed interruption of utility.
 - 3. Do not proceed with interruption of utility without the Engineer's and Owner's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent soil borings and tests, conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
 - 2. The geotechnical report is included elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Do not permit excavations below the level of the base of adjacent existing foundations or retaining walls, unless excavation design and bracing includes an analysis of stability of structure supported by foundation and if necessary, incorporates required bracing or underpinning of foundation.
- B. For support systems in which bracing is installed between opposite sides of the excavation, design excavation support of both sides to be nearly the same as feasible.

- C. Where necessary to resist point loads, fill pipe piles used as soldier piles with concrete. Do not consider concrete strength in design of pipe pile for bending stress.
- D. Design, install, operate, and maintain ground water control system to control ground water inflows, prevent piping or loss of ground, and maintain stability of the excavation. Refer to the requirements of Section 312319 “Dewatering.”
- E. Design review and field monitoring activities by Owner or the Engineer does not relieve Contractor of its work responsibilities.

2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Pipe Used as Soldier Piling: ASTM A 252, Grade or better.
- D. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
 - 1. Steel sheet piling conforming to ASTM A 572, Grade or better.
 - 2. Corners: Site-fabricated mechanical interlock or Roll-formed corner shape with continuous interlock.
- E. Steel Liner Plates: ASTM A 1101, structural quality hot-rolled carbon steel sheets or plates of either the two- or four-flange type, punched for bolting on all sides. Space bolts according to manufacturer’s standards and be multiples of plate length, so members having same curvature are interchangeable with bolt numbers and patterns determined by liner supplier.
 - 1. Tensile Strength: 42,000 psi
 - 2. Yield strength: 28,000 psi .
- F. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 4 inches with minimum allowable flexural strength of 1,100 psi .
- G. Cast-in-Place Concrete: ACI 301, with minimum compressive strength of 3,000 psi unless a higher strength is required for application.
- H. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Obtain permits from local authority having jurisdiction prior to initiating excavation work.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- C. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 2. Install fencing, gates, lights, and signs around excavations and staging areas to provide for public safety.
- D. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.3 GENERAL

- A. Install excavation support systems in accordance with the shop drawings and applicable permits.
- B. Fill voids between excavation support system and earth with materials acceptable to the Engineer.
- C. If unstable material is encountered during excavation, take immediately measures to contain it in place and prevent ground displacement.
- D. If settlement or deflections of supports indicate that support system requires modification to prevent excessive movements, redesign and resubmit revised shop drawings and calculations to the Engineer without additional compensation.
- E. Maintain sufficient quantity of material on site for protection of work and for use in case of accident or emergency.

3.4 PORTABLE TRENCH BOXES

- A. Use portable trench boxes or sliding trench shields only for worker protection.
- B. Additional excavation, backfilling, and surface restoration required as result of trench box use shall be provided without additional compensation.
- C. Design, construct, and maintain trench boxes or shields to meet acceptable engineering and industry standards.

- D. Install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of sudden lateral loads.
- E. Maintain a written copy of trench box manufacturer's specifications, recommendations, and limitations at job site during excavation work.

3.5 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
 - 1. Install using impact hammer or vibratory hammer in predrilled holes.
 - 2. Soldier Piles in Predrilled Holes:
 - a. Provide casing or other methods of support to prevent caving of holes and loss of ground.
 - b. Backfill with concrete from elevation of bottom excavation to pile tip elevation. Backfill remainder of predrilled hole with lean concrete or sand.
 - c. Predrilled hole of sufficient diameter allowing for proper alignment and concrete backfilling of pile.
 - 3. Install driven piles with driving shoes where hard driving is anticipated.
 - 4. Advance driven soldier piles without aid of a water jet, unless otherwise authorized.
 - a. Perform authorized jetting on both sides of pile simultaneously and discontinue when pile tip is approximately 5 feet (1525 mm) above indicated pile tip elevation. Make final 5 feet (1525 mm) of penetration by driving. Firmly seat pile in place by application of a number of reduced energy hammer blows before commencing driving of final penetration.
- B. Extend soldier piles below excavation grade level to depths shown on reviewed Shop Drawings. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging.
 - 1. Install lagging so ground loss does not occur between adjacent or below lowest board. As excavation proceeds, do not maximum height of 4 feet (1220 mm) for unlagged face of excavation.
 - 2. Do not exceed unlagged face of 2 feet (610 mm), if water seeps or flows from excavation face or excavation face becomes unstable.
- D. As installation progresses, pack voids between excavation face and lagging with materials such as hay, burlap, or geotextile filter fabric to allow drainage of ground water without loss of ground. Fill voids behind lagging with soil, and compact.
- E. Install wales at locations indicated on Drawings and secure to soldier piles.

3.6 STEEL SHEET PILING

- A. Thoroughly cleaned and inspect sheet piles for defects and proper interlock dimensions prior to installation. Provide a tool for checking interlock dimensions.
- B. Before starting excavation, drive one-piece sheet piling lengths in plumb position and tightly interlock vertical edges for its entire length to form a continuous barrier. Form a continuous diaphragm throughout length of each run of wall, bearing tightly against original ground.
 - 1. Exercise care in driving so interlocking members can be extracted without damaging adjacent structures or utilities.
 - 2. Use driving, cutting, and splicing methods conforming to approved Shop Drawings.
 - 3. Use templates or other temporary alignment facilities to maintain piling line.
- C. Accurately place piling, using templates and guide frames unless otherwise recommended in writing by sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 5 feet . Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- D. Install each sheet pile having sufficient clearance in interlocks to slide under its own weight into interlock of previously placed sheet pile.
- E. Do not excavate in advance of steel sheet piling installation.
- F. Where obstructions are anticipated, pre-excavate or pre-drill along sheet pile wall alignment without additional compensation. Do not extend pre-excavation and pre-drilling below lowest excavation level or into bearing soils for existing or future structures.
- G. Remove obstructions encountered before the specified embedment for piles. Where obstructions cannot be removed, re-evaluate sheet pile system by Contractor's design Engineer show reduced embedment and additional toe stability measures to be implemented for sheet pile wall realignment. Submittal proposed design measures to the Engineer for review.
- H. Withdraw damaged or faulty aligned pilings with provide new piling, driven properly in its place without additional compensation.
- I. Cut tops of sheet piling to uniform elevation at top of excavation.

3.7 LINER PANELS

- A. Install liner plates as soon as excavation has progressed sufficiently to install next complete circumferential ring of liner plates. Complete ring of liner plates prior to continuing excavation.
 - 1. Do not install more than one ring of liner plates at any time.
- B. Stagger plates in vertical direction to facilitate shaft strength and leakage resistance.
- C. Grout liner plates in accordance with approved Shop Drawings.

3.8 INTERNAL BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by the Engineer.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
- B. Provide internal bracing to carry maximum design load without distortion or buckling.
- C. Include web stiffeners, plates, or angles required to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.
- D. Install and maintain bracing support members in tight contact with each other and with the surface being supported. Do not use wood shims.
- E. Coordinate excavation work with installation of bracing. Extend excavation no more than 2 feet (610 mm) below any brace level prior to installation of the bracing.
- F. Use procedures that produce uniform loading of bracing member without eccentricities, overstressing, or distortion of system members.

3.9 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.10 REMOVAL

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches (1220 mm) below overlying construction and abandon remainder.

2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earthwork."
 3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.
- C. Do not remove vertical support members that were installed within zone of influence of new or existing structures. Cut off support members installed within this zone at 5 feet (1525 mm) below finished grade and abandon in place.
- D. Do not remove internal bracing or transfer loads to permanent structure without prior acceptance of the Engineer.
- E. Begin removal at excavation bottom and progress upward. Slowly release members noting indication of possible failure of remaining members or possible cave-in of excavation sides.
- F. Progress backfilling together with removal of support systems from excavations.
- G. Remove all portions of excavation support, unless otherwise indicated by approved Shop Drawings.
1. Zone of Influence Definition: Zone extending down and away from outer edge of the structure at 1 horizontal to 1 vertical.
- H. Do not leave untreated wood as part of abandoned portion of the work.
- I. When removing excavation support system, do not disturb or damage adjacent buildings, structures, waterproofing material, or utilities. Fill voids immediately with lean concrete or well-graded cohesionless sand or as directed by the Engineer.
- J. Immediately remove excavation support system material from site.

END OF SECTION 315000

This page intentionally left blank.

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Asphalt materials.
- 2. Aggregate materials.
- 3. Aggregate subbase.
- 4. Asphalt paving base course, binder course, and wearing course.
- 5. Asphalt paving overlay for existing paving.
- 6. Surface slurry.

- B. Related Requirement:

- 1. Section 310515 – Soils and Aggregates for Earthwork

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.

- B. Product Data:

- 1. Submit product information for asphalt and aggregate materials.
- 2. Submit mix design with laboratory test results supporting design.

- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Mixing Plant: Conform to Florida Department of Transportation (FDOT) requirements.
- B. Obtain materials from same source throughout.
- C. Perform Work in accordance with FDOT requirements.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum 5 years of experience.

1.6 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Do not place asphalt mixture when ambient air or base surface temperature is less than 40, or surface is wet or frozen.
- C. Place asphalt mixture when temperature is not more than 15 less than initial mixing temperature.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

- A. Performance / Design Criteria:
 - 1. Paving: Design for parking, chemical delivery trucks.
- B. Asphalt Materials:
 - 1. Asphalt Binder: AASHTO M320; performance grade PG 58-28.Aggregate Materials:
 - 2. Coarse Aggregate: ASTM D692; crushed stone, gravel, or blast furnace slag.
- C. Aggregate Subbase: Specified in 310515.

2.2 MIXES

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Paving Mixtures: ASTM D3515; designed in accordance with AI MS2.
 - 1. Base Course: Dense Mixture.
 - 2. Binder Course: Dense Mixture.
 - 3. Wearing Course: Dense Mixture.
- C. Surface Slurry: ASTM D3910, Type S-1 – 1 ½-inch thick; emulsified asphalt slurry.
- D. Paving Surfaces: Minimum solar reflectance index (SRI) of 29, calculated in accordance with ASTM E1980.

1. Reflectance: Measured in accordance with ASTM E903, ASTM E1918, or ASTM C1549.
2. Emittance: Measured in accordance with ASTM E408 or ASTM C1371.

2.3 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.
- B. Sealant: ASTM D6690, Type I; hot applied type.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- C. Test samples in accordance with AI MS-2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify compacted subgrade subbase is dry and ready to support paving and imposed loads as required by FDOT standards
 1. Proof roll subbase with in minimum two perpendicular passes to identify soft spots.
 2. Remove soft subbase and replace with compacted fill as specified in Section 310515.
- D. Verify gradients and elevations of base are correct.

3.2 PREPARATION

- A. Prepare subbase in accordance FDOT Standards.

3.3 DEMOLITION

- A. Saw cut and notch existing paving as indicted on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INSTALLATION

A. Subbase:

1. Prepare subbase in accordance with FDOT Standards

B. Primer:

1. Apply primer in accordance with AI MS-2.

C. Tack Coat:

1. Apply tack coat in accordance with AI MS-19

D. Single Course Asphalt Paving:

1. Install Work in accordance with FDOT Standards
2. Place asphalt within 24 hours of applying primer or tack coat.
3. Place asphalt wearing course to thickness indicated on Drawings.
4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

E. Double Course Asphalt Paving:

1. Place asphalt binder course within 24 hours of applying primer or tack coat.
2. Place binder course to thickness indicated on Drawings.
3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
4. Place wearing course to thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Surface Slurry

1. Install uniform thickness surface slurry over existing paving in accordance with ASTM D3910.
2. Allow slurry to cure.
3. Roll paving to achieve uniform surface.

3.5 TOLERANCES

A. Section 014000 - Quality Requirements: Tolerances.

- B. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

- C. Scheduled Compacted Thickness: Within 1/4 inch.
- D. Variation from Indicated Elevation: Within 1/2 inch.

3.6 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.
- B. Take samples and perform tests in accordance with AI MS-2.
- C. Asphalt Paving Mix Temperature: Measure temperature at time of placement.
- D. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.
- E. Asphalt Paving Density: ASTM D1188 or ASTM D2726; test one core sample from every 1000 square yards compacted paving.

3.7 PROTECTION

- A. Section 017300 "Execution": Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

3.8 ATTACHMENTS

- A. Paving at Parking Areas: Two courses; binder course of 2-1/2-inch compacted thickness and wearing course of 1-inch compacted thickness.

END OF SECTION 321216

This page intentionally left blank.

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Chain-link fences.
2. Horizontal-slide, motor-operated gates.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete equipment bases/pads for gate operators and controls and post footings.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Fence and gate posts, rails, and fittings.
 - b. Chain-link fabric, reinforcements, and attachments.
 - c. Gates and hardware.
 - d. Gate operators, including operating instructions and motor characteristics.

- B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.
3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
4. Wiring Diagrams: For power, signal, and control wiring.

- C. Samples for Initial Selection: For each type of factory-applied finish.

- D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
 - 1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.
- E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to comply with performance requirements.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. Faulty operation of gate operators and controls.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fencing shall be six feet (6') high unless otherwise shown. All fencing materials shall be hot-dip galvanized and green vinyl coated per St. Johns County Standards. All materials and components shall be new, first quality items specifically manufactured for the intended application.

2.2 MATERIAL

- A. Fence fabric shall be No. 9 gage galvanized steel wire, 2-inch mesh. The fabric shall have a twisted and barbed finish on the top and bottom edges.
- B. Fabric ties shall be No. 9 galvanized steel wire, spaced 14 inches apart on posts and 24 inches apart on rails. Aluminum ties will not be permitted. A continuous No. 7 gage galvanized steel wire shall be interlaced with the fabric or attached to the fabric with clips along the extreme bottom of the fence.
- C. All posts shall be one-piece without circumferential welds, and shall be as follows:
 - 1. Line posts shall be 2.375-inch OD hot-dip GSP
 - 2. End and corner posts shall be 2.875-inch OD hot-dip GSP
 - 3. Gate posts shall be 4-inch Schedule 40 steel pipe, 9.1 lb/ft.
- D. Top rail and braces shall be 1.66-inch hot-dip GSP
- E. Stretcher bars shall be 1/4-inch by 3/4-inch steel bars and steel bands for fastening stretcher bars to the posts shall be 1/8-inch by 3/4-inch.
- F. Nuts, bolts and screws shall be of steel, hot-dipped galvanized after fabrication, minimum size 3/8-inch diameter. Gate hardware shall be hot-dip galvanized after fabrication.
- G. All material (fencing, posts, etc.) shall be green vinyl coated.
- H. Concrete shall have a minimum compressive strength of 2,000 psi at 28 days.
- I. Three strand barbed wire, conforming to ASTM A121, shall consist of two 12-1/2 gauge twisted line wires with 14 gauge round aluminum wire barbs, having 4 points and spaced 5-in on center.
- J. Barbed wire support arms shall be single arm, for three strands of barbed wire and be at an angle of 45 degrees, with the top strand of barbed wire being 12-in above and 12-in out from the fence line.

2.3 HORIZONTAL-SLIDE GATES

- 1. Gate shall be overhead slide type with an opening width of 24 ft and shall be 6 ft in height. The gate shall conform to ASTM F1184 standards for aluminum overhead slide gates, Type

- 1, Class 2. Frame is to be welded for rigid connections and shall be fabric covered with identical fence fabric and braced to eliminate any possible sagging condition.
2. The gate frame shall be fabricated from 6063-T6 aluminum alloy extrusions. The top member shall be 3-in by 5-in aluminum channel or tube weighing not less than 3.9 lb/ft. The bottom member shall be a 2-in x 5-in aluminum structural tube weighing not less than 2.0 lb/ft. The outside vertical members shall weigh not less than 1.6 lb/ft. Intermediate vertical members shall weigh not less than 1.1 lb/ft and shall be spaced at a maximum of 3-ft on center. Bracing of 3/16-in minimum diameter stainless steel cable shall be installed throughout the gate to ensure squareness of the gate frame.
3. A separate semi-enclosed overhead track, extruded from 6105-T5 aluminum alloy, shall weigh 2.7 lb/ft. Aluminum overhead track shall be bolted to an overhead aluminum angle "I" or "W" beam.
4. The gate frame is to be supported from the overhead track by a minimum of two swivel type, self-aligning, 4-wheeled, sealed lubricant, ball-bearing truck assemblies. The bottom of each center support post shall be equipped with a 3-in guide wheel.
5. The gate is to be hung from three sets of 4-in diameter galvanized steel posts, set apart as required by the gate manufacturer. A 3-in x 3-in steel angle shall be welded between the steel posts to support the "I" or "W" beam. The "I" or "W" beams shall extend for a distance approximately twice the width of the gate. A lockable catch assembly shall be provided.
6. The gate shall be operated by a chain driven motor. The gate operator shall be UL325 and UL991 listed for Class IV.

2.4 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.
 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.
- E. Tension and Brace Bands: Pressed steel.
- F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

- G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- H. Barbed Wire Arms: Pressed steel, with clips, slots, or other means for attaching strands of barbed wire integral with post cap, for each post unless otherwise indicated, and as follows:
 - 1. Provide line posts with arms that accommodate top rail or tension wire.
 - 2. Provide corner arms at fence corner posts unless extended posts are indicated.
 - 3. Single-Arm Type: Type I, slanted arm.
- I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
 - a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire.
- J. Finish:
 - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
 - a. Polymer coating over metallic coating.
 - 2. Aluminum: Mill finish.

2.5 GATE OPERATORS

- A. Gate Operator shall be HySecurity SlideDriver 15.
- B. Controller shall be Apollo AAN-4. See Drawings for additional site access details.
- C. Control Devices:
 - 1. Control Station: Keyed, three-position switch, located remotely from gate. Provide two keys per station.
 - a. Function: Open, stop, and close.
 - 2. Card Reader shall be HID R10 900N.
 - 3. Keypad shall be International Electronics Model 0-211466.
 - 4. Vehicle Presence Detector: System that includes automatic closing timer with adjustable time delay before closing, timer cut-off switch, and presence detector designed to open and close gate.
 - a. Provide retroreflective detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway

when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.

- D. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.
 2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
 3. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using take-up cable reel.
 - a. Along entire gate leaf leading edge.
 - b. Along entire gate leaf trailing edge.
 - c. Across entire gate leaf bottom edge.
 - d. Along entire length of gate posts.
 - e. Along entire length of gate guide posts.
 - f. Where indicated on Drawings.
 4. Photoelectric/Infrared Sensor: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.
- E. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully open and fully closed positions.
- F. Emergency Release Mechanism: Quick-disconnect release of operator drive system, permitting manual operation if operator fails. Control circuit power is disconnected during manual operation.
1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.
- G. Operating Features:
1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability for monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
 2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
 3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
 4. Automatic Closing Timer: With adjustable time delay before closing and timer cut-off switch.
 5. Open Override Circuit: Designed to override closing commands.
 6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
 7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
 8. Clock Timer: 24 hour, programmable for regular events.

H. Accessories:

1. Warning Module: Audio alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
 - a. Fail Safe: Gate opens and remains open until power is restored.
 - b. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.
3. External electric-powered solenoid lock with delay timer allowing time for lock to release before gate operates.
4. Fire box.
5. Fire strobe alarm.
6. Intercom System: [to coordinate with SJCUD]
7. Instructional, Safety, and Warning Labels and Signs: According to UL 325.
8. Equipment Bases/Pads: Cast-in-place or precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.

2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.7 GROUNDING MATERIALS

- A. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
 1. Connectors for Below-Grade Use: Exothermic welded type.
 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Engineer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
 1. Install fencing as shown on plans inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. All earth, brush, or other obstructions which interfere with the proper alignment of construction of fences shall be removed and disposed of at the expense of the Contractor.
Line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts and generally parallel to the ground slope. Posts shall be set plumb and shall be centered in 12-inch diameter concrete encasement extending 36 inches into the ground.
- C. Gate post shall be provided with concrete foundation.
- D. Changes in the fence lines, where the horizontal angle is 15 degrees or more, shall be considered as corners and corner posts shall be installed.
- E. Bracing shall be provided at all end, gate, and corner posts, the latter in both directions. Horizontal brace rails shall be set midway between top rail and ground running from the corner, end, or gate post to first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.
- F. Corner posts shall be installed in lieu of line posts at intervals not exceeding 500 feet and shall be braced horizontally in both directions.
- G. The chain-link fabric shall be fastened on the side of the posts as shown or as designated by the Engineer. The fabric shall be stretched and securely fastened to the posts, and, between the posts, the top and bottom edges of the fabric shall be fastened to the top rail and tension wire, respectively. The tension wires shall be stretched tight with turnbuckles at the end and corner posts. The bottom tension wire shall be installed on a straight grade between posts.
- H. The fabric shall be fastened to the end, corner, and gate posts with stretcher bars and stretcher bar bands spaced at approximately 14 inches on line posts and at approximately 18 inches on tension wires.

- I. Encasement concrete for footings shall be placed immediately after mixing in a manner such that there will be no concentration of the large aggregates. The concrete shall be consolidated by tamping or vibrating in an approved manner. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Prior to placing the concrete, the earth around the hole shall be thoroughly moistened. The concrete shall completely fill the hole and top surfaces of the concrete encasement shall be sloped outward to shed water and shall have a neat appearance. Not less than 7 days shall elapse after placing the concrete footings before the fence fabric is fastened to the posts.
- J. Any galvanized coating damaged during construction of the fencing shall be repaired by application of molten Galvo-Weld; Galvinox; or approved equal.

3.4 GATE INSTALLATION

- A. Install sliding gate in accordance with manufacturer's written instructions and as follows:
 1. Install steel support posts in concrete foundations to provide rigid structure for sliding gate and within two percent of level and within two percent of plumb when in the fully open and closed positions.
 2. Install track hanger brackets and guide roller assemblies.
 3. Install truck assemblies into the track and attach gate frame to hanger bolt.
 4. Make final adjustment to line up and level gate frame to align gate with latch.
 5. Install operator on concrete support pad and align with gate frame.
 6. Install operator and chain drive in accordance with manufacturer's instructions, dimensional schematics and shop drawings. Adjust the operator in accordance with manufacturer's installation manual. Test the adjustments to verify correct settings.
 7. Install embedded vehicle detection loop wire in accordance with the manufacturer/system supplier's instructions:
 - a. Clean saw cut before installing wire. Do not use sharp objects to push loop wire into saw cut.
 - b. Do not splice wire. Install one continuous length of wire from the detector out to and around the loop then back to the detector.
 - c. Seat loop wire in sealant before filling the saw cut. Encapsulate the loop wire in the sealant.
 - d. Twist the lead-in wire (5 to 7 twists per foot or as recommended by the manufacturer/system supplier). Do not twist the loop wire.
 - e. Test the loop for leakage to ground due to breaks in insulation. Use megometer and follow manufacturer/system supplier's instructions.

8. Test and adjust the operation of the loop detector frequency/sensitivity relays as directed by the manufacturer/system supplier to adjust and optimize settings for timing, delay, sensitivity and frequency.
9. Install all provided warning signs within view of both sides of the gate as required by the manufacturer.
10. Test gate and gate operator utilizing card access system and remote pushbutton in accordance with Section 16000. If the operation does not meet the specification, make appropriate modifications and retest to the satisfaction of the Engineer.

3.5 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
 1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
 2. Test and adjust operators, controls, alarms, and safety devices. Replace damaged and malfunctioning controls and equipment.
 3. Lubricate operator and related components.
- C. Lubricate hardware and other moving parts.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

SECTION 329119 - LANDSCAPE GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
- B. Related Sections:
 - 1. Section 329200 Turf and Grasses

1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures
- B. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.
- C. Materials Source: Submit name of imported materials source.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish each topsoil material from single source throughout the Work.
- B. Perform Work in accordance with St Johns County Landscaping Regulations.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. Topsoil: Fill Type S2

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 – Execution: Verification of existing conditions before starting work.
- B. Verify building and trench backfilling have been inspected.
- C. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

- A. Protect landscaping and other features remaining as final Work.
- B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of 1 inch in size. Remove contaminated subsoil.
- C. Scarify surface to depth of 6 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

- A. Place topsoil in areas where seeding and sodding is required, to thickness as scheduled. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to structures to prevent damage.
- E. Lightly compact placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.

- B. Top of Topsoil: Plus or minus **1/2** inch.

3.6 PROTECTION OF INSTALLED WORK

- A. Section 017300 “Execution”: Requirements for protecting finished Work.
- B. Prohibit construction traffic over topsoil.

3.7 SCHEDULES

- 1. Seeded Grass: 6 inches.
- 2. Sod: 4 inches.

END OF SECTION 329119

This page intentionally left blank.

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Sodding.
 - 3. Erosion-control material(s).

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for sod Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in the Turfgrass Producers International's (TPI) "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Association of Official Seed Analysts (AOSA's) "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: Species to be Scarified Argentine Bahia Seed.

2.2 SOD

- A. Sod shall be planted within 100-feet of all structures, 5-feet of all paved areas, and on all pond embankments.
- B. Sod shall be Bahia, except for restoration, where type of sodding shall match existing sodding. Sod shall be of firm texture having a compacted growth and good root development as approved.
- C. Sod shall be certified to meet Florida State Plant Board specifications, absolutely true to varietal type, and free from weeds or other objectionable vegetation, fungus, insects and disease of any kind.
- D. Before being cut and lifted the sod shall have been mowed three times with the final mowing not more than a week before cutting into uniform dimensions.

2.3 WATER

- A. CONTRACTOR shall provide water free of substances harmful to plant growth; free from chemicals or minerals that stain or discolor.

2.4 FERTILIZERS

- A. Fertilizer shall be a complete fertilizer, the elements of which are derived from organic sources. Fertilizer shall be a standard product complying with State and Federal fertilizer laws.
- B. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Engineer. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.
- C. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 20 percent available phosphoric acid.

2.5 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable, or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 FERTILIZING

- A. Apply specified fertilizer three (3) weeks after sod installation. Broadcast at rate of 1-1/2 pounds of nitrogen per 1,000 sq. ft. of sod. Water to saturate all fertilized areas immediately after installation.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.6 SODDING

- A. During delivery, prior to planting, and during the planting of the lawn areas, the sod panels shall at all times be protected from excessive drying and unnecessary exposure of the roots to the sun

or wind. Deliver sod on pallets. Do not deliver more sod than can be installed within 24 hours of delivery.

- B. After delivery but prior to planting, keep stored sod moist and under shade or covered with moistened burlap. Do not stack sod more than 2' deep, and do not tear, stretch, or drop sod. All sod shall be stacked during construction and planting so as not to be damaged by sweating or excessive heat and moisture.
- C. After completion of soil conditioning as specified above, sod panels shall be laid tightly together so as to make a solid sodded lawn area. On mounds and other slopes, the long dimension of the sod shall be laid perpendicular to the slope. Immediately following sod laying the lawn areas shall be rolled with a lawn roller customarily used for such purposes, and then thoroughly watered.
- D. Bring the sod edge in a neat, clean manner to the edge of all paving and shrub areas. Top dressing with approved, clean, weed free, sand may be required at no additional cost to the OWNER if deemed necessary by the Engineer.

3.7 LAWN ESTABLISHMENT

- A. The CONTRACTOR shall produce a dense, well established lawn. The CONTRACTOR shall be responsible for the repair and resodding of all eroded or bare spots until project acceptance. Repair sodding shall be accomplished as in the original work except that fertilizing may be omitted.
- B. Watering:
 - 1. Keep sod uniformly moist for the first two weeks after planting.
 - 2. After two weeks, supplement rainfall to produce total of approximately 1-1/2" of water per week or until sod has fully acclimated.
 - 3. Monitor all newly sodded areas to insure that the manual watering operations are providing sufficient water to sod until acceptance by the OWNER's representative.
- C. Mowing:
 - 1. Sod shall not be mowed for a period of three (3) weeks after installation.
 - 2. The initial mowing should remove approximately 2-inches of leaf but no more than 40% of leaf shall be removed in any single mowing.
 - 3. The SUBCONTRACTOR shall maintain all newly sodded areas until final acceptance by the OWNER's representative. Sod shall be mowed based on the following:
 - a. Argentine bahia: every 14 days, mow to 4-inches.
- D. Re-sod areas larger than 1-square foot not having uniform stand of grass.
- E. Weed Eradication: CONTRACTOR shall be responsible to insure that all newly sodded areas are maintained in a seed-free condition until acceptance by the OWNER's representative. Apply herbicides only upon approval by the OWNER's representative.
- F. The CONTRACTOR's maintenance period shall begin immediately after sod is installed and extend until acceptance by the OWNER's representative.

3.8 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.9 MAINTENANCE SERVICE

- A. Soil should be kept continuously moist, but not too wet, until seed has germinated and become well established. Request final inspection for acceptance when all specified work is completed.
- B. Replace rejected sod areas as directed by the Owner's representative.

END OF SECTION 329200

This page intentionally left blank.

SECTION 330531.16 - POLYVINYL CHLORIDE PRESSURE PIPE FOR WATER SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Polyvinyl chloride (PVC) water pipe and fittings, complete as shown on Drawings and as specified.
 - 1. Pipe or Piping: Refers to all pipe, fittings, material and appurtenances required to construct PVC water pipe complete, in place.
 - 2. Equipment and materials specified are intended to be standard types used in transporting potable water.
- B. Related Requirements:
 - 1. Section 310515 "Soils and Aggregates for Earthwork" for granular fill.
 - 2. Section 312333 "Trenching and Backfilling."
 - 3. Section 331216 "Water Utility Distribution Valves"
 - 4. Section 331300 "Disinfecting of Water Utility Distribution."

1.3 COORDINATION

- A. Section 013100 "Project Management and Coordination" for coordination requirements.

1.4 ACTION SUBMITTALS

- A. Section 013300, "Submittal Procedures" for submittals requirements.
- B. Product Data: Name of pipe and fitting manufacturers, materials list furnished by each manufacturer and catalog information for each product.
- C. Shop Drawings:
 - 1. Piping layouts and schedules including dimensioning, fittings, types and locations of valves and appurtenances, and joint details.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures" for submittals requirements.

- B. Project Record Documents: Document actual locations of installation.

1.6 QUALITY ASSURANCE

- A. Perform Work according to St. Johns County Utility Department standards.
- B. PVC water pipe shall be from a single manufacturer.
- C. Inspections of pipe may be made by the Engineer or other representatives of the Owner after delivery.
 - 1. Pipe is subject to rejection at any time due to failure to meet any of the requirements specified, even though sample pipes may have been accepted as satisfactory at the place of manufacture.
 - 2. Marked for identification, rejected pipe and removed from job at once.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products requirements.
- B. Delivery:
 - 1. Bundled or package items to provide adequate protection of ends during transportation to site. Pipe damaged in shipment will be replaced as directed by the Engineer.
 - 2. Where applicable, deliver materials in manufacturer's packaging including application instructions.
- C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
 - 1. Any gouges or scratches that extend 10 percent or more into the pipe wall shall be cause for rejection of that pipe.
 - 2. The undamaged portion may cut off and used.
 - 3. Clearly mark rejected materials as rejected. Segregate and remove from the site.
- D. Storage: Per manufacturer's instructions, referenced standards and as specified
 - 1. Adequately support stored pipe from below, at 3 feet maximum intervals to prevent deformation. Pipe stored in stacks no higher than that given in the following table or the manufacturer's instructions whichever is more restrictive:
 - a. Pipe Diameter 8 inches or Less: Maximum Number of Rows Stacked: 5
 - b. Pipe Diameter 12 to 21: Maximum Number of Rows Stacked: 4

- c. Pipe Diameter 24 to 30: Maximum Number of Rows Stacked: 3
 - d. Pipe Diameter 33 to 48: Maximum Number of Rows Stacked: 2
 - 2. Do not store plastic manholes, pipe, and fittings in direct sunlight.
 - 3. Store in a manner keeping materials at ambient outdoor temperatures.
 - 4. No pipe or fitting is to be exposed to sunlight for more than 60 days.
 - 5. Temporary shading as required to meet this requirement shall be provided.
 - 6. Simple covering of the pipe and fittings which allows temperature buildup, or direct or indirect sunlight, will not be permitted.
- E. Protection:
- 1. Pipe and fittings showing cracks, or which have received a blow that may have caused an incident fracture, even though no such fracture can be seen, are to be marked as rejected and removed at once from the work.
 - 2. Thoroughly clean pipe and fittings before installation. Keep interior clean until testing
 - 3. Store gaskets for mechanical and push-on joints in cool and dry location, out of direct sunlight, and not in contact with petroleum products.
 - 4. Provide additional protection according to manufacturer instructions

1.9 EXISTING CONDITIONS

- A. Field Measurements:
- 1. Verify field locations and sizes of connections to existing piping and equipment prior to submitting pipe lay drawings.
 - 2. Document field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 017700 "Closeout Procedures" for warranty requirements.
- B. Furnish one-year manufacturer's warranty for PVC pipe and fittings.

PART 2 - PRODUCTS

2.1 SYSTEMS

- A. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

2.2 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

- A. Polyvinyl Chloride (PVC) Pipe:
- 1. PVC Pressure Pipe: 3 through 60 inch per AWWA C900 requirements.
 - 2. Piping 12 inch and Less: Class 150 with a Dimension Ratio of 18.

3. Piping Materials: PVC compounds Class 12454 as defined in ASTM D 1784.
 - a. Mark pipe lengths with manufacturer's name or trademark, size, material code, pressure class, AWWA designation number and seal of test agency that verified pipe material for potable-water service.

B. Polyvinyl Chloride (PVC) Fitting:

1. Bell and Spigot Push-on Joints.
 - a. Bell: Consists of integral wall section with solid cross-section elastomeric gasket securely locked in place to prevent displacement during assembly.
 - b. Installation of elastomeric gasketed joints and joint performance: Per ASTM F477, ASTM D3139. Joint lubricants as recommended by manufacturer and meet all requirements of NSF/ANSI Standard 61 (NSF 61).
2. Fittings and Accessories for Waterlines and Sewers: Bell and/or spigot configurations compatible with the pipe.
3. Fittings for Water Mains: Cast or ductile iron per AWWA C110 for mechanical joints. Furnish Adaptors, fittings and transition gaskets necessary to connect cast or ductile iron fittings to PVC.
4. PVC Fittings: Per AWWA C900. Pressure rating the same as or higher than the pipeline.
5. Water Lines: Blue in color.
6. Reclaimed Water: Purple in color.
7. Restrained joints shall be installed at all joints. Restraining glands for PVC pipe shall conform to AWWA C111 and be Megalug Series 2000PV by EBAA Iron Sales Inc., or approved equal.

2.3 ACCESSORIES

- A. Provide Plastic ribbon tape and Trace wire for placement above direct buried utility meeting the requirements of St Johns County Utility Department Standards and Specifications.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000, "Quality Requirements" for testing, inspection, and analysis requirements.
- B. Owner and Engineer Witnessing: Allow witnessing of pipe installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution" specifies requirements for installation examination.
- B. Verify that excavation base is ready to receive Work.

- C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.
- D. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/6 inch per foot of length.

3.2 PREPARATION

- A. Section 017300 "Execution" for installation preparation requirements.
- B. Pipe and Fittings: Thoroughly cleaned before installation and kept clean until they are used in the Work.
 - 1. When laid, must conform to the lines and grades required.

3.3 INSTALLATION

- A. As soon as excavation is complete to normal grade of bottom of trench:
 - 1. Place bedding, compact and grade to provide firm, uniform and continuous support for the pipe.
 - 2. Excavate bell holes so only the barrel of the pipe bears upon the bedding.
 - 3. Lay pipe accurately to lines and grades indicated on Drawings.
 - 4. Blocking under the pipe is not permitted.
- B. Bedding Placement:
 - 1. Place Bedding evenly on each side of pipe to mid-diameter.
 - a. Use hand tools to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe.
 - 2. Place bedding to 12 inches above top of pipe.
 - 3. Place the initial 36 inch of backfill above bedding in 12 inches layers and carefully compacted.
 - 4. Compaction: Generally done evenly on each side of pipe.
 - a. Compaction Equipment: Do not operate directly over pipe until sufficient backfill has been placed ensuring such compaction equipment will not damage the pipe.
 - b. Equipment used in compacting the initial 36 inch of backfill shall be approved by the pipe manufacturer's representative prior to use.
- C. Piping:
 - 1. Install PVC pipe and fittings per requirements of manufacturer, ASTM D2321 and AWWA C605 or as otherwise specified.
 - 2. Sound and clean before installation.
 - 3. When installation is not in progress, including lunchtime, open ends of pipe must be closed by watertight plug or other approved means.
 - 4. Preserve proper alignment during installation.

5. Joint Deflection: Not to exceed manufacturer recommendations.
 6. Fittings: Provide in addition to those shown on Drawings, if required, in crossing utilities that may be encountered upon opening the trench.
- D. Defective Pipe Discovered After Installation: Remove and replace with sound pipe in a satisfactory manner.
- E. When Cutting Pipe: By machine, leaving a smooth cut at right angles to the pipe axis.
1. Cut Ends of Pipe Used with Bell: Bevel to conform to manufactured spigot end and a reference mark made at the same distance from the pipe end as measured from a factory marked end from the same manufacturer.
 2. Engineer may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation.
 - a. Reject pipe having defective joint surfaces. Marked as defective and immediately remove from job site.
- F. Pipe lengths must have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints must not be subjected to any applied longitudinal or lateral stresses other than bedding compaction as specified.
- G. Before Joint are Made: Inspect pipe to assure a close joint with the next adjoining pipe has been maintained and that inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.
- H. Precautions shall be taken to prevent flotation of the pipe in the trench.
- I. Moveable Trench Bracing: Trench boxes, moveable sheeting, shoring or plates to support the sides of the trench.
1. Prevent movement of pipe, and disturbance of pipe bedding and backfill, when placing and moving the boxes or supporting bracing.
- J. Jointing
1. Restrained joints installed at all joints.
 2. Jointing PVC Pipe (Push-on type):
 - a. Installed in strict accordance with the manufacturer's instructions.
 - b. Lay pipe with bell ends looking ahead.
 - c. Be sure joint surfaces clean.
 - d. Insert a rubber gasket in the groove of the bell end of the pipe.
 - e. Lubricate with approved lubricant per manufacturer's recommendations.
 - f. Insert the plain end of pipe to be installed into the bell of the pipe to which it is to be joined, and when in alignment pushed home with a come-along or by other means.
 - g. Check that the reference mark on the spigot end is flush with the end of the bell.
 3. Jointing Mechanical Joint Fittings:

- a. Mechanical Joints at Valves, Fittings and Where Designated: Jointed per AWWA C111 and manufacturer detailed instructions.
- b. Install Suitable PVC to cast iron adaptors prior to installing fittings.
- c. Cut PVC beveled spigot flush prior to insertion in mechanical joint pipe.
- d. Field Assembled Joints: Thoroughly clean joint surfaces and rubber gaskets with soapy water before tightening bolts to specified torques.
 - 1) Under no circumstances are extension wrenches or pipe over handle of ordinary ratchet wrench to be used to secure greater leverage.

K. Pipe Identification: Install Plastic ribbon tape and Trace wire above direct buried utility.

3.4 FIELD QUALITY CONTROL

- A. Section 014000, "Quality Requirements" for inspecting and testing requirements.
- B. After Installation: Test pipe for compliance as specified below. Furnish necessary equipment and labor for hydrostatic pressure test on pipelines.
- C. Submit detailed test procedures and method for Engineer's review. In general, conduct testing per AWWA C605.
 1. Hydrostatic pressure test methods and procedures must be approved by the Engineer.
 2. Submit testing plan to Engineer 10 days before testing.
- D. Subject pressure pipelines to a hydrostatic pressure of 150 psig or 1.5 times the working pressure at the highest point along the test segment.
 1. Maintain test pressure a minimum of 2 hours.
 2. Hydrostatic testing allowances must not exceed those indicated in AWWA C605.
 3. Provide suitable restrained bulkheads as required to complete the hydrostatic testing specified.
- E. Contractor will make any taps and furnish necessary caps, plugs etc, as required in conjunction with performing the testing.
- F. Gravity Pipelines: Hydrostatic pressure test as specified in AWWA C605.
- G. Valves and Valve Boxes: Properly located and installed and operable prior to testing.
 1. Provide bulkheads with sufficient number of outlets for filling and draining the line and for venting air.
- H. Hydrostatic Pressure Tests: Per Section 7.3 of AWWA C605.
 1. Furnish gauges, meters, pressure pumps and other equipment needed to fill the line slowly and perform the required hydrostatic pressure tests.
- I. Owner will provide a source of supply from the existing treated water distribution system for Contractor's use in filling the lines. Maintain an air break at all times between the Owner's distribution system and the Contractor's equipment to prevent cross-connection.

1. Slowly fill lines with water and maintain specified test pressure in the pipe for the entire test period by means of a pump furnished by the Contractor.
2. Provide accurate means for measuring makeup water volume required to maintain pressure.
3. Pressure Test Duration: Not less than 2 hours.
 - a. Leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test.
 - b. Lines Failing to Meet Tests: Repaired and retested as necessary until test requirements are met.
 - c. Remove and replace defective materials, pipes, valves and accessories.

3.5 CLEANING AND DISINFECTION

- A. Before Being Placed in Service and Hydrostatic Testing: Chlorinate new water pipelines per AWWA C651.
 1. Chlorination procedures must be approved by the Engineer.
 2. Submit testing plan to Engineer 10 days before testing.
- B. Location of chlorination and sampling points will be determined by the Engineer in the field.
 1. Taps for chlorination and sampling will be installed by Contractor. Uncover and backfill the taps as required.
 2. General Procedure for Chlorination:
 - a. Flush dirty or discolored water from the pipeline.
 - 1) Flushing Velocity: Minimum of 3 ft/sec.
 - 2) Flushing operations: Conducted without causing erosion, damage, nuisance or interruption of traffic and comply with all regulatory requirements.
 - b. Introduce chlorine in approved dosages through a tap at one end, while water is being withdrawn at the other end of the line.
 - c. The concentration and residence time of the chlorine solution in the pipeline will depend on the type of disinfection method used, as described in AWWA 651.
- C. Following the Chlorination Period:
 1. Flush treated water from the lines at their extremities and replace with water from the distribution system.
 2. Dispose of treated water flushed from the lines by discharging to the nearest sanitary sewer or other approved means.
 - a. No discharge to any storm sewer or natural water courses will be allowed.
 3. Bacteriological sampling and analysis of the replacement water may then be made by the Engineer per AWWA C651.
 - a. Rechlorinate if necessary.

- b. Do not place line in service until the requirements of the Florida Department of Environmental Protection are met.
4. Where method outlined above is not practical, such as at certain connections to existing mains, the Contractor is to develop and use special disinfecting procedures, subject to approval by the Engineer.

3.6 PROTECTION

- A. Section 017300 “Execution” for protecting finished Work requirements.

END OF SECTION 330531.16

This page intentionally left blank.

SECTION 330532 – HIGH DENSITY POLYETHYLENE PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. High density polyethylene (HDPE) pipe water and force main sewer pipe and fittings, complete as shown on Drawings and as specified.
 - 1. Pipe or Piping: Refers to all pipe, fittings, material and appurtenances required to construct HDPE water and force main sewer pipe complete, in place.
 - 2. Equipment and materials specified are intended to be standard types used in transporting **potable water and sewage**.
- B. Related Requirements:
 - 1. Section 310515 “Soils and Aggregates for Earthwork” for granular fill.
 - 2. Section 312333 “Trenching and Backfilling.”
 - 3. Section 321216 “Asphalt Paving.”
 - 4. Section 330526 “Utility Identification.”
 - 5. Section 330519 “Ductile-Iron Utility Pipe for Water Service.”
 - 6. Section 331300 “Disinfecting of Water Utility Distribution.”

1.3 COORDINATION

- A. Section 013100 “Project Management and Coordination” for coordination requirements.

1.4 ACTION SUBMITTALS

- A. Section 013300, “Submittal Procedures” for submittals requirements.
- B. Product Data: Name of pipe and fitting manufacturers, materials list furnished by each manufacturer and catalog information for each product.
- C. Shop Drawings:
 - 1. Piping layouts and schedules including dimensioning, fittings, types and locations of valves and appurtenances, and joint details.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures” for submittals requirements.
- B. Project Record Documents: Document actual locations of installed HDPE piping
- C. Operation and Maintenance Data: per Section 017823.

1.6 QUALITY ASSURANCE

- A. Perform Work according to Owner utility standards.
- B. Maintain a copy of each standard affecting Work of this Section on Site.
- C. HDPE pipe shall be from a single manufacturer. Supplier is responsible for provisions of test requirements specified in ASTM D 3034 and NSF 61 as applicable.
- D. Inspections of pipe may also be made by the Engineer or other representatives of the Owner after delivery.
 - 1. Pipe is subject to rejection at any time due to failure to meet any of the requirements specified, even though sample pipes may have been accepted as satisfactory at the place of manufacture.
 - 2. Marked for identification, rejected pipe and removed from job at once.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years’ experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years’ experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000, “Product Requirements” for transporting, handling, storing, and protecting products requirements.
- B. Delivery:
 - 1. Bundled or package items to provide adequate protection of ends during transportation to site. Pipe damaged in shipment will be replaced as directed by the Engineer.
 - 2. Where applicable, deliver materials in manufacturer's packaging including application instructions.
- C. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.
 - 1. Any gouges or scratches that extend 10 percent or more into the pipe wall shall be cause for rejection of that pipe.

2. The undamaged portion may cut off and used.
3. Clearly mark rejected materials as rejected. Segregate and remove from the site.

D. Storage: Per manufacturer's instructions, referenced standards and as specified

1. Adequately support stored pipe from below, at 3 feet (1 m) maximum intervals to prevent deformation. Pipe stored in stacks no higher than that given in the following table or the manufacturer's instructions whichever is more restrictive:
 - a. Pipe Diameter 8 inches (203 mm) or Less: Maximum Number of Rows Stacked: 5
 - b. Pipe Diameter 12 to 21 (305 to 533): Maximum Number of Rows Stacked: 4
 - c. Pipe Diameter 24 to 30 (610 to 762): Maximum Number of Rows Stacked: 3
 - d. Pipe Diameter 33 to 48 (838 to 1220): Maximum Number of Rows Stacked: 2
2. Do not store plastic manholes, pipe, and fittings in direct sunlight.
3. Store in a manner keeping materials at ambient outdoor temperatures.
4. No pipe or fitting is to be exposed to sunlight for more than 60 days.
5. Temporary shading as required to meet this requirement shall be provided.
6. Simple covering of the pipe and fittings which allows temperature buildup, or direct or indirect sunlight, will not be permitted.

E. Protection:

1. Pipe and fittings showing cracks, or which have received a blow that may have caused an incident fracture, even though no such fracture can be seen, are to be marked as rejected and removed at once from the work.
2. Thoroughly clean pipe and fittings before installation. Keep interior clean until testing
3. Store gaskets for mechanical and push-on joints in cool and dry location, out of direct sunlight, and not in contact with petroleum products.
4. Provide additional protection according to manufacturer instructions

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field locations and sizes of connections to existing piping and equipment prior to submitting pipe lay drawings.
2. Document field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 017700 "Closeout Procedures" for warranty requirements.
- B. Furnish one-year manufacturer's warranty for HDPE pipe and fittings.

PART 2 - PRODUCTS

2.1 SYSTEMS

- A. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.
- B. All force mains 4-inches and smaller shall be HDPE DR11
- C. All underground reuse water and potable water 4-inches and smaller shall be HDPE DR11

2.2 MATERIALS

- A. HDPE Pipes
- B. Only HDPE, CTS, SDR 11 and DR 11, colored green for force mains, blue for potable water and pantone purple 522C for reuse water will be allowed. HDPE pipe supplied shall minimize the number of joints by the use of HDPE rolls.
 - 1. Connections between ends of the force main shall be accomplished using approved heat fusion techniques.
- C. Connection between the 4" force main and the existing 4" force main shall be accomplished using a typical 4" Stainless Steel service saddle.
- D. If rework compounds are required, only those generated in the manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.
- E. The pipe shall be joined with butt, heat fusion joints (HDPE pipe to HDPE pipe) or electrocoupling according to ASTM D3261 or mechanical adapter for valve, fitting, or dissimilar pipe to pipe connections. All joints shall be made in strict compliance with the manufacturer's recommendations.
- F. All HDPE pipe and fittings shall be made from the same resin.
- G. Contractor to provide all fittings, transitions, and appurtenances needed for connections between High Density Polyethylene Pipe and Ductile Iron Pipe.
- H. Compliance with the above requirements must be certified in writing by the pipe supplier.
- I. All HDPE pipe shall be upsized to provide the required internal diameter of PVC and DI pipe unless otherwise specified in the Drawings or Specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. HDPE pipe shall be installed in accordance with the instructions of the manufacturer, as shown on the Drawings and as specified herein. All heat fusion joints shall be done by a factory qualified joining technician as designated by the pipe manufacturer.
- B. Pipe shall be laid to the lines and grade and with bedding and backfill as shown on the Drawings.
- C. When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means. All plugs shall be outside diameter (OD) fitting type plugs. No plugs will be allowed that require insertion of the plug into pipe.
- D. Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches, or gouges on the exterior of the pipe is 10 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges, or scratches.
- E. Sections of pipe with cuts, scratches, or gouges deeper than allowed shall be removed completely and the ends of the pipeline rejoined.
- F. The pipe shall be joined by the method of thermal butt fusion, as outlined in ASTM D2657. All joints shall be made in strict compliance with the manufacturer's recommendations.
- G. Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps, and tanks shall be through flanged connections that shall consist of the following:
 - 1. An HDPE flange adapter shall be thermally butt-fused to the pipe end. A Type 316 stainless steel back up ring shall be used in conjunction with the flange adapter.
 - 2. A Type 316 stainless steel back up ring on both sides of the connection shall be used as approved by the Engineer.
 - 3. Type 316 stainless steel bolts and nuts as specified in ASTM A726 and ASTM A307.
- H. Flange connections shall be provided with a full-face viton or teflon gasket.
- I. All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

3.2 INSPECTION AND TESTING

- A. All pipelines shall remain undisturbed for 24 hours to develop complete strength at all joints. Prior to backfilling, all pipelines shall be blown out and cleared of all sand and construction debris. All leaks shall be repaired as approved by the Engineer.

- B. Any material showing the slightest leakage (aside from drilled perforations) or structural and/or installation deficiencies shall be replaced as directed by the Engineer at no additional cost to the Owner.
- C. Pipeline Testing
1. General – Hydrostatic testing shall consist of a pressure test and leakage test. Hydrostatic tests shall be conducted on all newly laid pressure pipes, joints, hydrants and valves including all service lines to the curb stops. Air testing of pressure pipes shall not be permitted under any circumstance. Tests shall be made on sections not exceeding 3,000 feet. Contractor shall furnish all necessary equipment and material, make all taps, and furnish all closure pieces in the pipe as required. Equipment to be furnished by the Contractor shall include graduated containers, pressure gauges, hydraulic force pumps, and suitable hoses and piping. The Owner or their designated representative shall monitor and approve a satisfactory test. The basic provisions of ASTM F2164 – “Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure” shall apply.
 2. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for his informational purposes only. The hydrostatic tests for acceptance shall only be conducted after the trenches have been completely backfilled and compacted as specified.
 - a. Testing Criteria – All pipe sections to be pressure tested shall be subjected to a hydrostatic pressure no more than the pressure rating printed on the pipe. Force main pipes will be tested at 100 psi. Water main pipes will be tested at 150% of operating pressure or 150 psi, whichever is greater, never to exceed the pressure rating printed on the pipe. Reclaimed water mains will be pressure tested at 150% of operating pressure or 150 psi, whichever is greater, never to exceed the pressure rating printed on the pipe. If there is multiple pressure rated pipes or pipe material types on the project, it will be the Contractor’s responsibility to isolate the different pipes from each other. The duration of each pressure test shall be a maximum of eight (8) hours including time to pressurize, time for initial expansion, time at test pressure, and time to depressurize the test section. If during the test, the integrity of the tested line is in question, the Owner may require other pressure tests at no expense to the Owner. All line valves shall be hydrostatically tested for 15 minutes to ensure tight seal when closed.
 - b. Initial Expansion Phase – Each section of pipe to be tested, as determined by the Owner, shall be slowly filled with water, and the specified test pressure shall be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made and appropriate valves installed to ensure bleeding of all air from the main. During the initial expansion phase, gradually pressurize the test section to test pressure and maintain the test pressure for three (3) hours; continue to add water to the test section to account for the expansion of the pipe. If defective pipes, fittings, valves, or hydrants are discovered during the pressure test, all such items shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory results are obtained. Prior to scheduling the Owner witnessed pressure test, the Contractor shall preliminarily test the main to ensure it will pass when the Owner is present.

- D. Failed Tests - If a section fails to pass the tests, the contractor shall locate, uncover, and replace the defective pipe, valve, fitting, or joint. Visible leaks shall be corrected regardless of total leakage. Lines which fail to meet these tests shall be retested as necessary. All testing and retesting shall be performed at the Contractor's expense

3.3 CLEANING

- A. At the conclusion of the work, thoroughly clean all of the new pipelines to remove all dirt, stones, pieces of wood, or other material that may have entered during the construction period.
- B. Debris cleaned from the lines shall be removed from the job site. If, after this cleaning, any obstructions remain, they shall be removed.

3.4 PROTECTION

- A. Section 017300 "Execution" for protecting finished Work requirements.

END OF SECTION 330532

This page intentionally left blank.

SECTION 331216 - WATER UTILITY DISTRIBUTION VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Valves.
- 2. Valve boxes.

- B. Related Requirements:

- 1. Section 033000 - Cast-in-Place Concrete: Concrete for thrust restraints.
- 2. Section 331300 - Disinfecting of Water Utility Distribution: Flushing and disinfection requirements.

1.3 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.

1.4 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's latest published literature. Include 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.
- G. Qualifications Statements:

1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for submittals.
- B. Project Record Documents: Record actual locations of valves.
- C. Operation and Maintenance Data: Submit information for valves.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for maintenance materials.
- B. Tools: Furnish one tee wrench of required length to Owner.

1.8 QUALITY ASSURANCE

- A. Cast manufacturer's name, pressure rating, and year of fabrication into valve body.
- B. Perform Work according to St. Johns County Utility Department standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Prepare valves and accessories for shipment according to applicable AWWA standards.
- C. Seal valve and ends to prevent entry of foreign matter.
- D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- E. Storage:
 1. Store materials in areas protected from weather, moisture, or other potential damage.
 2. Do not store materials directly on ground.
- F. Handle products carefully to prevent damage to interior or exterior surfaces.
- G. Protect threads and seats from corrosion and damage. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until time of use.

PART 2 - PRODUCTS

2.1 RESILIENT WEDGE GATE VALVES

1. See Specification 400561

2.2 VALVE BOXES

A. Manufacturers:

1. Clow F2452.
2. Substitutions: or Owner approved equal.

B. Description:

1. Valves Larger than 12-inch Diameter:
 - a. Material: Cast iron.
 - b. Type: Two-piece, screw.
 - c. Base: Round.
2. Lid Inscription: WATER.
3. All gate valves shall be provided with extension shafts, operating nuts and valve boxes as follows:
 - a. Extension shafts shall be Type 304 stainless steel and the operating nut shall be 2-in square. Shafts shall be designed to provide a factor of safety of not less than four. Operating nuts shall be pinned to the shafts.
 - b. Top of the operating nut shall be located two-inches below the rim of the valve box.
4. All buried valves shall have cast iron two-piece screw-type valve boxes. Valve boxes shall be provided with suitable heavy bonnets and shall extend to such elevation at or slightly above finished grade. The barrel shall be two-piece, adjustable type, having 5-1/4 inch shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling and shall have "WATER" cast into the top for all water mains.
5. Valve boxes shall be constructed to ensure that valve stems are vertical and the cast iron box has been placed over the stem with base bearing on compacted fill and top flush with final grade. Boxes shall have sufficient bracing to maintain alignment during backfilling. Contractor shall remove any sand or undesirable fill from valve box prior to final inspection. The top of the valve box lid and the inside of the top section of the valve box shall be painted blue for in-line valves.
6. All fasteners shall be Type 304 or 316 stainless steel.

2.3 ACCESSORIES

- A. Valve Box Aligner: High-strength plastic device designed to automatically center valve box base and to prevent it from shifting off center during backfilling.

- B. A locator peg shall be installed under the concrete valve box pad on all Owner valves. Locate pegs shall be 145.7 kHz, C9789 by Communication Tech. A 3-inch diameter bronze disc anchored in concrete shall be required for all valves. The bronze tag shall indicate service, size, type, number of turns to open and year installed. Where valves are approved to be installed in existing pavement (where concrete collar nut is required) the brass tag shall be affixed to the bottom of the valve box lid by epoxy or other approved method.

2.4 SURFACE PREPARATION AND SHOP COATINGS

- A. The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-10 and painted with two coats of an approved two-component epoxy coating specifically formulated for potable water use. The coating shall be NSF certified to Standard 61.
- B. Exterior ferrous metal surfaces of all buried valve shall be blast cleaned in accordance with SSPC SP-6 and given two shop coats of an approved two-component coal tar epoxy paint.
- C. Exterior ferrous metal surfaces of all non-buried valves shall be shop painted with one coat of primer in accordance with the requirements of Section 099010.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Determine exact location and size of valves from Drawings.
- C. Verify that invert elevations of existing work prior to excavation and installation of valves are as indicated on Drawings.

3.2 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. 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.
- C. Identify required lines, levels, contours, and datum locations.
- D. Locate, identify, and protect from damage utilities to remain.
- E. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
 - 1. Notify Engineer/Engineer not less than two days in advance of proposed utility interruption.
 - 2. Do not proceed without written permission from Engineer/Engineer.

3.3 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 312333 “Trenching and Backfilling”.
- B. Install valves in conjunction with pipe laying.
- C. Set valves plumb.
- D. Before backfilling, all exposed portions of all bolts shall be coated with two coats of bituminous paint.
- E. Installation Standards: Install Work according to St. Johns County Utility Department standards.
- F. Disinfection of Water Piping System:
 - 1. Flush and disinfect system as specified in Section 331300 - Disinfecting of Water Utility Distribution.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 017300 “Execution”: Requirements for testing, adjusting, and balancing.
- C. Perform pressure testing on water distribution system according to St. Johns County Utility Department standards.
- D. Conduct a functional field test of each valve, including actuators and valve control equipment, in presence of Engineer to demonstrate that each part and all components together function correctly. All testing equipment required to be furnished by the Contractor.

END OF SECTION 331216.00

This page intentionally left blank.

SECTION 331300 - DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Disinfection of potable water distribution and transmission system.
 - 2. Testing and reporting of results.

1.3 ACTION SUBMITTALS

- A. See Section 013300 "Submittal Procedures" for detailed submittal.
- B. Product Data: Procedures, proposed chemicals, and treatment levels.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Products meet or exceed specified requirements.
- B. Certify cleanliness of water distribution system meets or exceeds specified requirements.
- C. Certify water conforms or fails to conform to bacterial standards of authority having jurisdiction.
- D. Certify water conforms to quality standards of authority having jurisdiction.
- E. Test and Evaluation Reports: Testing results comparative to specified requirements.
- F. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.
- G. Disinfection and Chlorination Water Disposal Plan: To be submitted by Contractor for review and acceptance by Owner and Engineer.

1.5 CLOSEOUT SUBMITTALS

- A. See Section 017700 "Closeout Procedures" for submittal requirements.
- B. 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. Special disinfecting procedures used for connections to existing pipes.
5. Name of person collecting samples.
6. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
7. Date and time of flushing start and completion.
8. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Submit bacteriologist's signature and authority associated with testing.

1.6 QUALITY ASSURANCE

- A. Perform Work according to FDEP Chapter 62-555.340, FAC.

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

- A. Chemicals: Hypochlorite: Comply with AWWA B300.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See Section 017300 "Execution" for installation examination requirements.
- B. Verify that piping system has been cleaned, inspected, and pressure tested.
- C. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

- A. Provide and attach required equipment to perform Work of this Section. Closely coordinate efforts with Owner for maintenance of site operations and for testing services.

- B. Perform disinfection of water distribution system and installation of system and pressure testing as specified in this Section.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved using municipal domestic water.
- F. Replace permanent system devices that were removed for disinfection.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 “Quality Requirements” for inspecting and testing requirements and Section 017300 “Execution” for testing, adjusting, and balancing requirements.
- B. Disinfection, Flushing, and Sampling:
 - 1. Disinfect pipeline installation.
 - 2. Use of liquid chlorine is permitted.
 - 3. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
 - 4. Disposal:
 - a. Legally dispose of chlorinated water.
 - b. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.
 - 5. After final flushing and before pipeline is connected to existing system or placed in service, employ an approved independent testing laboratory to sample, test, and certify that water quality meets quality standards of St. Johns County Utility Department.

END OF SECTION 331300

This page intentionally left blank.

SECTION 331310 - DOUBLE CONTAINMENT CHEMICAL PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Double containment chemical piping.
- B. Related Requirements:
 - 1. Section 312333 “Trenching and Backfilling”

1.3 ACTION SUBMITTALS

- A. Submit, in accordance with Section 013300, shop drawings and product data including the following:
 - 1. Shop drawings including piping layouts and schedules shall be submitted to the Owner and Engineer and shall include dimensioning, fittings, types and locations of valves and appurtenances, joint details, methods and locations of supports, anchorage, grade of material and all other pertinent technical information for all items to be furnished.
 - 2. Shop drawing submittals for piping under this Section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 2. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
 - 3. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 4. ASTM D2467 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 5. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 6. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - 7. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.

8. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
9. ASTM F441 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
10. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
11. ASTM3222 - Standard Specification for National, Unpigmented, Virgin Polyvinylidene Fluoride (PVDF) Homopolymer.

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. All double walled plastic pipe and fittings shall be a prefabricated system furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall be suitable for the intended service.

1.6 QUALIFICATIONS

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum ten years' documented experience.

1.7 SYSTEM DESCRIPTION – SODIUM HYPOCHLORITE

- A. Double walled piping systems shall be installed in those locations as shown on the Drawings.
- B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting chemicals.
- C. Double walled piping systems shall be designed for the following chemical systems:

System:	Chemicals – Sodium Hypochlorite
Carrier Pipe and Fittings Material:	Schedule 80 PVC
Containment Pipe and Fittings Material:	Schedule 80 PVC Pipe and Fittings
Fluids:	15 % sodium hypochlorite
Pressure:	Atmosphere to 100 psig
Flow Velocity:	Up to 7 fps
Temperature:	35 to 100 degrees F

1.8 SYSTEM DESCRIPTION – SODIUM HYDROXIDE

- A. Double walled piping systems shall be installed in those locations as shown on the Drawings.
- B. The equipment and materials specified herein are intended to be standard types of plastic pipe and fittings for use in transporting chemicals.
- C. Double walled piping systems shall be designed for the following chemical systems:

System:	Chemicals – Sodium Hydroxide
Carrier Pipe and Fittings Material:	Schedule 80 CPVC
Containment Pipe and Fittings Material:	Schedule 80 CPVC Pipe and Fittings
Fluids:	50 % sodium hydroxide
Pressure:	Atmosphere to 100 psig
Flow Velocity:	Up to 7 fps
Temperature:	35 to 100 degrees F

1.9 DELIVERY, STORAGE AND HANDLING

- A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Pipes and fittings damaged in shipment shall be replaced as directed by the Engineer.
- B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.
- C. Pipe and fittings shall be stored in a manner that will keep them at ambient outdoor temperatures and out of sunlight. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings that allows temperature buildup or direct or indirect sunlight will not be permitted.
- D. Any pipe or fitting showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All buried chemical piping, fittings, and valves shall be a prefabricated double wall containment piping system.
- B. The sodium hypochlorite double wall piping system shall consist of Schedule 80 PVC primary piping system supported within a Schedule 80 PVC secondary containment housing.
- C. The sodium hydroxide double wall piping system shall consist of Schedule 80 CPVC primary piping system supported within a Schedule 80 CPVC secondary containment housing.

2.2 PRIMARY CARRIER PIPE AND FITTINGS

- A. PVC and CPVC pipe and fittings for the buried pressurized chemical carrier pipes for the chemical systems defined in Paragraph 1.06 and 1.07 shall be Schedule 80.

2.3 SECONDARY CONTAINMENT PIPING AND FITTINGS

- A. Containment pipe and fittings shall be based on the size of the primary carrier pipe as follows:

<u>Carrier Pipe Diameter</u>	<u>Containment Pipe Diameter</u>
½-in	2-in
¾-in	3-in
1-in	3-in
1- ½ -in	4-in
2-in	4-in

- B. The double walled chemical piping system shall be Guardian as manufactured by IPEX USA, LLC, New Baltimore, MI, or approved equal.
- C. Secondary Containment Pipe
 1. PVC secondary containment pipe shall be manufactured from PVC compounds meeting ASTM D1784, Class 12454-B. The pipe shall be manufactured in accordance with ASTM D1785, PVC 1120. The pipe shall have a minimum hydrostatic design stress of 2,000 psi at 73 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes indicated above and shall be Schedule 80 unless otherwise shown.
 2. The CPVC secondary containment pipe and fittings shall be manufactured from CPVC compounds meeting ASTM D1784, Class 23447. Pipe shall be manufactured in accordance with ASTM F441, CPVC 4120. The pipe shall have a minimum hydrostatic design stress of 2000 psi at 73 degrees F and 500 psi at 180 degrees F and shall be suitable for field cutting and solvent welding. Pipe shall be of the sizes indicated on the Drawings and shall be Schedule 80.
 3. Solvent cement for CPVC piping shall be as specified in ASTM F493. Solvent cement for PVC piping shall be as specified in ASTM D2564. Solvent cements shall be suitable for installation of lines for Sodium Hydroxide and Sodium Hypochlorite applications.

4. The burst pressure of fittings shall be not less than the burst pressure of the size and thickness of the pipe with which it is to be used in accordance with ASTM D2467.

D. Secondary Containment Fittings.

1. Double wall containment fittings shall be prefabricated. Splitting and rewelding of fittings and two piece gasketed fittings will not be accepted.
2. Interstitial supporting devices used to center and support the primary piping and fittings within the secondary containment piping and fittings shall be PVC for the PVC piping and CPVC for the CPVC piping and shall be installed prior to delivery of the pipe and fittings. The spacers shall be designed to permit the carrier and containment pipes to expand and contract without stress or wear on the pipes as well as provide for drainage and free air circulation.

2.4 DOUBLE WALL PIPE LEAK DETECTION SYSTEM

- A. Provide a manual leak detection system for the double wall chemical pipe systems. Provide two manual leak detection stations as shown on the drawings. For each dual containment chemical pipe line, two visual inspection risers shall be provided. As recommended by the supplier of the dual containment piping system, slope chemical piping towards the closest leak detection station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. See Section 017300 "Execution" for installation examination requirements.
- B. Verify that piping system has been cleaned, inspected, and pressure tested.
- C. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting and balancing, and demonstration procedures, including coordination with related systems.

3.2 INSTALLATION

- A. Provide and attach required equipment to perform Work of this Section. Closely coordinate efforts with Owner for maintenance of site operations and for testing services.
- B. Flush, circulate, and clean until required cleanliness is achieved using municipal domestic water.
- C. Pipe spacers shall be attached to the carrier pipe every three feet prior to the installation on the containment piping. The spacers shall be designed to permit the carrier and containment pipes to expand and contract without stress or wear on the pipes as well as provide for drainage and free air circulation. Lay out the system, cut and dry fit the carrier piping, then place the containment pipe over the carrier pipe before joining. The containment pipe must be installed over the carrier pipe as the system is being assembled.

- D. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required.
- E. Joints for PVC and CPVC pipe shall be solvent welded. In making solvent welded connections, clean dirt and moisture from the pipe, bevel pipe ends slightly with emery cloth to remove any shoulder or burrs created by the cutting of the pipe. Solvent welded joints shall be made in accordance with ASTM D2855 except that solvent cement formulated especially for and as specified above shall be used for joining CPVC pipe. Primer shall be used whenever recommended by the pipe manufacturer and in all cases for joints on the pipe systems 4-in in diameter or larger. IPS Weldon #724 Heavy bodied grey CPVC/PVC cement formulated for improved chemical resistance to caustics including Sodium Hypochlorite shall be used as manufactured by IPS Corporation Compton, CA or equal for installation of lines for Sodium Hydroxide and Sodium Hypochlorite applications. Primer shall be used whenever recommended by the pipe manufacturer and in all cases for joints on the pipe systems 4-inch in diameter or larder.

3.3 FIELD QUALITY CONTROL

- A. See Section 017300 "Execution" for testing, adjusting, and balancing requirements.
- B. Field Testing- PVC and CPVC Pipe Systems
 - 1. All pipelines shall remain undisturbed for the minimum curing time specified for each type of pipe material but no less than 24 hours to develop full curing and complete strength at all joints. Primary carrier pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test as required by St. Johns County Utility Department Standards and Specifications.
 - 2. After testing of the carrier pipe, the containment system shall be tested pneumatically at 5 psi for a duration of 2 hours prior to backfilling. All containment piping joints shall be checked for leaks by applying a soapy solution to the joints. Furnish all necessary equipment and labor to perform the air test, including air compressor, gauges, conduit caps, temporary pipe and connections, etc and complete the test to the satisfaction of the Owner and Engineer.
 - 3. After backfilling is completed, a 5 psig air test of the containment pipe shall be conducted to the satisfaction of the Owner and Engineer.
 - 4. All leaks detected during the pressure test shall be repaired and the pressure/temperature test rerun.
 - 5. Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.
 - 6. The Contractor shall notify the Owner a minimum of 48 hours prior to testing of containment and carrier pipe.

END OF SECTION 331300

SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Pipe penetrations
- 2. Restrained joints
- 3. Sleeve-type couplings.

- B. Related Requirements:

- 1. Section 099010 – Shop Painting
- 2. Section 099100 – Painting
- 3. Section 330531.16 – Polyvinyl Chloride Pressure Pipe for Water Service
- 4. Section 331300 - Disinfecting of Water Utility Distribution: Disinfection of potable water piping
- 5. Section 400507 - Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures
- 6. Section 400519 - Ductile Iron Process Pipe: Ductile-iron piping materials and appurtenances
- 7. Section 400551 - Common Requirements for Process Valves: Common product requirements for valves for placement by this Section

1.3 DEFINITIONS

- A. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.
- B. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

1.4 COORDINATION

- A. Section 013100 “Project Management and Coordination”: Requirements for coordination.
- B. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

1.5 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

1.6 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit manufacturer catalog information for each specified product, including installation instructions.
- 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. Indicate restrained joint details and materials.
 - 3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
 - 4. Indicate layout of piping systems, including offsets, and swing joints.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and setting dimensions.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer.

1.7 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping appurtenances.
- C. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
- B. Perform Work according to ASME B31.3 for installation of piping systems.
- C. Perform Work according to St. Johns County Utility Department standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. 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.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. All construction except new concrete walls:

1. Material: Schedule 40 galvanized steel conforming to ASTM A53.
2. 2-inch minimum circumference water stop welded to exterior sleeve at midpoint
3. Ends cut and ground to be:
 - a. Flush with ground
 - b. Flush with ceiling
 - c. 2 inches above finished floors
 - d. Sealed with caulking
 - e. Sized as required.

B. New concrete with pipes 20 to 60 inches in diameter:

1. Material: molded HDPE modular interlocking discs to make the width of the wall
 - a. Corrugated
 - b. Cell-Cast as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

C. External wall penetrations:

1. 36-in diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork:
2. Seal of the annular space between the carrier pipe and the sleeve made by means of a confined rubber gasket and be capable of withstanding 350 psi.
3. Sleeve to have an integrally cast waterstop of 1/2-in minimum thickness, 2-1/2-in minimum height.
4. Manufacturers: Omni-Sleeve, Malden, MA or equal.

2.2 WALL CASTINGS

A. Ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53.

B. Diameter as required.

C. Flanges and/or mechanical joint bells drilled and tapped for studs where flush with the wall.

D. Castings provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded to the casting.

E. Located as follows:

1. for castings set flush with walls: located at the center of the overall length of the casting,
2. for castings which extend through wall: located within the middle third of the wall.

2.3 SEALING MATERIALS

A. Mechanical seals:

1. Of rubber links shaped to continuously fill the annular space between the pipe and the wall opening or sleeve.
2. Link pressure plates molded of glass reinforced nylon:
 - a. colored throughout elastomer,
 - b. permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element.
3. Hardware:
 - a. Mild steel with a 60,000 psi minimum tensile strength
 - b. 2-part Zinc Dichromate coating per ASTM B-633
 - c. Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test.
 - d. Use Type 316 Stainless Steel hardware:
 - 1) in chemical areas
 - 2) for submerged service
4. Completed sealing system:
 - a. Duty pressure rated for 20 psig differential pressure.
 - b. EPDM for all services except fire rated assemblies
 - 1) fire rated seals use silicone link material.
 - c. Manufacturer: PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.

B. Sealant:

1. A two-part foamed silicone elastomer manufactured by:
 - a. Dow Corning Co., Product No. 3-6548 silicone R.T.V.
 - b. 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+;
 - c. Flame-Safe fire stop systems FS-900 by Rectorseal.
2. Sealant bead configuration, depth and width in accordance with manufacturer's recommendations.

2.4 DISMANTLING JOINTS

A. Manufacturers:

1. Romac Industries, Inc.
2. Approved Equal

B. Description

1. Style DJ400 by Romac Industries, Inc. or approved equal.
2. Working pressure shall be equal to or greater than the maximum rating of the flange.
3. End ring and body shall be ASTM A536 65-45-12 ductile iron.
4. Bolts and nuts shall be 304 stainless steel.
5. Tie rods shall be 304 stainless steel
6. NSF 61 certified

C. Finishes

1. Fusion bonded epoxy coated.

2.5 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. Xylem (Smith-Blair).
2. Substitutions: Owner approved equal.

B. Description:

1. Comply with AWWA C213, C219.
2. Middle Ring: Steel.
3. Followers: Steel.
4. Gaskets:
 - a. Material: Buna-N.
 - b. Comply with ASTM D2000.
5. Bolts: 316 Stainless Steel.

C. Finishes:

1. Factory fusion bonded epoxy coated.

2.6 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 099100 – Painting.

2.7 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

1. Provide shop inspection and testing of completed assemblies.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 “Execution”: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Drawings.
- C. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.
- D. Verify that openings are ready to receive sleeves.
- E. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.
- F. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Cleaning: Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to ASME B31.3.
- B. Coating: Finish piping appurtenances as specified in Section 099100 - Painting.
- C. Pipe Penetrations:
 - 1. Sleeves:
 - a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
 - b. Set sleeves in position in forms and provide reinforcement around sleeves.
 - c. Extend sleeves through floors 1 inch above finished floor level and calk sleeves.
 - d. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
 - e. Install stainless-steel escutcheons at finished surfaces.
- D. Air Release and Vacuum Breakers: Provide vacuum breakers as indicated on Drawings and Specified in 400578.
- E. Disinfection: Disinfect potable water piping as specified in Section 331300 - Disinfecting of Water Utility Distribution.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. After installation, inspect for proper supports and interferences.
- C. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

- A. Sections 017300 “Execution” and 017700 “Closeout Procedures”: Requirements for cleaning.
- B. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This specification requires Contractor to delegate pipe support design to a pipe support design engineer hired by the Contractor. Where the Drawings show support types and/or locations, they shall be analyzed for adequacy to support loads and stresses calculated by the pipe support designer, modified if required, installed generally where shown, and integrated with the pipe support system design provided by the Contractor.
- C. Related Requirements:
 - 1. Section 033000 - Cast-in-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this Section.
 - 2. Section 099010 – Shop Priming: Product and execution requirements for shop priming specified by this Section.
 - 3. Section 400506 – Couplings, Adapters, and Specials for Process Piping.
 - 4. Section 400519 – Ductile Iron Process Pipe

1.2 COORDINATION

- A. Section 013100 “Project Management and Coordination”: Requirements for coordination.
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.3 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

1.4 ACTION SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog data including load capacity.
- C. Shop Drawings: Submit scaled piping layouts for each system. Indicate flow stream, pipe size(s) material(s), schedule(s), lining(s), critical dimensions between pipes, and equipment. Indicate by schedule pipe support type and locations. Provide detail of each type of supports, anchors, and guides.

- D. Manufacturers' Instructions: Submit special procedures and assembly of components.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Qualifications Statements:
 - 1. Submit qualifications for manufacturer.

1.6 DEFINITIONS

- A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.
- B. Wetted or submerged: Submerged, less than 1-foot above liquid surface, below top of channel or tank wall, under cover or slab of channel or tank, or in other damp locations.
- C. "Pipe" or "piping" shall mean all piping, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.
- D. Supports: wherever the word "supports" or "pipe supports" are used, they shall mean pipe supports, structural connections, concrete inserts (if allowed), anchors, guides, bolts, expansion units, restraints and all restraint, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

1.7 DELIVERY, STORAGE AND HANDLING

- A. All supports shall be crated, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished metal surfaces not galvanized, that are not of stainless steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

1.8 QUALITY ASSURANCE

- A. Perform Work according to applicable authority for welding support attachments to building structure.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum ten years' experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum ten years' experience.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- C. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.11 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pipe supports.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer's requirements regarding piping loads being or not being transmitted to their equipment.
- B. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances.
- C. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.
- D. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported to prevent transfer of force systems to the equipment. Do not install fixed or restraining supports between a flexible coupling and the piece of equipment.
- E. Pipe supports:
 - 1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
 - 2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.

3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
 4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
- F. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings, shall be used. Base elbow and base tees shall be supported on concrete pedestals.
- G. Restraints, flexible connections, expansion items, and related items as included in other specifications and shown on the Drawings.

2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

- A. All supports and appurtenances shall be standard products from approved manufacturers wherever possible, and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as proprietary. Note that different materials required, as specified in Part 2 MATERIALS, may require different figures or model numbers than those shown.
- B. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.3 MATERIALS

- A. For support of metallic pipe:
1. Submerged, buried, or within outdoor structures (vaults, etc.): Type 316 stainless steel (SS).
 2. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2 inch, epoxy coated steel for 2-1/2 inches size and larger.
 3. Other locations: galvanized steel.
 4. Additional requirements (including dielectric insulation): see following paragraphs.
- B. For support of non-metallic pipe:
1. Submerged, buried, or within vaults: Type 316 stainless steel or FRP.
 2. Within chemical areas: vinyl ester FRP.
 3. Other locations: galvanized steel.
- C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

2.4 SUPPORT AND RESTRAINT SYSTEMS

- A. Steel or Ductile Iron Piping

1. Cast iron and ductile iron, steel, and stainless steel piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
2. Support spacing for ductile iron, steel, and stainless steel piping 2-in and smaller diameter shall not exceed 5 feet.

B. Non-Metallic Piping

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.
 - a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.
 - b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length, and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.
2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer.

2.5 SINGLE PIPE SUPPORTS FROM BELOW

A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt
 - a. Anvil, Figure 259.
 - b. Cooper B-Line, Figure B3090.
2. Adjustable Saddle: MSS SP 58, Type 38 without clamp
 - a. Anvil, Figure 264.
 - b. Cooper B-Line, Figure B3093.

B. Pipes less than 3 inch in diameter

1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.
2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
4. More than one pipe may be supported from a common fabricated support.

C. Pipes 3 inch in diameter and larger

1. Support by adjustable stanchions.
 2. Provide at least 4 inch adjustment
 3. Flange mount to floor.
- D. Use yoked saddles for piping whose centerline elevation is 18 inch or greater above the floor and for all exterior installations.

2.6 WALL SUPPORTED SINGLE AND MULTIPLE PIPES

- A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets, where use of steel is allowed, as manufactured by Carpenter and Patterson, Figure No. 69, 84, or 139.
- B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.
- C. Individual pipes, up to 8-in diameter, where noted, may use MSS Type 8 pipe clamps as noted on the Drawings.
- D. Securely fasten all members to wall, column, etc., using double-expansion shields or other method as approved by the Engineer. Provide additional wall bearing plates as required.

2.7 BASE ANCHOR SUPPORT

- A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.
- B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

2.8 SHOP FACTORY FINISHING

- A. Prepare and prime metallic (except stainless steel) supports in accordance with Division 09.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013100 "Project Management and Coordination": Requirements for installation examination.
- B. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Obtain permission from Engineer before drilling or cutting structural members.
- C. Inserts:
 - 1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
 - 2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
- D. Pipe Supports:
 - 1. Install according to: ASME B31.3.
 - 2. Support horizontal piping as indicated on Drawings, depending upon pipe size.
 - 3. Support riser piping independently of connected horizontal piping.
 - 4. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
 - 5. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
 - 6. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
 - 7. Use offset clamps where pipes are indicated as offset from wall surfaces.
 - 8. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
 - 9. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by the Engineer.
 - 10. Repair mounting surfaces to original condition after attachments are made.
 - 11. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
 - 12. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.
- E. Equipment Bases and Supports:
 - 1. Provide housekeeping pads as detailed on Drawings.
 - 2. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
- F. Prime Coat:
 - 1. Prime coat exposed steel supports.
 - 2. Conform to Section 099010.

3.3 FIELD QUALITY CONTROL

- A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of the Engineer.
- B. After the work is installed, but before it is filled for start-up and testing, the Support System Design Engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
- C. Submit a report, including all field modifications and including all certificates.
 - 1. The report shall bear the stamp of a professional engineer registered in Florida and shall be subject to the review of the Engineer.

END OF SECTION 400507

SECTION 400519 - DUCTILE IRON PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Ductile-iron pipe.
- 2. Ductile-iron, malleable-iron, and cast-iron fittings.
- 3. Accessories.

- B. Related Requirements:

- 1. Section 099010 – Shop Priming: Product and execution requirements for shop priming specified by this Section.
- 2. Section 099100 – Painting: Product and execution requirements for painting specified by this Section.
- 3. Section 330519 – Ductile-Iron Utility Pipe for Water Service
- 4. Section 331216 - Water Utility Distribution Valves: Installation requirements for buried valves.
- 5. Section 331300 - Disinfecting of Water Utility Distribution: Disinfection requirements for potable water systems.
- 6. Section 400506 - Couplings, Adapters, and Specials for Process Piping: Piping appurtenances.
- 7. Section 400507 - Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
- 8. Section 400551 - Common Requirements for Process Valves: Common product requirements for valves for placement by this Section.

1.3 COORDINATION

- A. Section 013100 “Project Management and Coordination”: Requirements for coordination.
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information regarding pipe and fittings.
- C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.
- D. Manufacturer's Certificate: Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings and exterior coating for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- E. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizing methods and calculations used.
- F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
 - 1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Materials (including linings) in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- B. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.
- C. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.

- D. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.
- E. Engineer will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.
- F. Permanently mark pipe and fittings with the following information:
 - 1. Manufacturer name and trademark
 - 2. Manufacturing date.
 - 3. Size, type, class, or wall thickness.
 - 4. Production Standard (AWWA, ASTM, etc.).
- G. Perform Work according to St. Johns County Utility Department standards.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Coverall openings to prevent entrance of dirt, water, and debris.
 - 3. Protect piping and appurtenances by storing off ground
 - 4. Limit stacking height to manufacturers specified maximum
 - 5. Provide additional protection according to manufacturer instructions.

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 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA C115.
2. Pipe class shall conform with requirements of St. Johns County Utility Department Manual of Water, Wastewater and Reuse Design Standards and Specifications.
3. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).

B. Fittings:

1. Material: AWWA C110, ductile iron.
2. Pressure Rating: Same as that of connected piping.
3. Mechanical Joints:
 - a. Comply with AWWA C110 and AWWA C111.
 - b. Glands: Ductile iron with asphaltic coating.
 - c. Push-on Joints: Comply with AWWA C111.
4. Restrained Joints: Comply with AWWA C111. Shall be Megalug as manufactured by EBAA Iron or approved equal.
5. All below grade piping shall be restrained.
6. Flanged Fittings: Comply with AWWA C110 and AWWA C115, ASME B16.1. Class 125.
 - a. Bolts and nuts shall conform to Grade B ASTM A 307.
7. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.
8. Flanged coupling adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.

C. Cement-Mortar Lining:

1. Comply with AWWA C104.
2. Thickness: Standard.

D. Exterior Coating:

1. Exposed Service: As specified in Sections 099010.
2. If required, coatings "hold-backs" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
3. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.

4. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer coating damage is beyond repair, pipe to be replaced at the expense of the Contractor.
5. All flange bearing surfaces shall be uncoated.
6. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

2.2 ACCESSORIES

A. Gaskets:

1. Full face type SBR per AWWA C111 to provide positive sealing for the flanged ductile iron joints.
2. Thickness: 1/8-in.
3. NSF61 certified for potable water applications.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

C. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 "Execution": Requirements for installation examination.

B. Verify that field dimensions are as indicated on Drawings.

C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

A. Section 017300 "Execution": Requirements for installation preparation.

B. Thoroughly clean pipe and fittings before installation.

C. Surface Preparation:

1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
2. Touch up shop-primed surfaces with primer as specified in Sections 099100 – “Painting”.
3. Solvent-clean surfaces that are not shop primed.

3.3 INSTALLATION

- A. Buried Service Piping: As specified in Section 331216 - Water Utility Distribution Valves.
- B. Exposed Service Piping:
 1. According to ASME B31.3.
 2. In compliance with manufacturer’s instructions.
 3. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.
 4. Clean each length prior to installation.
 5. Support per Section 400507.
 6. Do not use equipment flanges for support; support pipe separately.
- C. Fittings:
 1. According to manufacturer instructions.
 2. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
 3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
 4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges.
 5. Provide required upstream and downstream clearances from devices as indicated on Drawings.
- D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.
- E. Install piping with sufficient slopes for venting or draining liquids and condensate to low points.
- F. Support exposed piping as specified in Section 400507 - Hangers and Supports for Process Piping.
- G. Provide expansion joints as specified in Section 400506 - Couplings, Adapters, and Specials for Process Piping, and pipe guides as specified in Section 400507 - Hangers and Supports for Process Piping, to compensate for pipe expansion due to temperature differences.
- H. Disinfection: Disinfect potable water piping as specified in Section 331300 - Disinfecting of Water Utility Distribution.
- I. Dielectric Fittings: Provide between dissimilar metals.
- J. Field Cuts: According to pipe manufacturer instructions. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the

satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.

- K. Finish primed surfaces according to Sections 099100.
- L. Installation Standards: Install Work according to St. Johns County Utility Department standards.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Deflection at joints not to exceed that recommended by the pipe manufacturer.
- C. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

3.5 FIELD QUALITY CONTROL

- A. Section 014000 "Quality Requirements" for inspecting and testing requirements.
- B. Inspection:
 - 1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
 - 2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
- C. Pressure Testing: According to St. Johns Count Utility Department Manual of Water, Wastewater, and Reuse Design Standards and Specifications.

3.6 CLEANING

- A. Sections 017300 "Execution" and 017700 "Closeout Procedures" specify requirements for cleaning.
- B. Keep pipe interior clean as installation progresses.
- C. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519

This page intentionally left blank.

SECTION 400551 - COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Common requirements for valves.
2. Common requirements for valve actuators.
3. Valve tags.
4. Valve Schedule.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for execution requirements for placement of concrete as required by this Section.
2. Section 099010 "Shop Priming" for product and execution requirements for shop priming specified by this Section.
3. Section 099100 "Painting" for product and execution requirements for painting specified by this Section.
4. Section 331300 "Disinfection of Water Utility Piping Systems."
5. Section 400507 "Hangers and Supports for Process Piping" for product and execution requirements for valve supports specified by this Section.

1.2 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Coordinate Work of this Section with individual process valve specifications.

1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures" for submittal requirements.

B. Valve Schedule:

1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

C. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
 2. Color palate for Owner selection.
 3. Full scale drawing of sample with lettering dimensions and scribe depth.
 4. Valve tag lettering provided with Valve Schedule above.
- D. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.
- E. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.4 DELEGATED DESIGN SUBMITTALS

- A. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.
- B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.
- E. Qualifications Statement:
1. Submit qualifications for manufacturer and licensed professional.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures" for submittal requirements.
- B. Section 017839 "Project Record Documents" for record actual locations of valves and actuators.

1.7 QUALITY ASSURANCE

- A. Maintain clearances as indicated on Drawings.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.

- C. Mate valves to actuators at manufacturer's or integrator's facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.
- D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.
- F. Obtain Manufacturer's Certification of Proper Installation for Specified valves and valve assemblies.
- G. Perform Work according to St. Johns County Utility Department standards.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' experience.
- B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 "Product Requirements" for requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Deliver factory mated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.
- D. Store materials according to manufacturer instructions.
- E. 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.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to materials ordering or any fabrication.

2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for valves and actuators.

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.
- B. All valves of the same type shall be the product of one manufacturer
- C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.
- D. Operation:
 1. Close by turning clockwise.
 2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.
- E. Valve Marking and Labeling:
 1. Marking: Comply with MSS SP-25.
 2. As indicated in valve schedule.
 3. Labeling (valve tags):
 - a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 1/4-inch.
 - b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
 - c. Colors of lettering and backing as selected by Owner.
 - d. Two, 1/4-inch clear opening 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
 - e. 3/32-inch 316 SS cable and splice hardware.
- F. Valve Construction: As Specified in Valve Sections.

2.2 FINISHES

- A. Valve Coating: Comply with AWWA C550.
- B. Factory finishes are included in individual valve sections.

- C. Exposed Valves: As specified in Sections 099010 – Shop Priming and Section 099100 – Painting.
- D. Stainless Body Valves: Do not coat.
- E. Do not coat flange faces of valves unless otherwise specified.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.
- B. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.
- C. Owner Witnessing:
 - 1. Allow witnessing of factory inspections and test at manufacturer's test facility.
 - 2. Notify Owner at least seven days before inspections and tests are scheduled.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.
- B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.
- C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer's attention via job meetings, submittal process or request for information process.

3.2 INSTALLATION

- A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.
- B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.
- C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.
- D. Rigidly support valves to avoid stresses on piping.
- E. Coat studs, bolts and nuts with anti-seizing lubricant.
- F. Dielectric Fittings: Provide between dissimilar metals.

- G. Clean field welds of slag and splatter to provide a smooth surface.
- H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturer's or integrator's facility.
- I. In no case shall stems be installed vertically downward.
- J. Unless otherwise indicated on the Drawings:
 - 1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.
 - 2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
 - 3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position,
 - 4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
- K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.
- L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Valve flange covers shall remain in place until connected piping is in place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.
- M. Where installation is covered by a referenced standard, installation shall be in accordance with that standard, except as herein modified, and the Contractor shall certify such. Also note additional requirements in other parts of this Section.
- N. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torquing requirements for all valves.
- O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.
- P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.
- Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.
 - 1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
 - 2. Support boxes and stem guides during concrete placement to maintain vertical alignment.

- R. Install 1-inch ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.
- S. Provide access where valves and fittings are not accessible.
- T. Pipe Hangers and Supports: As specified in Section 400507 - Hangers and Supports for Process Piping.
- U. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.
- V. Installation Standards: Install Work according to St. Johns County Utility Department standards.

3.3 FIELD QUALITY CONTROL

- A. Section 014000 "Quality Requirements"- Requirements for inspecting and testing.
- B. Section 017300 "Execution" - Requirements for testing, adjusting, and balancing.
- C. Valve Field Testing:
 - 1. Test for proper alignment.
 - 2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
 - 3. Engineer will witness field testing.
 - 4. Functional Test:
 - a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
 - b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
 - c. Cycle valves equipped with electric, pneumatic or hydraulic actuators 5 times from full open to full closed in the presence of the Engineer to exhibit operation without vibration, jamming, leakage, or overheating.
 - d. Operate pressure control and pressure relief valves in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.
 - 5. Field test pipe lines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to the Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to the Engineer.

END OF SECTION 400551

This page intentionally left blank.

SECTION 400553 - IDENTIFICATION FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Labels.
6. Lockout devices.

- B. Related Requirements:

1. Section 099100 - Painting: Requirements for painting as specified by this Section.
2. Section 400551 - Common Requirements for Process Valves: Basic materials and methods for valves.

1.3 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog literature for each specified product.
- C. Shop Drawings:
 1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
 2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

- D. Samples: Submit two tags, labels, and pipe markers for each size to be used on Project.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- G. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 QUALITY ASSURANCE

- A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.
- B. Perform Work according to St. Johns County Utility Department standards.
- C. Comply with recommended water treatment plant color coding from the latest version of Ten State Standards unless otherwise requested by Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Craftmark Pipe Markers,
2. Kolbi Pipe Marker Co.,
3. Pipemarket.com (Brimar Industries, Inc.),
4. Seton Identification Products
5. Furnish materials according to St. Johns County Utility Department standards.

B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

A. Metal Tags:

1. Manufacturers:

- a. Brady ID,
- b. Craftmark Pipe Markers,
- c. Kolbi Pipe Marker Co,
- d. Marking Services, Inc.,
- e. Pipemarket.com (Brimar Industries, Inc.),
- f. R&R Identification Co.
- g. Seton Identification Products
- h. Substitutions: Not permitted.

2. Description:

- a. Stainless-steel construction; stamped letters.
- b. Minimum Tag Size and Configuration: 2 inches; diameter with finished edges.
- c. Provide with brass hooks suitable for attaching the tag to the valve operator.
- d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

2.3 STENCILS

A. Manufacturers:

1. Kolbi Pipe Marker Co,
2. Marking Services, Inc.,
3. Pipemarket.com (Brimar Industries, Inc.),
4. R&R Identification Co.
5. Seton Identification Products
6. Substitutions: Not permitted.

B. Description:

1. Quality: Clean-cut symbols.
2. Letters:

OUTSIDE DIAMETER
OF PIPE

SIZE OF LETTERS

3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

C. Stencil Paint:

1. Description: Semigloss enamel.
2. As specified in Section 099100 - Painting.

2.4 PIPE MARKERS

A. Plastic Tape Pipe Markers:

1. Manufacturers:
 - a. Brady ID,
 - b. Craftmark Pipe Markers,
 - c. Kolbi Pipe Marker Co.,
 - d. Marking Services, Inc.,
 - e. Pipemarket.com (Brimar Industries, Inc.),
 - f. Seton Identification Products
 - g. Substitutions: Not permitted.
2. Description:
 - a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
 - b. Letter sizes per Paragraph 2.3B.
 - c. Color shall be white or black depending on background color.

B. Plastic Underground Pipe Markers:

1. Manufacturers:
 - a. Kolbi Pipe Marker Co.,
 - b. Marking Services, Inc.,
 - c. Pipemarket.com (Brimar Industries, Inc.),
 - d. Rhino Marking and Protection System,
 - e. Seton Identification Products
 - f. Substitutions: Not permitted.

2. Description:

- a. Brightly colored, continuously printed plastic ribbon tape.
- b. Minimum Size: 6 inches wide by 4 mils thick.
- c. Manufactured for direct burial service.
- d. Letter sizes per Paragraph 2.3B.

2.5 LABELS

A. Manufacturers:

1. Brady ID,
2. Seton Identification Products
3. Substitutions: Not permitted.

B. Description:

1. Material: Aluminum
2. Minimum Size: 1.9 by 0.75 inches.
3. Adhesive backed, with printed identification.

2.6 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:

- a. Brady ID,
- b. Master Lock Company, LLC
- c. Substitutions: Not permitted.

2. Description:

- a. Material: Anodized aluminum
- b. Furnish hasp with erasable label surface.
- c. Minimum Size: 7-1/4 by 3 inches.

B. Valve Lockout Devices:

1. Manufacturers:

- a. Brady ID,
- b. Master Lock Company, LLC
- c. Substitutions: Not permitted.

2. Description:

- a. Material: Steel
- b. Furnish device to restrict access to valve operator and to accept lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Stencil Painting: Prepare surfaces as specified in Section 099000 - Painting and Coating.

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Apply stencil painting as specified in Section 099000 - Painting and Coating.
- C. Install identifying devices after completion of coverings and painting.
- D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- E. Labels:
 - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 - 2. For unfinished covering, apply paint primer before applying labels.
 - 3. Titles:
 - a. Locate a maximum 26 feet apart.
 - b. Locate directly adjacent to pipeline breaches on each side wall.
 - c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.
 - d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.
- F. Tags:
 - 1. Identify valves in main and branch piping with tags.
 - 2. Install tags using corrosion-resistant chain.
 - 3. Number tags consecutively by location.
- G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- H. Piping:
 - 1. Identify piping, concealed or exposed, with plastic tape pipe markers.
 - 2. Use tags on piping 3/4-inch diameter and smaller.
 - 3. Identify service, flow direction, and pressure.
 - 4. Install in clear view and align with axis of piping.

5. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 400553

This page intentionally left blank.

SECTION 400561 - GATE VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Solid wedge, resilient-seated gate valves
- 2. Tapping valves and sleeves

- B. Related Requirements:

- 1. Section 400551 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.3 DEFINITIONS

- A. Outside screw and yoke (os&y) valve: A valve in which the operating screw is driven by a threaded nut that is built into the handle.

1.4 SUBMITTALS

- A. As specified in Section 400551 – Common Requirements for Process Valves: Submittal requirements for compliance with this section.

1.5 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C500, C509, C515.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 SOLID WEDGE, RESILIENT-SEATED GATE VALVES – TAG TYPE GV4

A. Manufacturers:

1. Mueller Co. A2360.
2. Substitutions: Owner approved equal.

B. Description:

1. Comply with AWWA C509.
2. Minimum Working Pressure: 150 psig at 72 deg. F.
3. Maximum Process Fluid Temperature: 72 deg. F.
4. End Connections: ASME B16.1, ASME B16.5, and ASME B16.42, flanged, and Mechanical joint.
5. Gear Actuators for Manual Valves: Comply with AWWA C509.
6. Body: no recesses in valve body.

C. Operation:

1. As specified in Section 400551 - Common Requirements for Process Valves.
2. Stem: Non-rising.
3. Handwheel.
4. Furnish gear operators for valves 8 inches and larger.

D. Materials:

1. Wedge: Resilient ASTM A126, cast iron, fully encapsulated with molded rubber.
2. Body and Disc: ASTM A126, cast iron or ASTM A536, ductile iron, AWWA C509, vulcanized rubber coated.
3. Stem, Stem Nuts, Glands, and Bushings: Type 316 stainless steel.
4. Connecting Hardware: Type 316 stainless steel.

E. Finishes:

1. As specified in Section 400551 - Common Requirements for Process Valves.
2. Body, internal and external, including bonnet: AWWA C550, Epoxy, 4-mil minimum thickness.

2.2 TAPPING VALVES AND SLEEVES – Tag Type TPGV

A. Manufacturers:

1. Tapping Valves: Mueller Co., T2360.
 - a. Substitutions: Approved equal.
2. Tapping Sleeves: JCM Model 432, SS.

a. Substitutions: Approved equal.

B. Description:

1. Tapping Valves: Tapping valves shall be iron body, bronze mounted gate valves, non-rising stem, open left, resilient seat, 2 inch square operating nut, for vertical mounting on buried water lines.
2. Tapping Sleeves: Tapping sleeves shall be stainless steel. The tapping sleeve including the flange, nuts and bolts shall be 304 stainless steel. The pilot flange shall be recessed for tapping in accordance with MSS SP-60 and rated Class D per AWWA C207 with a 125 pound drilling conforming to ANSI B16.
3. As specified in Section 400551 - Common Requirements for Process Valves.
4. Gate Guide: Plugged, bottom flush port
5. Include tap for pressure/leak testing
6. Pass full, normal sized cutter

C. Connection:

1. The valve ends shall be MSS-SP-60, Mechanical joint for use with ductile iron pipe on one side, and ASME B16.1, ASME B16.5, and ASME B16.42, flanged on the other side.
2. Tapping service port

D. Materials:

1. Wedge Disc: iron and fully encapsulated with molded rubber.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 400551 - Common Requirements for Process Valves.
- C. Testing: Test gate valves according to AWWA C509.
- D. UL and FM approved

PART 3 - EXECUTION

3.1 INSTALLATION

- A. According to AWWA C509.

END OF SECTION 400561

This page intentionally left blank.

SECTION 400563 - BALL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Rubber-seated ball valves.
- 2. Plastic ball valves.

- B. Related Requirements:

- 1. Section 400551 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 PLASTIC BALL VALVES FOR SODIUM HYPOCHLORITE

- A. Manufacturers:

- 1. ASAHI-America, NIBCO Inc., or approved equal.

- B. Up to 4 Inches:

1. AWWA C507, Class 150.
2. Minimum Working Pressure: 150 psig at 73 deg. F.
3. Design minimum fluid velocity: 35 feet per second.
4. Body:
 - a. Material: PVC
 - b. Seats and Seals: PTFE.
5. Ball:
 - a. Material: PVC.
 - b. Opening: Full port.
 - c. Vented
6. End Connections:
 - a. True Union
7. Operator: Manual quarter turn.

2.2 BALL VALVES FOR SODIUM HYDROXIDE SERVICE

A. Manufacturers:

1. ASAHI-America, NIBCO Inc., or approved equal.

B. Up to 4 Inches:

1. AWWA C507, Class 150.
2. Minimum Working Pressure: 150 psig at 73 deg. F.
3. Design minimum fluid velocity: 35 feet per second.
4. Body:
 - a. Material: CPVC
 - b. Seats and Seals: PTFE.
5. Ball:
 - a. Material: CPVC.
 - b. Opening: Full port.
6. End Connections:
 - a. True Union
7. Operator: Manual quarter turn.

2.3 BALL VALVES FOR WATER SERVICE

A. Manufacturers:

1. Jamebury Corporation, Jenkins Bros., or equal.

B. Description:

1. Ball valves for water service shall be threaded or flanged as shown on the drawings. Ball valves shall have 316 stainless steel body and trim, PTFE seats and seals. Valve body shall be either two or three piece design, no internal ring for the ball shall be acceptable. Valves shall be class 150.

C. Actuator:

1. Valves shall be supplied with stainless steel manual lever or “T” handle. Valves used as moisture drains shall be installed at low points of the line and piped to drain.
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 400551 - Common Requirements for Process Valves.
- C. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

- A. According to AWWA C507.
- B. As specified in Section 400551 – Common Requirements for Process Valves.

END OF SECTION 400563

This page intentionally left blank.

SECTION 400564 - BUTTERFLY VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. AWWA butterfly valves.

- B. Related Requirements:

- 1. Section 400551 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 AWWA BUTTERFLY VALVES- Tag Type BFV1

- A. Manufacturers:

- 1. Mueller B-3211-20 or Owner approved equal.

- B. Description:

1. Comply with AWWA C504, Class 150A or B.
2. Buried valves shall have mechanical joint ends with corrosion resistant alloy steel or stainless steel nuts and bolts.
3. Above ground valves shall be flanged in accordance with ANSI B16.1, Class 125.
4. Minimum Working Pressure: 150 psig.
5. Maximum Process Fluid Temperature: 85 deg. F.
6. Body Style: Rubber seated butterfly valve, AWWA Designation C504.
7. Shaft: "Stub Shaft" type or one piece extending full size through the disc bearings. Shaft diameters shall meet the requirements of AWWA C504 for Class 150B.
8. Bearings: Self-lubricating.
9. Shaft Seals/Packing:
 - a. self compensating V-type- primary means
 - b. multiple O-rings for up to 24-inch
 - c. pull down seals using a square braid of graphite fiber for over 24-inch
 - d. retained by bolted retainer plate or gland, clips not acceptable
 - e. retained by stuffing box with follower gland for over 24-inch
 - f. replacement without removal of valve from line.
 - g. Adjustment without disturbing actuator assembly for over 24-inch
10. Seats:
 - a. Mounting: On disc.
 - b. For body mounted seats, supply machined metal seating edges on disc. Seats mechanically retained and adjustable with common tools for valves larger than 24-inch.
 - c. For disc mounted seats, fasten with a segmented or one piece machined metal retaining ring, and self-locking bolts or set screws, fully adjustable with common tools. Machined metal seat ring installed in the valve body
 - d. Type: Resilient and replaceable. Field adjustable and replaceable.

C. Actuator:

1. Handwheel with horizontal stem except where noted on the drawings. Operator with handwheel and stem shall be top-mounted for the butterfly valve installed on the interconnect of the two clearwells as indicated on the Drawings.
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

D. Materials:

1. Body: Cast iron, ASTM A126 or Ductile iron, ASTM A536.
2. Stem: ASTM A276 Type 316 stainless steel.
3. Disc: Ni-Resist, Type 1 or ductile iron, ASTM A536, Grade 65-45-12 with stainless steel seating edges or cast iron ASTM A-126.
4. Seats:
 - a. Elastomer: Neoprene.
 - b. Retaining Ring: ASTM A276 Type 316 stainless steel.
 - c. Seat Ring: ASTM A276 Type 316 stainless steel.

5. Shaft: ASTM A276, type 304 stainless steel or high tensile steel with stainless steel shaft journals
6. Bearings:
 - a. Sleeve: Nylatron.
 - b. Thrust: Bronze ASTM 763, Alloy C99500.
7. Connecting Hardware: ASTM A276 Type 316 SS.

E. Finishes:

1. As specified in Section 400551 - Common Requirements for Process Valves.
2. Manufacturers standard fusion bonded epoxy
3. All valve materials shall be NSF 61 compliant.

2.2 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. As specified in Section 400551 - Common Requirements for Process Valves.
- C. Testing: Test butterfly valves according to AWWA C504.
- D. Submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504 and specifically list all exceptions.
- E. Valves shall be bubble-tight in both directions of flow.

PART 3 - EXECUTION

3.1 Examination

- A. As specified in Section 400551 - Common Requirements for Process Valves: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

- A. As specified in Section 400551 – Common Requirements for Process Valves.
- B. According to Manufacturer’s Instructions.

END OF SECTION 400564

This page intentionally left blank.

SECTION 400565.23 - SWING CHECK VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Swing check valves 4 inches and larger.
- B. Related Requirements:
 - 1. Section 099100 - Painting
 - 2. Section 400551 - Common Requirements for Process Valves: Basic materials and methods related to valves commonly used for process systems.

1.3 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Section 400551 - Common Requirements for Process Valves- valve schedule
- C. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Section 400551 - Common Requirements for Process Valves
- C. Product Data: Submit manufacturer's catalog information, indicating materials of construction and compliance with indicated standards.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and centerline elevations.

1.6 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- B. Perform Work according to St. Johns County Utility Department standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Section 400551 - Common Requirements for Process Valves
- C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- D. Store materials according to manufacturer instructions.
- E. Protection:
 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Protect valves and appurtenances by storing off ground.
 3. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 4. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Section 017700 “Closeout Procedures”: Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for swing check valves.

PART 2 - PRODUCTS

2.1 IRON BODY SWING CHECK VALVES 4-INCH AND LARGER

A. Manufacturers:

1. Mueller or approved equal.

B. Description:

1. Comply with AWWA C508.
2. Size: 4 inches and larger.
3. Type: Swing, metal disc, with hinge shaft extended from body, sealed with stuffing box, packing and gland. Furnish outside lever and control specified below or in valve schedule.
4. Seat: Bronze.
5. Minimum Working Pressure: 175 psig at 70 deg. F.
6. Maximum Fluid Temperature: 72 deg. F.
7. Disc controller:
 - a. spring
8. Mounting: Horizontal.
9. End Connections: Flanged, ASME B16.1.

C. Materials:

1. Body and Cover: Cast iron, ASTM A126 or Ductile iron, ASTM A536.
2. Disc: Bronze, ASTM B62 or Ductile iron, ASTM A536.
3. Seat: Field replaceable, bronze, ASTM B62.
4. Cover hardware: 316 stainless steel.
5. Chamber and Plunger: Bronze, ASTM B62.
6. Hinge Shaft and Key: A582 Type 416 Stainless Steel.
7. Hinge Shaft Gland: A582 Type 416 Stainless Steel
8. Packing and O-Ring: Reinforced Teflon and Buna N.
9. Grease Fittings: Type 316 stainless steel
10. Rubber Components: Buna-N.
11. Connecting Hardware: Type 304 stainless steel.

D. Finishes: As specified in Section 400551 - Common Requirements for Process Valves.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Section 400551 - Common Requirements for Process Valves.

C. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C508.

2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 “Execution”: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Drawings.
- C. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Thoroughly clean valves before installation.
- C. Surface Preparation:
 1. Touch up shop-primed surfaces with primer as specified in Section 099010 – Shop Priming.
 2. Solvent-clean surfaces that are not shop primed.
 3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
 4. Prime surfaces as specified in Section 099010 – Shop Priming.

3.3 INSTALLATION

- A. According to AWWA C508 and manufacturer instructions.
- B. Installation Standards: Install Work according to St. Johns County Utility Department standards.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspection:
 1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer/Engineer.
 2. Repair damaged valve or provide new, undamaged valve.
 3. After installation, inspect for proper supports and interferences.
- C. Pressure test valves with piping.

3.5 CLEANING

- A. Sections 017300 “Execution” and 017700 “Closeout Procedures”: Requirements for cleaning.
- B. Keep valve interior clean as installation progresses.
- C. After installation, clean valve interior of soil, grit, loose mortar, and other debris.

END OF SECTION 400565.23

This page intentionally left blank.

SECTION 400578.13 - AIR/VACUUM VALVES FOR WATER SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Air release/vacuum breaker valves for water treatment facilities.
- B. Related Requirements:
 - 1. Section 099010 "Shop Priming" Preparing and priming, including field-applied and equipment finishing.
 - 2. Section 099100 "Painting" Painting surfaces, including field-applied and equipment finishing.
 - 3. Section 400507 - Hangers and Supports for Process Piping: Anchors and supports.
 - 4. Section 400551 - Common Requirements for Process Valves: Typical product and installation requirements for valves specified in this Section.

1.3 COORDINATION

- A. Coordinate Work of this Section with installation of process piping.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer catalog information.
- C. Shop Drawings: Indicate materials, dimensions, weights, and end connections on assembly drawings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and setting dimensions.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

1.5 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. 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.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Section 017700 "Closeout Procedures": Requirements for warranties.
- B. Furnish one year manufacturer's warranty for air release/vacuum breaker valves.

PART 2 - PRODUCTS

2.1 AIR/VACUUM RELIEF VALVES FOR WATER SERVICE – Tag Type AVR/V

- A. Manufacturers:

1. Val-Matic Valve & Manufacturing Corp Model 100S, ARI Model D-040, ARI Model D-060, or approved equal.

B. Description:

1. Type: Fully automatic, float operated.
2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for potable water service.
5. Pressure Rating: 150 psig or Maximum service pipeline pressure.
6. Maximum Operating Temperature: 85 deg. F.
7. Valves shall be designed to release large amounts of air during pipeline filling, release small amounts of air accumulated during pipeline operation, and allow large volume of air during pipeline drainage or pipe break. Valves shall have an intake orifice area equal to nominal size of valve.
8. Discharge of pressurized air shall be controlled by seating and unseating of a small orifice needle on the control float. Venting of large quantities of air during pipeline filling shall be accomplished through a large orifice at top of valve. Vacuum relief shall be accomplished through the large orifice when the control float falls due to negative pressure in the pipeline. Valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is released suddenly. Feature shall consist of easily replaceable gaskets.
9. Pipeline air and vacuum relief valves shall be supplied with shutoff gate, butterfly or ball valves.

C. Materials:

1. Body and Cover: Cast iron, ASTM A126 or Ductile iron, ASTM A536l
2. Float: Type 316 stainless steel
3. Trim: Type 316 Stainless steel
4. Seats: Buna-N or VITON
5. Seals: Buna-N/Nitrile
6. Hardware: Type 316 Stainless steel

D. End Connections:

1. 1-Inch threaded, NPT.
2. Material: brass.
3. Accessories: Furnish one additional NPT connections.

E. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.
2. Epoxy lining.

2.2 VACUUM BREAKER

A. Manufacturer and Model:

1. Watts LF288A, or approved equal.

2.3 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 099010 – Shop Priming.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 “Execution”: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.
- C. Installation Standards: Install Work according to St. Johns County Utility Department standards.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Inspect for interferences and proper supports.
- C. Testing:
 - 1. As specified in Section 400551 - Common Requirements for Process Valves.
 - 2. Demonstrate operation without undue noise or vibration.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 1 day on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- E. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
 - 3. Repair damaged coatings with material equal to original coating.
- F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

- A. Section 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

- A. Section 017900 "Demonstration and Training": Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.13

This page intentionally left blank.

SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.
- B. Work does not include the following:
 - 1. Application Engineering Services (AES) including PLC programming, OIT configuration/programming, and HMI development shall be provided by the Owner's programmer.
- C. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.
- D. All equipment and installations shall satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.
- E. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.
- F. Related Requirements:
 - 1. Section 406263 - Operator Interface Terminals.
 - 2. Section 406343 - Programmable Logic Controllers.
 - 3. Section 406643 - Wireless Network Equipment.
 - 4. Section 406717 - Industrial Enclosures.
 - 5. Section 406733 – Panel Wiring.
 - 6. Section 407000 – Instrumentation for Process Systems.
 - 7. Section 407243 through 407513 for field instruments and analyzers.

1.3 DEFINITIONS

- A. PCSS – Process Control System Supplier.
- B. AESS - Applications Engineering System Supplier.
- C. MOPO - Maintenance of Plant Operations.
- D. LEED – Leadership in Energy and Environmental Design.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at St. Johns County Utility Department Northwest Water Treatment Plant (WTP) for the purpose of a preinstallation meeting.
- B. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 4 hours.
- C. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting is to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS and AESS. The meeting will last up to 4 hours.
- D. Attendance at MOPO meeting.
- E. Bi-Weekly on-site or conference call coordination meetings with Engineer, Contractor, Vendors, and AESS as required prior to any field start-up or activity testing begins.
- F. Schedule the mandatory coordination meetings as described herein. Hold the meetings at the Owner's designated location and include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Prepare and distribute an agenda for the meetings a minimum of one week before the scheduled meeting date. Schedule the meetings for a minimum of one week before the requested meeting date.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of equipment, control panels, and instrumentation as specified herein.
4. Include diagrams for power, signal, and control wiring.

C. Qualifications Submittal:

1. For non-listed PCSS', submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. The Qualifications submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements shall be grounds for rejection as a PCSS. The Qualifications Submittal shall, as a minimum, contain the following:
 - a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
 - b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
 - c. Copy of UL-508 certificate for panel fabrication facilities.
 - d. Project references for water or wastewater projects as defined in the "Quality Assurance" paragraphs.
 - e. Documentation to demonstrate the ability to complete this project including: resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

D. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. The Project Plan is required to be submitted and approved before further submittals shall be accepted. The Project Plan shall contain the following:
 - a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, switchover (Maintaining Plant Operations during system transition), approach to testing and training, and other tasks as required by these specifications.
 - b. Preliminary list of PLC hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. Review and approval of software and hardware systems as part of this Project Plan stage shall not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer approval.

- c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
 - d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, control system architecture, and I/O wiring diagrams.
2. Exceptions to the Specifications or Drawings shall be clearly defined in a Deviation List. The Deviation List shall consist of a paragraph by paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. If no exceptions are taken to the specifications or drawings the PCSS shall make a statement as such. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.
3. The PCSS must coordinate their work with the General Contractor's overall schedule and is responsible for ensuring a schedule is included in this submittal that incorporates all PCSS milestones including but not limited to the following:
- a. Schedule for all subsequent project submittals. Include the time required for Contractor submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
 - b. Proposed dates for all project coordination meetings.
 - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
 - d. Shipment of instrument and control system equipment.
 - e. Installation of instrument and control system equipment.
 - f. Testing: Schedule for all testing.
 - g. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
 - h. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
 - i. Arrange project schedule to accommodate requirements of AESS to develop, test, troubleshoot, and train Owner on PLC and HMI systems. Timing of these coordination efforts will be determined by PCSS; however, PCSS shall include all necessary costs to accommodate the following minimum time slots in their overall project schedule. All time allotments shall exclude any legal holidays, or days lost due to delays caused by Contractor or PCSS.
 - 1) Deliver detailed I/O listing to the AESS as specified herein.
 - 2) Completion of AESS's Application Software Test at PCSS's facility: Twenty-one calendar days after successful completion and acceptance by Engineer of PCSS's Unwitnessed Factory Test and Witnessed Factory Tests.
 - 3) Completion of AESS's Application Software Operational Readiness Tests: Twenty-one calendar days after successful completion and acceptance by the Engineer of PCSS's operational readiness testing.
 - 4) Completion of AESS's Functional Acceptance Tests: Twenty-one calendar days after successful completion and acceptance by the Engineer of PCSS's functional acceptance testing.

- 5) Completion of Training on PLC and HMI equipment: Twenty-one calendar days after successful completion and acceptance by the Engineer of PCSS's training.

E. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. I/O list shall be based on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
3. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. The I/O list shall reflect all active and spare I/O points. Add points to accommodate spare I/O as required in the specifications.
5. The I/O list shall be arranged such that each control panel has a dedicated worksheet. At a minimum, I/O worksheet shall include the following information:
 - a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, the loop number of the tag shall be broken out to allow for sorting by loop.
 - b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
 - c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
 - d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
 - e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
 - f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points are "1."
 - g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
 - h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
 - i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
 - j. EXISTING or NEW I/O POINT: Indicate if point is existing (E) or new (N).
 - k. CONDITION OF EXISTING SIGNAL: Condition of existing I/O signals shall be noted as functional (F) if working properly or if not functioning (NF) with issue described.
6. The I/O list shall be sorted in order by:
 - a. Physical location.
 - b. I/O Type.
 - c. Loop Number.
 - d. Device Tag.

7. Once the I/O list is approved, the PLC I/O addresses shall not be modified without approval by the Engineer.

F. MOPO and Sequencing Submittal

1. The PCSS shall assist in the development of the Contractor's MOPO and sequencing submittal to ensure an orderly transition from the existing control system to the new control system. See Section 011011 for specific requirements. The PCSS may not proceed with the submission of any hardware and software submittals until this submittal is approved.
2. Include step-by-step procedures and required durations to install, commission, and place into operation the new Instrumentation Control Panel ICP100 which contains RTU100. This panel replaces the existing RTU100 and the timing of the replacement shall be coordinated with other MOPO sequencing to ensure a smooth transition from the existing RTU to the new RTU.
3. Include step-by-step procedures to modify RTU200 to be capable of Modbus TCP communications with the high service pump VFDs.
4. Include step-by-step procedures to modify RTU300 to be capable of Modbus TCP communications with the transfer pump VFDs.
5. Include step-by-step procedures to modify RTU300 to incorporate the Wireless I/O Base Station for the Well Pump No. 1 and Well Pump No. 2 flow meters and wiring the signals to analog inputs on an existing RTU300 I/O module.
6. Include any interim programming that shall be required by the Owner's programmer. The interim programming and testing shall be coordinated with the Contractor, the Owner and the Owner's programmer.
7. All procedures shall include a minimum 1 week notification to the Owner for any system alterations that affect operation of the facility including parties involved at each phase.
8. Provide a spreadsheet indicating point-by-point transition of all I/O points.
9. Provide network architecture phasing plans showing the condition of the new and existing network at each phase of construction. Network architecture phasing plans shall include the transition to the CAT6 punch-down patch panel to accommodate the existing network cabling that uses the existing ICP100 as a pass-through.

G. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

H. Control System Architecture, Computer Equipment , and Hardware Packages Submittal:

1. Refer to the sections below for equipment required as part of the Hardware and Software Packages submittal:
 - a. Section 406263 - Operator Interface Terminals.
 - b. Section 406343 - Programmable Logic Controllers.
 - c. Section 406643 - Wireless Network Equipment.
 - d. Section 406717 - Industrial Enclosures.
2. For each hardware and software packages component specified in the sections above, submit a cover page that lists, at a minimum, date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the

- cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.
3. Complete system architecture drawing(s) showing in schematic form showing the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc. The PCSS is required to provide unique network architecture drawings for the following networks:
 - a. SCADA
 4. The system architecture drawing(s) shall be developed in accordance with the following information and guidelines at a minimum:
 - a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
 - b. All communication cable types should be uniquely identified with a specific linetype and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125 micron multimode mode fiber, or CAT-6E Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend shall clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)
 - c. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
 - d. Network protocols shall be clearly identified for each communication path or for system and indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP, or DNP3.
 - e. Any device that has multiple ports or connection points, shall clearly indicate which port or connection number the communication cable is terminating at. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
 - f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing shall clearly reference other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
 - g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
 - h. The intent of this specification requirement is to develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.

- i. Sheet size shall be 11"x17" minimum and using more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Line continuations must between drawings must be clearly identified.

I. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all panels specified. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be 11"x17" in size. At a minimum, the panel drawings shall include the following:
 - a. A legend sheet clearly indicating all symbols used on drawings and with voltage, color and size of each wire clearly indicated and in accordance with requirements of Section 406733 – Panel Wiring.
 - b. Interior and exterior panel elevation drawings to scale.
 - c. Nameplate schedule.
 - d. Conduit access locations.
 - e. Panel construction details.
 - f. Cabinet assembly and layout drawings to scale. Assembly drawing shall include a bill of material on the drawing with each panel component clearly defined. Bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
 - g. Fabrication and painting specifications including color (or color samples).
 - h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
 - i. Submit evidence that all control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections shall be borne by Contractor.
2. Wiring Diagrams Submittal:
 - a. Where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions, Contractor shall provide to PCSS approved submittals in order for PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. These drawings shall be included in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.
 - b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring shall include the device ISA-tag and a

unique numeric identifier. Diagrams shall identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme. Panel drawings shall be 11" x 17" in size.

c. ISA Loop Wiring Diagrams: Not required.

J. Testing Plan Submittals:

1. Refer to Section 406121.10 "Process Control System Testing" for specific testing submittal requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For any named PCSS, submit a statement on company letterhead indicating that the requirements in the "Quality Assurance" paragraph below are met by the firm.

B. Product Test Reports: Refer to individual instrument, component or hardware specifications for specific requirements.

C. Evaluation Reports: Refer to individual instrument, component or hardware specifications for specific requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in to include in operation and maintenance manuals.

1. Submit in accordance with Section 017823 "Operation and Maintenance Data".
2. The operations and maintenance manuals shall, at a minimum, contain the following information:

a. Table of Contents:

1) A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.

b. Instrument and Equipment Lists:

1) The following lists shall be developed in Microsoft Excel format:

a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier

- phone number, completion year replacement cost, and any other pertinent data.
- b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
 - c. Equipment Operations and Maintenance Information:
 - 1) ISA-TR20.00.01-2007 data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.
 - 2) Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages or sections that do not apply at all to the specific model supplied shall be removed.
 - 3) Include instrument/equipment calibration and configuration forms developed as specified in Section 406121.10 "Process Control System Testing".
 - d. As-Built Drawings:
 - 1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
 - 2) As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
3. The cover and edge of each volume shall contain the information as specified in Section 017823 "Operation and Maintenance Data".

1.8 MAINTENANCE MATERIAL SUBMITTAL

- A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refer to individual specification sections in Division 40 (Sections 406263 through 407513) for spare equipment requirements and provide one comprehensive spare parts submittal for project.
- B. All spare parts shall be packed in individual cartons and labeled with indelible markings clearly indicating component(s) inside. Complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable) shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the Owner or Engineer.

1.9 QUALITY ASSURANCE

- A. Fabricator Qualifications: PCSS shall hold a valid UL-508 certification for their panel fabrication facility.
- B. The PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
- C. The Process Control System Supplier (PCSS) shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:
 1. Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel shall hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel shall include, as a minimum, the lead field technician.
 2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.
 3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.
- D. The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.
- E. Listed suppliers will not be required to submit a qualifications proposal (see "Informational Submittals"). Contractors interested in listing an equal to the above listed suppliers shall submit PCSS' qualifications for review and approval as specified herein.

- F. The selected PCSS shall be one of the following:
 - 1. Curry Controls Company, Scott Cyphert, 863-646-5781
 - 2. Star Controls, Dana Muschemi, 561-305-6222
- G. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.11 FIELD CONDITIONS

- A. Environmental Requirements. Refer to Section 26 00 00 and Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Equipment shall be designed to operate at the project ground elevation.
- C. Temperature:
 - 1. Outdoor areas' equipment shall operate between -20 to 50 C degrees ambient.
 - 2. Equipment located in indoor locations shall operate between 10 to 35 C degrees ambient minimum.
 - 3. Storage temperatures shall range from 0 to 50 C degrees ambient minimum.
 - 4. Additional cooling or heating shall be furnished if required by the equipment as specified herein.
 - 5. Relative Humidity. Air-conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 5 to 100 percent relative, condensing humidity.
- D. None of the control system equipment located in the control room shall be shipped to the site until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.12 WARRANTY

- 1. Warranty Period: 1 year from date of Substantial Completion unless noted otherwise in individual specification sections.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Electrical Requirements for Control System:
 - 1. Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power

- supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
 3. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
 4. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.
 5. Switches and/or signals indicating an alarm, failure or upset condition shall be wired in a fail-safe manner as shown on the P&IDs. A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
 6. Materials and equipment shall be UL approved whenever such approved equipment and materials are available.
 7. All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.
 8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 "Isolators, Intrinsically Safe Barriers, and Surge Suppressors".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls and floors for suitable conditions where control panels and instrumentation will be installed.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

- A. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.
- B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.3 IDENTIFICATION

- A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling. Provide details as specified in the Project Plan.

3.4 STARTUP SERVICE

- A. Refer to Section 406121.10 “Process Control System Testing”.
- B. Refer to Section 406126 “Process Control System Training”.
- C. Weekly on-site coordination meetings with Engineer, Contractor, Vendors, and AESS as required during active construction period.

END OF SECTION 406100

SECTION 406121.10 - PROCESS CONTROL SYSTEM TESTING

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes process control system testing requirements.
- B. Related Requirements:
 - 1. Refer to Section 406100 "Process Control and Enterprise Management Systems and General Provisions."
 - 2. Refer to Section 017300 "Execution" for equipment testing and startup.
- C. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.
- D. A third party, referred to as Applications Engineering System Supplier (AESS), has been pre-selected to perform Applications Engineering. PCSS shall provide support services to the AESS as defined herein.
- E. AESS to program those PCSS provided PLCs, HMI's, and OITs shown on Drawings. Similar equipment provided by equipment vendors to be programmed by respective equipment vendor.
 - 1. AESS scope of work includes Programmable Logic Controller (PLC) programming, testing of PLC logic, Human Machine Interface (HMI) and Operator Interface Terminal (OIT) graphics development, HMI and OIT software configuration, database development, report development, and startup/training activities associated with the configured portions of the PLC/HMI/OIT system.
 - 2. HMI Software shall be the Owner's current version of Trihedral's VT SCADA and the PLC Programming Software shall be the Owner's current version of the Motorola System Tool Suite (STS), which is currently V20.70.
 - 3. Firmware in any new CPUs shall be flashed to V17.60 (minimum) by the AESS.
- F. Refer to Section 406100 for other general requirements.

1.3 ACTION SUBMITTALS

- A. Refer to Section 406100.
- B. Testing Submittals - Submit, in one submittal, the following testing related documents:
 - 1. Status signoff forms:

- a. Develop and submit project specific I/O Status signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
 - 1) Example forms are shown in the Appendices.
 - 2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
 - 3) Submit testing forms prior to start of testing.

2. Testing Procedures:

- a. Submit detailed procedures proposed to be followed for the PCSS portion of each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:
 - 1) Network and Communications Testing.
 - 2) I/O Testing.
 - 3) Control panel power, indicators, and hardwired logic tests.
- b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
- c. Test procedures indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
- d. Do not start testing until all Testing Submittals have been approved.
- e. AESS will write the software related test procedures.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

- A. Refer to Section 406100.

- B. Results of testing shall be tracked on a project specific status sign off form or similar document. The PCSS shall be responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.
- C. Tests the PCSS is required to perform are as follows:
 - 1. Field Testing:
 - a. Operational Readiness Test (ORT).
 - b. Site Acceptance Test (SAT).
- D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.
- E. PCSS shall coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.
- F. No equipment shall be shipped to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.
- G. Engineer reserves the right to test or re-test any functions.
- H. Correction of Deficiencies:
 - 1. Deficiencies in workmanship and/or items not meeting specified testing requirements shall be corrected to meet specification requirements at no additional cost to Owner.
 - 2. Testing, as specified herein, shall be repeated after correction of deficiencies is made until specified requirements are met. This work shall be performed at no additional cost to Owner.

3.2 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

- A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test will determine if the equipment is ready for operation.
- B. This test shall take place prior to startup. Prior to starting this test, relevant process equipment shall be installed and mechanically tested, instruments installed, control panels installed, and field wiring complete.
- C. Operational Readiness Testing, as well as Site Acceptance Testing, may need to be scheduled in phases per the Maintenance of Plant Operations (MOPO) plan. The PCSS shall coordinate the testing phases with the Contractor and the AESS.
- D. Required Documents for Test:
 - 1. Master copy of the PCSS developed field testing signoff forms.
 - 2. Testing procedures.

3. Calibration forms.
 - E. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check the testing process periodically. All deficiencies found shall be corrected by the PCSS prior to start-up.
 - F. PCSS shall maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.
 - G. Following steps shall be performed as part of the ORT:
 1. Instrument calibration, configuration, and set-up.
 2. PCSS hardware and I/O testing
 3. I/O Testing to the HMI and OITs with AESS.
 4. Testing of Automatic control strategies with AESS.
 - H. Instrument calibration, configuration, and set-up:
 1. Calibrate, configure, and set-up all components and instruments to perform the specified functions.
 2. Calibration form:
 - a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms shall provide a summary of the actual settings used in field to allow an Instrument technician to replace device entirely and configure it to function as it did before.
 - b. This information shall be added to Instrument data sheet, shall be added to a copy of manufacturer's standard "Configuration Sheet", or a separate form shall be created.
 - 1) If a separate form, the form shall list the Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.
 - c. Some examples of required information are:
 - 1) For Discrete Devices: Actual trip points and reset points.
 - 2) For Instruments: Any configuration or calibration settings entered into instrument
 - 3) For Controllers: Mode settings (PID).
 - 4) For I/O Modules: Dip switch settings, module configuration (if not documented in the native programming documentation).
 - d. Maintain a copy of these forms in field during testing and make them available for inspection at any time.
 - e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of O&M Manual as specified in Section 406100.

I. PCSS hardware and I/O testing:

1. Purpose of PCSS hardware and I/O signal testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. This test shall follow installation of the process control system components. This test shall be performed independent of the AESS as this test will determine if the system is ready for the AESS testing as defined below.
3. PCSS in conjunction with the Contractor and AESS shall test signals under process conditions. Preferred test method will always be to execute the test wherever possible to the end elements. For example, the preferred test will prove valve open/close limit switches by operating the valve, not by installing a jumper on the limit switch contacts. However, if equipment or process is not available to test signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
4. PCSS may load their own "dummy program" in PLC in order to facilitate their ORT requirements.
5. An I/O Signal test shall be performed by PCSS as part of ORT prior to AESS arriving on site to test the software:
 - a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within the loop such as PLC I/O register, pilot light, horn, beacon etc. as shown on P&IDs.
 - b. Discrete Output: Signals shall be tested by forcing the output on in the output register, then verify equipment responds accordingly.
 - c. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within the loop such as PLC I/O register, recorders, digital indicators, etc.
 - d. Analog Output: Signals shall be tested by entering values in the output register to force the output to zero percent, 50 percent, and 100 percent of full scale, then verifying equipment responds accordingly.
6. PCSS shall maintain Field Testing Spreadsheet at job site and make them available to Engineer/Owner at any time.
7. These inspections, calibrations, and tests do not require witnessing. However, Engineer will review and spot-check the PCSS test process periodically. All deficiencies found shall be corrected by PCSS prior to start-up.
8. Prior to AESS checkout of I/O to HMI, PCSS is required to submit a Field Testing Sign off spreadsheet with ORT sections completed to engineer for review along with any instrument calibration and configuration reports for PCSS supplied instruments in order to document the calibration and configuration procedures of instruments and checkout of I/O.

J. Input/Output (I/O) Testing to the HMI and OITs with AESS.

1. Purpose of the I/O testing to HMI and OITs with AESS is to check that the Instruments and field equipment are connected properly and work from the end device, through PLC, to HMI and OIT units.
2. PCSS in conjunction with the Contractor and AESS shall test signals under process conditions.

3. Following I/O tests shall be performed:
 - a. Discrete Input: At the device or instrument, change signal condition from the inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
 - b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
 - c. Discrete Output: Signals shall be tested by switching the equipment to manual control at HMI and OIT nodes and turning the output on or using other means to turn the output on. Then verify equipment responds accordingly.
 - d. Analog Output: Signals shall be tested by switching the equipment to manual control at HMI and OIT nodes and ramping the output up and down. Then verify equipment responds accordingly.

K. Testing of Automatic Control Strategies:

1. All automatic control strategies shall be verified using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document. This test shall be run by AESS. PCSS shall support AESS by simulating signals, jumping out switches, and any other related testing support as needed.

L. For all panels with enclosures modified by this contract, internal control panel temperature shall be tested under full running conditions to ensure proper cooling/ventilation is being provided.

M. After coordinating with Operations, a "Black Start" of the plant shall be performed to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Separate tests shall be performed by recovering the plant while on generator (if a generator is specified) and while on utility power.

N. Upon successful completion of ORT, PCSS shall submit a record copy of test results as specified in "informational Submittals"¹ and request scheduling of system startup.

3.3 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. A separate FDT is not required.

3.4 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After system is started-up and running treatment process in automatic control to extent possible, system shall undergo a test as defined in Section 017300 "Execution."

B. While this test is proceeding, Engineer and Owner shall have full use of system. Only plant operating personnel shall be allowed to operate equipment associated with live plant processes.

Plant operations shall remain responsibility of Owner and decision of plant operators regarding plant operations shall be final.

- C. During this test, PCSS personnel shall be present to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of equipment supplied as part of this system. When PCSS personnel are not on-site, PCSS shall provide cell phone/pager numbers that Owner personnel can use to ensure that support staff are available by phone and/or on-site within four hours of a request by operations staff.
- D. Any malfunction during test shall be analyzed and corrections made by PCSS. In event of rejection of any part or function, PCSS shall perform repairs or replacement within 5 days.
- E. Throughout duration of SAT, no software or hardware modifications shall be made to system without prior approval from Owner or Engineer.

END OF SECTION 406121.10

APPENDIX 40 61 21-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

4-Jun-14

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instru- ment Alarm Setpoint	Calibrate, config., and Wiring complete	Date	I/O Tested	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0						
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1						
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2						
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3						
PLC-SC	FI-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4						
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5						
PLC-SC	N/A	Spare Slot	N/A		Spare	2	5	N/A						
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0						
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1						
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2						
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3						
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4						
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5						
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0						
PLC-SC	YA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1						
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2						
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3						
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4						
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5						
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6						
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8						
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9						
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10						
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11						
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12						
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13						
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14						
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15						
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1						
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2						
PLC-SC	HSS-7000-2	Sludge Holding Tank Blower No. 2 Start Command	Start	17	DO	4	6	3						
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5						
PLC-SC	HSS-4105-1	Secondary Sludge Pump No. 2 Start/Stop	Start	15	DO	4	6	6						
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7						
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9						
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11						
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12						
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13						
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14						
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15						

This page intentionally left blank.

SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes process control system training requirements.
- B. Related Requirements:
- C. Furnish training as specified herein.
- D. This Section covers the training requirements for all devices and systems furnished and installed as detailed on the Drawings.
- E. Refer to Section 406100.

1.3 ACTION SUBMITTALS

- A. Preliminary Training Plan Submittal:
 - 1. Prior to the preparation of the Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.
- B. Final Training Plan Submittal:
 - 1. Upon receipt of the Engineer's comments on the preliminary training plan, submit the specific proposed training plan with the following:
 - a. Definitions, objectives, and target audience of each course.
 - b. Schedule of training courses including proposed dates, duration and locations of each class.
 - c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. The training and instruction shall be directly related to the system being supplied. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- B. Coordinate all training schedules with and at the convenience of the Owner, including shift training required to correspond to the Owner's working schedule.
- C. All onsite instructors must be intimately familiar with the operation and control of the Owner's facilities.
- D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. The manuals shall be provided in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.
- E. The trainer shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, all training materials shall be delivered to Owner.
- F. The Owner reserves the right to videotape all custom training sessions. All training tapes become the sole property of the Owner.
- G. Cost of Travel for off-site training:
 - 1. Cost of Travel for off-site training is paid directly by the entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

- A. Provide the following training courses listed in the summary table below:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Installed Control System	2	2	1	Maintenance, Administrator
PLC Hardware/Software	2	2	1	Maintenance
Instrument manufacturer training - analyzers	2	2	1	Maintenance
Instruments	2	2	1	Maintenance
Instruments - Operator familiarity	2	8	1	Operations

- B. Definitions of audience roles:
 - 1. Administrator - personnel responsible for maintaining the HMI / SCADA system.
 - 2. Maintenance - personnel responsible for maintaining the field controller hardware and instrumentation system.
 - 3. Operations - personnel responsible for daily plant operations.
 - 4. Management - non-daily operations personnel

3.3 ONSITE TRAINING

- A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.
- B. Installed Control System Training:
 - 1. Provide training for the Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. The training shall be held before the Functional Demonstrator Test (FDT), but not more than two months before.
 - 2. Provide training and instruction specific to the system that is being supplied.
 - 3. Provide training consisting of classroom instructions and hands-on instruction utilizing the Owner's system.
 - 4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:
 - a. System overview.
 - b. System hardware components and specific equipment arrangements.
 - c. Periodic maintenance.
 - d. Troubleshooting and diagnosis.
 - e. Network configuration, communications, and operation.
 - f. TCP/IP addressing procedures for all Ethernet devices.
- C. Programmable Logic Controller (PLC) Hardware and Software:
 - 1. Provide training for the Owner's personnel in the operation, maintenance, troubleshooting, etc. with the PLC hardware and software system. The training shall be held before the FDT, but not more than two months before.
 - 2. Provide training and instruction specific to the system that is being supplied.
 - 3. Provide training consisting of classroom instructions and hands-on instruction utilizing the Owner's system. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the PLC system that will allow the Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the PLC system. Provide training covering the following subjects:
 - a. PLC system overview.
 - b. PLC system architecture.
 - c. PLC system hardware components and specific equipment arrangements.

- d. PLC system startup, shut down, load, backup, and PLC failure recovery.
 - e. Periodic maintenance.
 - f. Troubleshooting and diagnosis down to the I/O card level.
 - g. PLC configuration, communications, and operation.
- D. Instrument Manufacturer Training:
1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. The manufacturer's representative is required to be fully knowledgeable in the operation and maintenance of the equipment.
- E. Instrument Training:
1. Provide instruction on the maintenance of the field and panel instrumentation for the Owner's instrumentation technicians. Conduct this training before the FDT, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. Training program is required to include the following elements:
 - a. Training in standard hardware maintenance for the instruments provided.
 - b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
 - c. Testing, adjustment, and calibration procedures.
 - d. Troubleshooting and diagnosis.
 - e. Maintenance and frequency.
- F. Instruments - Operator familiarity:
1. Provide operator level instruction on the use of the field and panel instrumentation for the Owner's operations staff. Conduct training before the 30-day site acceptance test, but no more than 1 month before and at a time suitable to the Owner. This training shall take place at the Owner's facility. Include hands on demonstration of the information each transmitter indicates, and the method used to retrieve any operator information from the transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

END OF SECTION 406126

SECTION 406263 - OPERATOR INTERFACE TERMINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- 1. Section includes operator interface terminals, including any existing terminals that are being replaced under this contract.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.

1.3 DEFINITIONS

- A. OIT – Operator Interface Terminal
- B. ICP – Instrumentation Control Panel
- C. PLC – Programmable Logic Controller

1.4 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions” for preinstallation meetings

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.
- B. Shop Drawings:
 - 1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.6 INFORMATIONAL SUBMITTALS

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.7 CLOSEOUT SUBMITTALS

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.10 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Not applicable to this Section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.12 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.13 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 OPERATOR INTERFACE TERMINAL (OIT)

- A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Maple Systems HMI5121XL.
 - b. Substitutions: Or equal.

- B. General
 1. OITs are standalone devices with an integrated hardware / software platform to monitor / control a process through an interactive display.

- C. Features
 1. Software
 - a. OITs shall be pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
 - b. Integrated OIT software shall have the following features:
 - 1) Trending
 - 2) Data logging
 - 3) Alarms
 - 4) Graphic symbols
 - 5) Animations
 2. Hardware
 - a. Minimum 1.0 GHz CPU
 - b. Make all necessary modifications for a professional installation including increasing the size of the cutout (if the existing cutout is too small).

- D. Communications
 1. Ports
 - a. Minimum one 10/100MB Ethernet
 - b. Minimum one USB
 - c. Minimum one serial RS-232
 2. Protocols
 - a. EtherNet/IP
 - b. Modbus TCP/IP

- E. Display:
 1. Minimum of 12.1" viewable as measured diagonally across screen
 2. Minimum display resolution
 - a. 1024 x 768 for 12" to 15" displays
 3. Color Active Matrix TFT.
 4. Display shall support touch screen input.

- F. Environmental:

1. Rating: OIT shall be rated to maintain the rating of the control panel it will be mounted on and meet the area classification.
2. Temperature: Operating temperature range of the OIT shall range 0 - 50 °C.
3. Relative Humidity: 10% - 90% (non-condensing).

G. Other Requirements:

1. Application: For replacement OITs, the existing application shall be capable of being downloaded to the new OIT or it shall be capable of being converted for use in the new OIT.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms> for suitable conditions where OITs will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

- A. Refer to Section 260600 "Grounding System".

3.4 IDENTIFICATION

- A. Refer to drawings and control system architecture for tagging designations

3.5 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports in accordance with the following:
 1. Section 406100 "Process Control and Enterprise Management General Provisions".
 2. Section 406121 "Process Control System Testing".

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 SOFTWARE SERVICE AGREEMENT

A. Not Required

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406263

This page intentionally left blank.

SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes programmable logic controller hardware.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.

1.3 DEFINITIONS

- A. AO – Analog Output
- B. AI – Analog Input
- C. DI - Digital Input
- D. DO - Digital Output
- E. I/O – Input/Output
- F. PLC - Programmable Logic Controller

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.
- B. Shop Drawings:
 - 1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.5 INFORMATIONAL SUBMITTALS

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.6 CLOSEOUT SUBMITTALS

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.8 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Not applicable to this Section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.11 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Configuration: Networked programmable controller for controlling the water treatment and distribution system.
- B. Spare I/O, Slots and Future Expansion:
 1. Spare PLC I/O:

- a. Provide 20 percent points per type AI, DI, and DO for future use, regardless of whether any of those point types are used in that panel or not.
 - b. Provide spare I/O points of same type of I/O modules supplied.
2. Spare PLC Slots (Chassis-Based PLC Systems): Provide at least 2 spare slots for addition of future I/O in each chassis provided.
 3. Provide external relay for spare output points that require their use.
 4. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

2.2 CHASSIS BASED PLC SYSTEM

A. Manufacturers:

1. Provide all PLC equipment from a single manufacturer. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third-party vendors will be acceptable.
2. Manufacturers and their products are subject to compliance with requirements. Provide the following:
 - a. Motorola ACE3600 PLC Hardware

B. General:

1. Provide Programmable Logic Controller equipment with the required memory and functional capacity to perform the specified sequence of operation with the scheduled input and output points.
2. Provide processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
3. Provide products listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
4. Provide products designed for continuous industrial service.
5. Provide products of a single manufacturer, insofar as possible
6. Provide equipment models that are currently in production.
7. Provide only equipment designed and constructed so that in the event of power interruption the systems go through an orderly shutdown with no loss of memory and resume normal operation without manual intervention when power is restored.
8. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings and specified herein.
9. Provide products such that communication protocols shall be transparent from any HMIs or OITs.
10. Provide a PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.
11. Provide I/O modules, interface modules, communication modules, and power supply to meet system I/O requirements.
12. Provide a PLC system that meets the following agency and environmental specifications:
 - a. Electrical supply voltage to the PLC:120VAC, \pm 15 percent, 48 - 63Hz. PLC system power supplies shall be fused for overload protection.

- b. Vibration: 3.5 mm Peak-to-Peak, 5 - 9 Hz: 1.0G, 9 - 150Hz. The method of testing is to be based upon IEC 68-2-6 and JIS C 0911 standards for vibration. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500Hz. in accordance with at least one of the following:
 - 1) Installed rating: DIN rail mounted PLC: 10 - 57 Hz, amplitude 0.075 mm, acceleration 25-100 Hz.
 - 2) Panel or plate mounted PLC: 2 - 25 Hz, amplitude 1.6mm, acceleration 25 - 200 Hz.
 - 3) In compliance with IEC 60068 and IEC 61131.
 - c. Shock: 15G, 11 msec. Method of testing is to be based upon IEC 68-2-27 and JIS C 0912 standards for shock. The system is to be operational during and after testing.
 - d. Temperature: All PLC hardware shall operate at an ambient temperature of 0° to 60° C (32° to 140° F), with an storage ambient temperature rating of -25° to 70° C (-40° to 185° F).
 - e. Relative Humidity: Programmable Controller hardware shall function continuously in the relative humidity range of 10 percent to 95 percent non-condensing.
 - f. Noise Immunity: Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
 - g. Altitude:
 - 1) Operation: 0 - 6,500 feet.
 - 2) Storage: 0 - 9,800 feet.
 - h. Degree of protection: NEMA 1 (IP20).
 - i. All products shall have corrosion protection.
- C. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:
- 1. Module product type such as analog or digital.
 - 2. Module catalog number.
 - 3. Module major revision number.
 - 4. Module minor revision number.
 - 5. Module manufacturer vendor.
 - 6. Module serial number.
- D. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.
- E. PLC CPU:
- 1. CPU shall be, at a minimum, a 16-bit microprocessor that provides system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a

single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.

2. CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU shall process the I/O with user program(s) stored in memory, then control the outputs based on the results of the logic operation.
3. Supply the CPU with a battery-backed time of day clock and calendar.
4. CPU family shall allow for user program transportability from one CPU model to another.
5. CPU shall be Motorola ACE3600 CPU 3680 Model V448 with Option Model VA00360AA Security Enable.

F. Diagnostics:

1. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum: Memory failure, memory battery low, and general fault, communications port failure, scan time over run, I/O failure, and analog or special function I/O module failure.
2. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
3. PLC shall have indicators and on-board status area to indicate the following conditions:
 - a. CPU run.
 - b. CPU error or fault.
 - c. I/O failure or configuration fault.
 - d. Status of Battery or back-up power module.
 - e. Communications indicator.

G. Memory:

1. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
2. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.
 - a. Backup Storage: Provide backup battery or capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
3. Operating system shall be contained in non-volatile firmware. The memory containing the operating system shall be field updateable via a separate update tool.

H. Communication Ports:

1. Provide expandable CPU supplied with additional modules to support the required communication interfaces.
2. Provide Motorola ACE3600 Option Model V212 for Ethernet 10/100 Mbps Plug-In Port.

I. Power Supplies:

1. Power Input: 100 to 240VAC, 47 - 63Hz.
 - a. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
2. Provide chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.
3. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
4. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
5. Size power supplies to accommodate the nominal load plus 30%.
6. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
7. Automatically shut down the Programmable Controller system whenever its output power is detected as exceeding 125% of its rated power.
8. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.
9. Provide battery backup for the power supply with a minimum of 10Ah Battery.
10. Power Supply shall be Motorola ACE3600 Model V251 with Option Model V328 for Battery Backup.

J. Chassis:

1. Provide chassis-based PLC system.
2. Distribute all system and signal power to the CPU and support modules on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers shall be acceptable.
3. Provide free air cooling for all system modules, main and expansion chassis. No internal fans or other means of cooling except heat sinks shall be permitted.
4. Provide means to remove all system modules from the chassis or inserted in to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
5. Modules shall be designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Perform an electronic keying check to ensure that the physical module is consistent with what was configured.
6. Chassis shall be Motorola ACE3600 3 I/O Slot Frame Model V103.

K. Discrete Input & Output Modules:

1. General:
 - a. Provide digital input and output modules to provide ON/OFF detection and actuation capability.
 - b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as noted below.
 - c. Provide modules capable of being installed or removed while chassis power is applied.

d. Provide the following status indicators.

- 1) On/Off state of the field device.
- 2) Module's communication status.
- 3) Module health

L. Analog Input & Output Modules:

1. General:

- a. Provide analog input modules to convert an analog signal that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal shall be transmitted on the backplane. Provide analog output modules to convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
- b. Provide modules designed to be installed or removed while chassis power is applied.
- c. Provide indicators to display the status of communication, module health and input / output devices.
- d. Provide both hardware and software indication when a module fault has occurred. Each module shall have an LED fault indicator and the programming software shall display the fault information.
- e. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.
- f. Following status shall be capable of being examined in ladder logic:
 - 1) Module Fault Word: Provides fault summary reporting.
 - 2) Channel Fault Word: Provides under-range, over-range and communications fault reporting.
 - 3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.
- g. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.
- h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 406717 for all signals that enter the panel from outside the building. Substitution of isolated analog input cards to meet this requirement is acceptable.

M. Module Specifications – Mixed I/O Module

1. Discrete Inputs:

- a. Maximum Input Voltage: 40VDC
- b. Nominal Input Voltage: 24VDC
- c. On-State Voltage: 9 to 30VDC
- d. Off-State Voltage: -3 to +3VDC

- e. On-State Current: 3.5mA @30V DC, maximum.
 - f. Number of Points per Card: 16.
 - 2. Relay Outputs:
 - a. Output Voltage Range: 30 VAC (42.4VAC Maximum), 60 VDC (Maximum).
 - b. Output Current Rating:
 - 1) Per Point: 2.0A maximum @ 30 VDC, 0.6A maximum @ 30 VAC.
 - 2) Per Module: 8A maximum.
 - c. Output Arrangement: Form C (SPDT)
 - d. Relay Contact Position: monitored via hardware back indication and capable of being mapped to data registers in the I/O configuration.
 - e. Output Isolation:
 - 1) Between open contacts: 1 kV
 - 2) Between contact and coil: 1.5 kV
 - 3) Between contact sets: 1.5 kV
 - f. Configurable States:
 - 1) Fault per Point: Hold Last State, ON or OFF.
 - 2) Program Mode per Point: Hold Last State, ON or OFF.
 - g. Number of Points per Card: 4.
 - 3. Analog Inputs:
 - a. Input Range: 0-20 mA.
 - b. Resolution: approximately 16 bits across range.
 - c. Input Impedance: Greater than 249 Ohms.
 - d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
 - e. Normal Mode Rejection: 60 dB at 60 Hz, 50 dB at 50 Hz.
 - f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
 - g. Isolation Voltage:
 - 1) Channel to Module - 1500 V RMS, per IEC60255-5.
 - h. Number of Points per Card: 4.
 - 4. Mixed I/O Module shall be Motorola ACE3600 16DI, 4 DO EE, 4AI ±20mA Model V245 with 24V Floating Power Supply Option Model FPN1653A.
- N. Communications Interfaces:
- 1. Supported protocols:
 - a. Motorola Data Link Communications (MDLC)
 - b. Modbus TCP/IP.

2. Ports:

- a. 10/100MB Ethernet.
- b. USB.
- c. RS-232 Serial.

3. Utilizing in-chassis communication modules or built-in ports on the PLC is acceptable to meet communication interface requirements.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Testing: Test programmable controller according to NEMA IA 2.2.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms for suitable conditions where PLCs will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 SOFTWARE SERVICE AGREEMENT

- A. Not Required

END OF SECTION 406343

This page intentionally left blank.

SECTION 406643 - WIRELESS NETWORK EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- 1. Section includes wireless network equipment.

- B. Related Requirements:

- 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions for submittal requirements".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions".

- B. Shop Drawings:

- 1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

1.4 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Not applicable to this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

1.6 FIELD CONDITIONS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

1.7 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 WIRELESS I/O SYSTEM

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
 - a. Phoenix Contact Wireless I/O Radioline Series.
 - b. Or equal

B. General:

1. Provide a wireless I/O solution to connect the well flow meter signals to RTU300 for remote monitoring of the flow data. Include all supplemental equipment to facilitate this communication including, but not limited to, weatherproof NEMA 4X control panels (or water resistant battery packs if applicable), wireless transceivers/radios at the flow sensor, wireless transceiver/radio/gateway at RTU300, antennas, power connections, surge protection and other miscellaneous electrical apparatus.
2. Wireless I/O solution shall provide 4-20 mA outputs at RTU300 for connection to the Motorola ACE3600 RTU I/O modules.

C. Physical Features:

1. Power: 24 VDC.
2. Antenna Connection: RSMA (Female).
3. Frequency: 900MHz, Unlicensed, Spread Spectrum.
4. Data Transmission Rate: adjustable between 16kbps and 500 kbps.
5. Receiver Sensitivity: -112dBm @ 16kbps transmission rate.
6. Transmit Power: 1W maximum (adjustable).
7. Operating Temperature: -40 to +70 degrees C.
8. Operating Humidity: 20% to 85%, non-condensing.

D. Additional Features:

1. RSSI Output: Voltage output 0-3 VDC, measurable from terminals on the radio module, and displayed via bar graph as follows:
 - a. No Connection – 0 VDC, all four LED bar graph segments OFF
 - b. LINK Confirmed – 1.0 to 1.5 VDC, Yellow LED bar graph ON
 - c. Good Signal – 1.5 to 2.0 VDC, Yellow LED and 1st Green LED ON; approx. -95dBm @ 16kbps
 - d. Very Good Signal – 2.0 to 2.5 VDC, Yellow LED and 1st two Green LEDs ON; approx. -85 dBm @ 16kbps
 - e. Maximum Signal – 2.5 to 3.0 VDC, Yellow LED and all three Green LEDs ON; approx. -75 dBm @ 16kbps

2. Diagnostic LEDs
 - a. PWR LED (Green) – indication of proper supply voltage
 - b. DAT LED (Green) – indication of bus communication status
 - c. ERR LED (Red) – indication of error in mode configuration or local bus error
 - d. TX LED (Green) – transmit data
 - e. RX LED (Green) – receive data
3. RF Link Relay – Form C Relay, energized when RF Link is established

E. Antennas:

1. Type: Omni-Directional
2. Gain: 2.15dBi, nominal; antenna gain shall be selected based on the dB gain required to produce a functional wireless I/O system with a minimum 20dB fade margin; transmission rate and radio output power may need to be adjusted to limit the effective isotropic radiated power (EIRP) to 36 dBm.
3. Connection: N (Female)
4. Cable: 10 feet, minimum; cable length to be determined by the PCSS by performing a physical site study.
5. Mounting: Wall-mount; mount to aluminum post of the panel mounting structure to be installed for the Wireless I/O RTU Enclosure; provide manufacturer's wall-mount bracket for use in installing the antenna.
6. External antenna is to be mounted outdoors and rated for such service.
7. Antenna Model: RAD-ANT-OMNI-2-N (P/N: 2904802)

F. Accessories:

1. Provide I/O Extension Modules from the following list, as required, to interface between the field I/O and the wireless I/O master panel:
 - a. Radio: RAD-900-IFS (P/N: 2901540)
 - b. I/O Extension Module: RAD-DAIO6-IFS (P/N: 2901533) – 2DI/2DO/1AI/1AO
 - c. I/O Extension Module: RAD-DI4-IFS (P/N: 2901535) – 4DI
 - d. I/O Extension Module: RAD-DOR4-IFS (P/N: 2901536) – 4DO Relay Outputs
 - e. I/O Extension Module: RAD-AI4-IFS (P/N: 2901537) – 4AI
 - f. I/O Extension Module: RAD-AO4-IFS (P/N: 2901538) – 4AO
2. Provide pre-engineered wireless I/O RTU enclosure RAD-SYS-NEMA4X-900 (P/N: 2917188) with the following components:
 - a. Power Supply: 24 VDC, 2A Output
 - b. DC-UPS
 - c. UPS Battery: 0.8AH Battery Backup for DC-UPS
 - d. Surge Protection: 10kA discharge surge current, max. (8/20 μ s impulse waveform)
 - e. Provide the wireless I/O RTU enclosure for each of the locations listed:
 - 1) Well Pump No. 1 Flow Meter
 - 2) Well Pump No. 2 Flow Meter

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms for suitable conditions where equipment will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406643

SECTION 406717 – INDUSTRIAL ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for the following control panels:
 - 1. Raw Water pH Control Panel (AIT/AE-300A and AIT/AE-300B).
 - 2. ICP100 (containing RTU100).
- B. Related Requirements:
 - 1. Section 406733 “Panel Wiring”.
 - 2. Section 407853 “Relays”.
 - 3. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors”.
 - 4. Section 407859 “Power Supplies”.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

PART 2 - PRODUCTS

2.1 INDUSTRIAL ENCLOSURES

- A. Manufacturers
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Schaefer Electrical Enclosures.
 - b. Substitutions: Or equal.
- B. Freestanding and Floor-Mounted Vertical Panels:
 - 1. Furnish freestanding and floor-mounted vertical panels that meet the NEMA classification as shown on the drawings or specified herein. Construct panels of 12 gauge

sheet steel, suitably braced internally for structural rigidity and strength. Construct all NEMA 4X rated panels of Type 316 stainless steel, unless FRP is specifically indicated to be provided. For front panels or panels containing instruments, provide not less than 10 gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

C. Wall and Unistrut Mounted Panels:

1. Furnish wall- and Unistrut- mounted panels that meet the NEMA classification as shown on the Drawings or specified herein. Construct panels of not less than USS 14 gauge steel, suitably braced internally for structural rigidity and strength. Construct NEMA 4X rated wall mounted panels of Type 316 stainless steel, unless FRP is specifically indicated. For chlorine areas, use FRP panels. Provide a protective coating and sun shield to prevent discoloration and cracking for FRP panels located in direct sunlight.

2.2 ACCESSORIES

A. Environmental Controls:

1. Provide sun shields, heat sinks, and / or air conditioning units as required to prevent temperature buildup inside of panel. Regulate internal temperature of all panels to a range of 45 Deg F to 104 Deg F under all conditions. Do not compromise the NEMA rating of the panel under any circumstances.
2. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, an air conditioner shall be provided.
3. Provide custom fabricated sun shields for all outdoor panels, unless otherwise stated on the Drawings, in accordance with the following requirements:
 - a. Fabricate sun shields from minimum 12 gauge Type 316 stainless steel. Design, fabricate, install, and support shields to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.
 - b. Depending on overall size, fabricate sun shields in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.
 - c. Do not attach sun shields directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces. Design and mount shields to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
 - d. Slope the top section of all sun shields at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, slope the top section downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures, slope the top section downward towards the back side of the enclosure.
 - e. Incorporate a narrow and more steeply sloped drip shield segment at the front edge of the top section of all sun shields that sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
 - f. Use continuous seam welds in sun shield fabrication and grind smooth.
 - g. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

4. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture to reduce condensation and maintain the minimum internal panel temperature. Mount unit near bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be Hoffman DAH 200 Watts (Minimum), 120 Volt, 50/60 HZ or equal. PCSS shall perform calculations to determine the heater wattage required based on the control panel in which it is mounted.

B. Nameplates:

1. Equip panels and panel devices with suitable nameplates to identify the panel and individual devices as required. Unless otherwise indicated, include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Recirculation Pump No. 1), and the third line containing a functional control description (e.g., Start).
2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, furnish nameplates as 3/32-inch thick, black and white, Lamicoid with engraved inscriptions. Use black against a white background unless otherwise noted. Bevel and smooth edges of the. Nameplates with chipped or rough edges are not acceptable.
3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless steel screws.
4. For every panel, provide a panel nameplate with a minimum of 1-in high letters. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights, and meters.
5. Use single lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

C. Corrosion Control:

1. Protect panels from internal corrosion by the use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.
2. Manufacturer:
 - a. Zerust VC.
 - b. Hoffman Model AHCI.
 - c. Or equal.

2.3 GENERAL FINISH REQUIREMENTS

- A. Descale, degrease, fill, grind and finish sections. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.
- B. Grind smooth, sandblast and then clean with a solvent. Fill surface voids and grind smooth.
- C. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. Apply final sanding to the intermediate exterior coat before top coating.

- D. Apply a minimum of two coats of manufacturer’s standard, flat light-colored lacquer, on the panel interior after priming.
- E. Unless otherwise noted, finish exterior colors as ANSI 61 gray with a textured finish.
- F. Finish products after assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

3.3 SCHEDULE

Panel Name	Size	NEMA Rating	Construction	Type	Additional Requirements
Raw Water pH Control Panel	36”Hx24”Wx12”D (Minimum)	NEMA4X	304SS	Wall-Mount	Painted White
ICP100 (RTU100)	36”Hx30”Wx12”D (Minimum)	NEMA12	Aluminum	Wall-Mount	

END OF SECTION 406717

SECTION 406733 - PANEL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for internal wiring of control panels and consoles.
- B. Related Requirements:
 - 1. Section 406717 for Industrial Enclosures.
 - 2. Section 407853 for Relays.

1.3 ACTION SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring:
 - 1. Provide stranded, type MTW interconnecting wiring with 600 volt insulation rated for not less than 90 degrees Celsius. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Develop panel layout such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
 - 2. For power distribution wiring on the line side of fuses or breakers, use 12 AWG minimum. For control wiring on the secondary side of fuses, use 16 AWG minimum. Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits. For all terminations at the Motorola I/O modules, use 18 AWG wiring.
 - 3. Cover power distribution blocks with protective guards to meet "finger-safe" requirements of IP20.
 - 4. Route power and low voltage DC wiring systems in separate wireways. Cross different system wires at right angles. Separate different system wires routed parallel to each other

- by at least 6-inches. Terminate different wiring systems on separate terminal blocks. Do not fill wiring troughs to more than 60 percent visible fill.
5. Terminations:
 - a. Terminate wiring onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components is not acceptable.
 - 1) Multi-level terminal blocks or strips are not acceptable.
 - b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal). Provide each group of terminal blocks with a minimum of 25 percent spares.
 - c. Use compression type, fused, unfused, or switched terminal blocks. Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments. Wire all active and spare PLC and controller points to terminal blocks.
 - d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Ground the shielded signal cable at the PLC cabinet. Wire all active and spare PLC and controller points to terminal blocks.
 - e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
 - f. Use only one side of a terminal block row for internal wiring. Field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
 - g. Isolate circuit power from the SCADA cabinet out to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Use an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
 - h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator. Use an Allen Bradley 1492-H4 or equal.
 6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
 7. Wiring shall be clearly tagged and color coded. Tag numbers and color coding shall correspond to panel wiring diagrams and loop drawings prepared by the PCSS. Power wiring, control wiring, grounding, and DC wiring shall utilize different color insulation for each wiring system used. Color coding scheme shall be in accordance with UL 508a. For I/O signal wiring, the following color scheme shall be utilized:
 - a. Discrete Input Wiring – Blue (24VDC to I/O Module); utilize interposing relays, if needed, for 120VAC field wiring
 - b. Discrete Output Wiring – Red or Pink
 - c. Analog Input / Analog Output Wiring – Red (+), Black (-) or White/Clear (+), Black (-); Black shall be used for the negative on all analog signal wiring

8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 – Isolators, Intrinsic Safety Barriers, and Surge Suppressors.
 9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication. Instruments requiring 120VAC power shall be powered as shown on the drawings.
 10. Wiring trough for supporting internal wiring shall be plastic type with snap-on covers. Side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives.
 11. Each panel shall have a single tube, LED light fixture, 20 Watt in size (minimum), mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
 12. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.
 13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
 14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
 15. Each panel shall have control, signal, and communication line surge suppression in accordance with Section 407856.
 16. Each panel shall be provided with a circuit breaker to interrupt incoming power.
 17. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. shall be in compliance with the requirements of Division 26.
- B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings shall be provided under this Section.
- C. Orientation of devices including PLC and I/O when installed shall be per the manufacturer's recommendations. No vertical orientation of PLC racks shall be allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

END OF SECTION 406733

SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

1.2 SUMMARY

- A. Section includes the general requirements for furnishing, installing, and servicing PCSS provided instruments.
- B. Related Requirements:
 - 1. Refer to individual instrument specifications.

1.3 DEFINITIONS

- A. PCSS – Process Control System Supplier as defined in Section 406100 "Process Control and Enterprise Management System General Provisions".

1.4 ACTION SUBMITTALS

- A. Submit complete documentation of all field instruments using ISA-TR20.00.01-2001 (updated in 2004-2006) data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment. The list shall be sorted by Loop Number.
- B. Submit separate data sheets for each instrument type including:
 - 1. Plant Equipment Number and ISA tag number per the Drawings.
 - 2. Product (item) name used herein and on the Drawings.
 - 3. Manufacturer's complete model number.
 - 4. Location of the device.
 - 5. Input - output characteristics.
 - 6. Range, size, and graduations in engineering units.
 - 7. Include construction details, material descriptions, dimensions of individual components and profiles.
 - 8. Instrument or control device sizing calculations where applicable.
 - 9. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.

10. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories Two-wire or four-wire device type as applicable.
11. Indicate which instruments will be provided with manufacturer's maintenance services if specified.

C. Instrument Vendor Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Detail fabrication and assembly of instrument.
 4. Include diagrams for power, signal, and control wiring.
- D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.
- E. Submit index and data sheets <in electronic format as well> <as hard copies> on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on DVD disk or USB thumb drive.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for any PCSS requirements regarding closeout submittals for instruments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Refer to individual instrument specifications for spare parts requirements.
- B. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for PCSS requirements regarding submission of maintenance materials

1.8 QUALITY ASSURANCE

- A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.
- B. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for overall quality assurance requirements for PCSS scope of work.

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

- A. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section and related sections. Equipment shall be tagged before shipping to the site.
- B. Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.
- C. All supplied instrument transmitters and instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1inch H x 3"W. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

PART 3 - EXECUTION

3.1 GENERAL

- A. See execution requirements in Section 406100 – Process Control and Enterprise Management Systems General Provisions.
- B. Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

3.2 INSTALLATION

- A. See installation requirements in individual specification sections.

3.3 INSTRUMENT SCHEDULE

Pressure and Differential Pressure Type Level Meters - Section 407243				
Tag Number	Service Description	Setpoint / Span	Dwg. #	Additional Requirements
LIT/LE-340	Clearwell Complex No. 2 Transfer Pump Wetwell Level	0-5 PSI (0.00-11.55 Feet)	I-5	Provide optional surge protection and lifetime warranty.
Level Switches - Section 407276				
Tag Number	Service Description	Setpoint / Span	Dwg. #	Additional Requirements
LSH-340	Clearwell Complex No. 2 Transfer Pump Wetwell High Level Float	Elev. 33.25	I-5	
LSL-340	Clearwell Complex No. 2 Transfer Pump Wetwell Low Level Float	Elev. 31.50	I-5	
Pressure and Differential Pressure Gauges – Section 407313				
Tag Number	Service Description	Setpoint / Span	Dwg. #	Additional Requirements
PI-220	High Service Pump No. 2 Discharge Pressure	0-100 PSI	I-3	Graduation Units: 1 PSI
PI-230	High Service Pump No. 3 Discharge Pressure	0-100 PSI	I-3	Graduation Units: 1 PSI
PI-240	High Service Pump No. 4 Discharge Pressure	0-100 PSI	I-3	Graduation Units: 1 PSI
PI-331	Transfer Pump No. 1 Discharge Pressure	0-100 PSI	I-4	Graduation Units: 1 PSI
PI-332	Transfer Pump No. 2 Discharge Pressure	0-100 PSI	I-4	Graduation Units: 1 PSI
PI-333	Transfer Pump No. 3 Discharge Pressure	0-100 PSI	I-5	Graduation Units: 1 PSI
PI-334	Transfer Pump No. 4 Discharge Pressure	0-100 PSI	I-5	Graduation Units: 1 PSI
PI-335	Transfer Pump No. 5 Discharge Pressure	0-100 PSI	I-5	Graduation Units: 1 PSI

Single Parameter Analyzer Transmitter - Section 407506				
Tag Number	Service Description	Setpoint / Span	Dwg. #	Additional Requirements
AIT-300A	Raw Water pH Transmitter No. 1	2-12 pH	I-4	Connect to sensor AE-300A.
AIT-300B	Raw Water pH Transmitter No. 2	2-12 pH	I-4	Connect to sensor AE-300B.
pH/ORP Analyzers – Section 407513				
Tag Number	Service Description	Setpoint / Span	Dwg. #	Additional Requirements
AE-300A	Raw Water pH Sensor No. 1	2-12 pH	I-4	Provide flow-through sample cell for the sensor.
AE-300B	Raw Water pH Sensor No. 2	2-12 pH	I-4	Provide flow-through sample cell for the sensor.

END OF SECTION 407000

This page intentionally left blank.

SECTION 407243 - PRESSURE AND DIFFERENTIAL PRESSURE TYPE LEVEL METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pressure and differential pressure type level meters.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
 - 2. Section 407000 “Instrumentation for Process Systems”.

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.
- B. Shop Drawings:
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.8 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.9 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 HYDROSTATIC-SUBMERSIBLE LEVEL MEASUREMENT DEVICES

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
 - a. Blue Ribbon - BC001 model.
 - b. Or equal.
- B. Type:
 - 1. Submersible, hydrostatic pressure type level transmitter.
- C. Function/Performance:
 - 1. Range: Manufacturer's standard range closest to the span to be measured.
 - 2. Temperature Compensation: Temperature compensated over a range of -18 to +60 °C.
 - 3. Accuracy: Plus or minus 0.5 percent of range.
 - 4. Over Pressure: Protected for over pressure of 2.0 times the span.
 - 5. Output: 4-20 mA proportional to the calibrated span.
- D. Physical:
 - 1. Provide an assembly with a Type 316 stainless steel or titanium body with a bottom diaphragm. Provide a bird cage clog resistant sensing diaphragm to protect the instrument.

2. Provide sensor with integral cable. Provide a vent tube as part of the cable for the transducer. Provide aneroid bellows for connection to the vent tube to prevent moisture from affecting the atmospheric pressure reference.
3. Provide a tension-relieving mounting clamp from a 4 inch flange. Provide Type 316 stainless steel material for both clamp and flange.
4. Sensor: Submersible (IP68), and CSA approved or CENELEC certified intrinsically safe when intrinsically safe barriers are provided for the instrument loop.
5. 24 VDC loop powered.

E. Accessories Required:

1. Sufficient manufacturer's cable for installation between the sensor/transmitter and the local indicator or control panel as indicated on the Drawings. Provide reinforced cable to support the weight of the transducer and cable.
2. Cable clamp for suspending instrument provided by instrument supplier.
3. All fittings required for pressure calibration of the instrument.
4. Provide optional BCP3000 surge protection package with lifetime surge warranty replacement.

2.2 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and tanks for suitable conditions where instrumentation will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

3.4 IDENTIFICATION

- A. Refer to drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. The factory-authorized service representative or manufacturer shall work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

- A. Not Required

END OF SECTION 407243

SECTION 407276 - LEVEL SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes level switches.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
 - 2. Section 407100 “Instrumentation for Process Systems”.

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.
- B. Shop Drawings:
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions for any PCSS requirements regarding informational submittals for instruments”.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.8 QUALITY ASSURANCE

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.11 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 FLOAT SWITCHES

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Contegra FS 90.
 - b. Siemens Water Technologies Model 9G-EF.
 - c. Or equal
- B. Type:
 - 1. Mercury free ball float switch.
- C. Function/Performance:
 - 1. Differential: Less than 8 inch.
 - 2. Type of Switch: SPDT snap switch
 - 3. Switch Rating: 1 amps at 120 VAC or 100 VA @ 120 VAC.
- D. Physical:
 - 1. Float: Type 316 stainless steel, Teflon or non-stick coating, minimum 5 in diameter.
 - 2. Totally encapsulated switch.

3. Cable shall be heavy-duty, PVC or equivalent jacketed integral to float.

E. Options/Accessories Required:

1. Provide stainless steel hardware.
2. Lead wire shall be a waterproof cable of sufficient length so that no splice or junction box is required in the vault.
3. Provide cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections.
4. Provide mounting equipment as shown on the drawings.

PART 1 - EXECUTION

1.1 EXAMINATION

- A. Examine walls, floors, roofs, and tank for suitable conditions where instrumentation will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

1.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

1.3 IDENTIFICATION

- A. Refer to drawings for tagging designations

1.4 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports.

1.5 STARTUP SERVICE

- A. Perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.

2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. The factory-authorized service representative or manufacturer shall work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

1.6 MAINTENANCE SERVICE

- A. Not Required

1.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION 407276

SECTION 407313 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pressure and differential pressure gauges.
- B. Related Requirements:
 - 1. Section 406100 – Process Control and Enterprise Management Systems General Provisions.
 - 2. Section 407000 – Instrumentation for Process Systems.

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 – Instrumentation for Process Systems.
- B. Shop Drawings:
 - 1. Refer to Section 407000 – Instrumentation for Process Systems.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 - Process Control and Enterprise Management Systems General Provisions for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.11 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Ametek US Gauge.
 - b. Ashcroft.
 - c. Weksler.
 - d. Substitutions: Or equal.
- B. Type: Differential or Gauge - Bourdon tube actuated dial face pressure gauge.
- C. Dials:
 - 1. Nominal Diameter: 4-1/2 inches. Minimum 4 inches.
 - 2. Face: White, laminated plastic dials with black graduations.
 - 3. Scale: Extend over arc not less than 200 and not more than 270 degrees.
 - 4. Ranges and Graduation Units: As indicated on Instrument Schedule in Section 407000.

D. Cases:

1. Liquid filled.
2. Material: Phenolic or Type 316 stainless steel.
3. Provide removable rear plate.
4. For gauge pressure, vented case for temperature/atmospheric compensation
5. Windows:
 - a. Material: Clear acrylic or shatterproof glass.
 - b. Thickness: 1/8 inch.
 - c. Provide gasket.

E. Connection:

1. Location: Bottom.
2. Socket:
 - a. 1/2-inch NPT male thread.
 - b. Material: Brass forging.
 - c. Extend minimum 1-1/4 inches below gage cases.
 - d. Provide wrench flats.
3. Mounting: Stem or surface.

F. Measuring Element:

1. Bourdon Tubes:
 - a. Material: Stainless steel, to brass socket.
 - b. Provide welded, stress-relieved joints.
2. Movement:
 - a. Material: Stainless steel.
3. Accuracy:
 - a. Comply with ASME B40.100.
 - b. Plus and minus 1.0 percent of full-scale range.

G. Adjustment:

1. Provide for zero-reading adjustment.
2. Adjusting Screws: Accessible from rear of case without need for disassembly.

H. Accessories:

1. Pressure Snubber:
 - a. Material: Type 316 stainless steel.
 - b. Provide isolation valve.

2. Shutoff Cocks: Furnished by gage manufacturer.
3. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
4. Gauges listed as liquid filled in the instrument device schedule shall be liquid filled at the factory.

2.2 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

- A. Items in this specification shall be tagged as follows:
 1. High Service Pump No. 2 Discharge Pressure: PI-220
 2. High Service Pump No. 3 Discharge Pressure: PI-230
 3. High Service Pump No. 4 Discharge Pressure: PI-240
 4. Transfer Pump No. 1 Discharge Pressure: PI-331
 5. Transfer Pump No. 2 Discharge Pressure: PI-332
 6. Transfer Pump No. 3 Discharge Pressure: PI-333
 7. Transfer Pump No. 4 Discharge Pressure: PI-334
 8. Transfer Pump No. 5 Discharge Pressure: PI-335

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.5 MAINTENANCE SERVICE

- A. Not Required

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor. Training shall be provided 1 time and last up to 1 hour in the field.

END OF SECTION 407313

This page intentionally left blank.

SECTION 407506 - SINGLE PARAMETER ANALYZER TRANSMITTER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes single parameter analyzer transmitters.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
 - 2. Section 407100 “Instrumentation for Process Systems”.
 - 3. Section 407513 “pH/ORP Analyzers”.

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.
- B. Shop Drawings:
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.11 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 SINGLE-PARAMETER ANALYZER TRANSMITTER

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. ProMinent D1C Series.
 - b. Substitutions: Or equal.
- B. Type:
 - 1. Microprocessor-based, intelligent transmitter compatible with a minimum of sensor (digital or analog) inputs.
- C. Function/Performance:
 - 1. Accuracy: $\pm 0.5\%$ of span.
 - 2. Repeatability: $\pm 0.05\%$ of span.

3. Response Time: 60 seconds to 90% of value on a step change.
 4. Temperature Compensation: Compensation over entire temperature range of the instrument.
 5. Environmental Conditions: -5 to 50 °C and 5 to 95% relative humidity.
 6. Hardwired Outputs:
 - a. Minimum: (1) 4-20mA output.
 - b. Minimum: (2) 250VAC, 3A, configurable relays.
 7. Diagnostics: On screen instructions and display of self-diagnostics.
- D. Physical:
1. Transmitter shall be suitable for surface or pipe stand mounting.
 2. Enclosure shall be NEMA 4X (IP65).
 3. Power Requirements: 120VAC powered.
- E. Accessories:
1. Provide sensor connection cable and plug between the transmitter and the analyzer sensor for rapid attachment and exchange of sensor.
 2. Provide connection box for analyzers.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where the transmitter will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

- A. Refer to Section 260600 – Grounding System.

3.4 IDENTIFICATION

- A. Refer to drawings and specifications for tagging designations

3.5 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter. Training shall be provided 1 time and last up to 1 hour in the field.

END OF SECTION 407506

SECTION 407513 - pH/ORP ANALYZERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pH-ORP analyzer.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions”.
 - 2. Section 407100 “Instrumentation for Process Systems”.

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.
- B. Shop Drawings:
 - 1. Refer to Section 407000 “Instrumentation for Process Systems”.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.9 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.10 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

PART 2 - PRODUCTS

2.1 pH FIELD ANALYZERS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. ProMinent PHEX 112 SE Sensor.
 - b. Or equal.
- B. Sensor:
 - 1. Type:
 - a. pH-sensitive glass membrane electrode, double or triple-junction reference electrode and ground electrode with integral preamplifier.
 - b. For submersion or flow-through application as indicated on the Drawings or in the Instrument Device Schedule.
 - 2. Function/Performance:
 - a. Range: 1 to 12.

- b. Temperature Compensation: Temperature element integral to sensor for temperature compensation.
 3. Physical:
 - a. Flat glass or shrouded pH electrode.
 - b. Sensor assembly constructed of PVDF, Tefzel, or similar material.
 - c. Sealed electrodes.
 - d. Solid electrolyte (Polymer with Potassium Chloride) to prevent reference system from becoming plugged
 - e. Temperature: 0 to 100 °C.
 4. Accessories Required:
 - a. Manufacturer's cable for connection of sensor to transmitter. Provide SN6 quick connect cable for easy installation and removal of the sensor. Length as required by installation indicated on Drawings.
 - b. One year's supply of consumables for calibration.
 - c. Handrail mounting kit where indicated on the Drawings to be required.
- C. Transmitter:
 1. Include a compatible transmitter that is by the same manufacturer as the instrument and is either a multi-parameter analyzer transmitter, as specified in Section 407505, or a single-parameter analyzer transmitter as specified in Section 407506, as required by the instrument device schedule.
- D. Manufacturer Start-up and Training services:
 1. Provide manufacturer's start-up and training services as specified in the "Manufacturer Start-up and Training Services" Article.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where instrumentation will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 IDENTIFICATION

- A. Refer to drawings for tagging designations

3.4 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.6 MAINTENANCE SERVICE

- A. Not Required

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, the manufacturer shall provide training to the Owner's instrumentation technicians. The training shall be in how to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor and transmitter.

END OF SECTION 407513

SECTION 407853 - RELAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes relays for control panels. All discrete outputs from the PLC/RTU I/O modules shall be wired to relays. Interposing relays shall be supplied, if required, for 120VAC powered field wiring in order to condition the signal for use on the 24VDC powered PLC/RTU discrete input modules.
- B. Related Requirements:
 - 1. Section 406100 Process Control and Enterprise Management Systems General Provisions for submittal requirements.
 - 2. Section 406717 Industrial Enclosures.
 - 3. Section 406733 Panel Wiring

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions for preinstallation meetings

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
 - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.5 INFORMATIONAL SUBMITTALS

- 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.6 CLOSEOUT SUBMITTALS

1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Relays: Full-size units including relay and relay socket equal to 10 percent of quantity installed for each size indicated, but no fewer than 1 unit.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Not applicable to this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

1.11 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.12 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE RELAYS AND TIME DELAYS

- A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Allen Bradley.
 - b. IDEC
 - c. Omron
 - d. Schneider Electric.
 - e. Substitutions: Or equal.

- B. Type:
 1. General purpose plug-in type.

- C. Functional:
 1. Contact arrangement/function shall be as required to meet the specified control function; Mechanical life expectancy shall be in excess of 10 million.
 2. Duty cycle shall be rated for continuous operation; Units shall be provided with integral indicating light to indicate if relay is energized.
 3. Solid state time delays shall be provided with polarity protection (DC units) and transient protection.
 4. Time delay units shall be adjustable and available in ranges from .1 second to 4.5 hours.

- D. Physical:
 1. For 120 VAC service provide contacts rated 10 amps at 120 VAC, for 24 VDC service provide contacts rated 5 amps at 28 VDC, for electronic (milliamp/millivolt) switching applicator provide gold plated contacts rated for electronic service; relays shall be provided with dust and moisture resistant covers.
 2. All relays shall be provided with number of poles required to meet the design intent.

- E. Options/Accessories Required:
 1. Provide blade terminal din rail mounting sockets with pressure type terminal blocks rated 300 volt and 10 amps.
 2. Provide mounting rails/holders as required.
 3. Provide LED/neon lamp indicator and manual check button.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.

- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

- A. Refer to Section 260600 – Grounding System.

3.3 IDENTIFICATION

- A. Refer to drawings for tagging designations

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407853

SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes isolators, intrinsically safe barriers, and surge suppressors.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.

1.3 DEFINITIONS

1.4 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 – “Process Control and Enterprise Management System General Provisions” for preinstallation meetings

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.
- B. Shop Drawings:
 - 1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

1.6 CLOSEOUT SUBMITTALS

- 1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions”.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Surge Suppressors: Full-size units, including the surge suppressor module and surge suppressor base, equal to 10 percent of quantity installed, but no fewer than two units.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Not applicable to this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

1.11 FIELD CONDITIONS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

1.12 WARRANTY

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions".

PART 2 - PRODUCTS

2.1 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acromag.
 - b. Action Instruments Slim Pak.
 - c. Pepperl+Fuchs.

d. Substitutions: Section 016000 - Product Requirements.

B. Type:

1. Solid state, ASIC technology; electronic type.

C. Functional:

1. Accuracy: 0.15 percent.

2. Inputs: Current, voltage, frequency, temperature, or resistance as required.

3. Outputs: Current or voltage as required.

4. Isolation: There shall be complete isolation between input circuitry, output circuitry, and the power supply.

5. Adjustments: Zero and span adjustment shall be provided.

6. Protection: Provide RFI protection.

D. Physical:

1. Mounting: DIN Rail.

2.2 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Citel DLA series
- b. MJ8 series,
- c. MTL Surge Technologies (Telematic) NP Series,
- d. Phoenix Contact PlugTrab Series,
- e. Transtector FSP Series,
- f. Substitutions: Section 016000 - Product

B. General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an $8 \times 20 \mu\text{s}$ impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground in accordance with 260526 "Grounding and Bonding for Electrical Systems".

- C. Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate NEMA 4X stainless steel enclosure (plastic is not acceptable) or conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.
- D. Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge protective devices shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.
- E. Non-Fiber Based Data Highway or Communications Circuits: Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Provide circuit protection at both ends of the line.
 - 1. Products: Provide one of the following surge protective devices:
 - a. Phoenix Contact PlugTrab Series,
 - b. Transtector FSP Series,
 - c. MTL Surge Technologies (Telematic) NP Series,
 - d. Citel DLA series
 - e. MJ8 series,
 - f. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

- A. Refer to Section 260600 – Grounding System.

3.3 IDENTIFICATION

- A. Refer to item in this specification for tagging designations.

3.4 FIELD QUALITY

- A. Perform the following tests and inspections:
 - 1. Isolators: At either the witnessed factory test or at the functional demonstration test, at the Engineer's discretion, a random quantity of installed isolators shall be tested by simulating the 4-20mA input signal to the isolator and verifying that the 4-20 mA output signal matches the input, within manufacturer specifications. Simulation of the input signal shall be implemented through the field instrument transmitter electronics, if equipped, or with a 4-20 mA signal generator if the field instrument transmitter electronics are not equipped with a simulation mode.
- B. Isolators and surge suppressors will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports in accordance with the following:
 - 1. Section 406100 "Process Control and Enterprise Management General Provisions".
 - 2. Section 406121 "Process Control System Testing".

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. If possible, verify functionality of isolators at the factory prior to shipping the control panels.
 - 3. Test isolators during the loop testing of the analog inputs, from the field device, through the isolator, to the PLC I/O module and to the HMI/SCADA graphics.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407856

This page intentionally left blank.

SECTION 407859 - POWER SUPPLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes power supplies for control panels.
- B. Related Requirements:
 - 1. Section 406100 Process Control and Enterprise Management Systems General Provisions for submittal requirements.
 - 2. Section 406717 Industrial Enclosures.

1.3 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions for preinstallation meetings

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.
- B. Shop Drawings:
 - 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.5 INFORMATIONAL SUBMITTALS

- 1. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.6 CLOSEOUT SUBMITTALS

1. Refer to Section 406100 – Process Control and Enterprise Management System General Provisions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Power Supply: Full-size units 24VDC power supplies equal to 10 percent of quantity installed, but no fewer than 1 unit.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 TECHNOLOGY OBSOLESCENCE MITIGATION

- A. Not applicable to this Section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

1.11 FIELD CONDITIONS

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions.

1.12 WARRANTY

- A. Refer to Section 406100 – Process Control and Enterprise Management Systems General Provisions

PART 2 - PRODUCTS

2.1 24 VDC POWER SUPPLIES

- A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Allen-Bradley.
 - b. Phoenix Contact.
 - c. SOLA HD.
 - d. Substitutions: Or equal.
- B. Provide a 24 VDC power supply in the control panel to power field instruments, panel devices, etc., as required. Equip the power supply with a power on/off circuit breaker.
- C. The 24 VDC power supply shall meet the following requirements:
 1. Input power: 115 VAC, plus or minus 10 percent, 60 Hz.
 2. Output voltage: 24 VDC.
 3. Output voltage adjustment: 5 percent.
 4. Line regulation: 0.05 percent for 10 volt line change.
 5. Load regulation: 0.15 percent no load to full load.
 6. Ripple: 3 mV RMS.
 7. Operating temperature: 32 to 140 degrees Fahrenheit.
- D. Size the 24 VDC power supply to accommodate the design load plus a minimum 25 percent spare capacity.
- E. If power supply on/off status signal is shown on drawings, provide a relay contact (internal to the power supply or external if the power supply is not so equipped) to indicate on/off status of the power supply.
- F. Provide output overvoltage and overcurrent protective devices with the power supply to protect instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
- G. Mount the 24 VDC power supply such that dissipated heat does not adversely affect other panel components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

- A. Refer to Section 260600 – Grounding System.

3.3 IDENTIFICATION

- A. Refer to drawings for tagging designations

3.4 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407859

SECTION 432359 HORIZONTAL SPLIT-CASE CENTRIFUGAL HIGH SERVICE PUMPS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, and incidentals required to completely install, put in operation and field test three (3) horizontally mounted, axial split-case, single stage, double suction, single or double volute, variable speed driven, centrifugal pumps and motors as shown on the Drawings and as specified herein
- B. All necessary and desirable accessory equipment and auxiliaries whether specifically mentioned in this Section or not shall be furnished and installed as required for an installation incorporating the highest standards for this type of service. This specification is intended to give a description of what is required, but does not cover all details, which will vary in accordance with the requirements of the pump supplier.
- C. These pumps are designed to pump potable water into the potable water distribution system for the Northwest Water Treatment Plant service area. All internal components shall be compatible for use in potable water distribution systems and shall be NSF61 approved.
- D. Unless otherwise approved by Owner, the Contractor shall provide pumps from the following list of Owner-approved pump manufacturers:
 - 1. Peerless
- E. Unless otherwise approved by Owner, the pump supplier shall provide motors from the following list of Owner-approved motor manufacturers:
 - 1. U.S. Motors
 - 2. GE
 - 3. Baldor-Reliance

1.2 RELATED WORK

- A. Concrete work and the installation of anchor bolts are included in Division 03; however, anchor bolts for these units as recommended by the pump supplier shall be furnished by the Contractor under this Section.
- B. Field painting is included in Division 09.
- C. Valves and appurtenances, mechanical piping, piping accessories, pipe hangers and supports are included in Division 40.
- D. Instrumentation and control work, except as specified herein, is included in Division 40. Instrumentation and controls provided in this Section shall adhere to Instrumentation and Control Specifications sections in Division 40.

- E. Electrical work except as hereinafter specified is included in Division 26.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 013300, shop drawings and product data. Submittals shall include the following:
 - 1. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
 - 2. Certified foundation, pump support and anchor bolt plans and details.
 - 3. Schematic electrical wiring diagram and other data as required for complete pump installation.
 - 4. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the detail specifications.
 - 5. Total weight of pumping unit.
- B. Design Data
 - 1. Manufacturer's certified rating curves, to satisfy the specified design conditions, showing pump characteristics of discharge, head, brake horsepower, efficiency and guaranteed net positive suction head required, 3% (NPSH3). Curves shall show the full recommended range of performance and include shut-off head. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.
- C. Test Reports
 - 1. The following test reports and information shall be provided:
 - 2. Certified motor test data as described in Division 26.
 - 3. Tabulated data for the drive motors including rated Hp, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply without affecting their design life for bearings or windings.
 - 4. A schedule of the date of shop testing and delivery of the equipment to the job site.
 - 5. Description of pump factory test procedures and equipment.
 - 6. A statement that the pump will function properly as installed with respect to the suction piping layout as shown on the Drawings.
- D. Operation and Maintenance Data
 - 1. The following design information shall be provided: complete operating and maintenance instructions shall be furnished for all equipment included under this Section as provided in Section 017823. The maintenance instructions shall include troubleshooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

1.4 REFERENCE STANDARDS

- A. Design, manufacture and assembly of elements of the equipment specified herein shall be in accordance with, but not limited to, published standards of the following, as applicable:
1. American Gear Manufacturers Association (AGMA)
 2. American Institute of Steel Construction (AISC)
 3. American Iron and Steel Institute (AISI)
 4. American Society of Mechanical Engineers (ASME)
 5. American National Standards Institute (ANSI)
 6. American Society for Testing Materials (ASTM)
 7. American Welding Society (AWS)
 8. American Bearing Manufacturers Association (ABMA)
 9. Hydraulic Institute (HI)
 10. Institute of Electrical and Electronics Engineers (IEEE)
 11. National Electrical Code (NEC)
 12. National Electrical Manufacturers Association (NEMA)
 13. Occupational Safety and Health Administration (OSHA)
 14. The Society for Protective Coatings (SSPC)
 15. Underwriters Laboratories (UL)
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. To assure unity of responsibility, the motors, and base plates shall be furnished and coordinated by the pump supplier. The Contractor and pump supplier shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, base plates and controls as specified.
- B. The equipment supplied by the pump supplier under this Section shall be standard pumping equipment of proven ability as manufactured by concerns having extensive experience in the production of such equipment similar to the applications stated in paragraphs 1.1 and paragraph 1.6. Units specified herein shall be furnished by a single manufacturer. The equipment furnished shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings.
- C. Pumps supplied shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified herein.
- D. The pump supplier shall be fully responsible for the arrangement and operation of all connected rotating components, of the assembled pumping unit mounted on a fabricated steel base plate, to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range. Base plates shall be installed so the discharge centerline elevation of all pumps are the same.
- E. Maximum vibration velocity in inches per second RMS, measured in the field, shall be less than the requirements of ANSI/HI 9.6.4-latest edition. In addition, for pump operating speeds less

than or equal to 600 rpm, field vibration displacement shall be measured in mils peak-to-peak and shall be less than the requirements of ANSI/HI 9.6.4-latest edition.

1.6 SYSTEM DESCRIPTION

- A. The pumps shall be horizontal axial split-case, single stage centrifugal pumps with single or double volute enclosed type impeller with stable constantly rising curve to shut-off head, renewable casing rings, flexible coupling and extended rigid structural steel base plate under each pump and driving motor.
- B. There shall be one type of pump provided – three (3), variable frequency driven (VFD) High Service Pumps, as described herein.
- C. The pumps shall be capable of operating over the range of system curves provided at the end of this Section.

1.7 MANUFACTURER SERVICES INCLUDING OPERATION INSTRUCTIONS

- A. Operating and Maintenance Manual:
 - 1. Operating and maintenance manual shall be furnished by the Manufacturer to the Engineer as provided for in Section 017823. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.
- B. Installation Inspection and Startup:
 - 1. The Contractor shall include in his bid price the services of a Manufacturer's factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time, and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition.
 - 2. Installation inspection: Complete review of installation in accordance with Section 017700. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. The Manufacturer shall supply the installation inspection services of an experienced Manufacturer's factory representative to verify the proper pump installation. The Manufacturer's factory representative shall specifically approve the installation and alignment of the pump with the motor, the grouting, and the alignment of the connecting piping and the installation of the field installed packing or mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the

Manufacturer's factory representative and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.

- a. Minimum time on-site shall be one 8-hour day per pump.
3. Start-Up: Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration testing, alignment check, etc.):
 - a. Minimum time on-site shall be one 8-hour day per pump.
- C. Training:
1. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.
 2. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- D. The Contractor alone shall be responsible for requesting these services, and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the Manufacturer's factory representative, the lost time shall not be counted against the above days.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during a prolonged period at the site. Store all equipment in accordance with the manufacturer's instructions.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- F. No shipment shall be made until approved by the Engineer in writing.
- G. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period

of storage, while waiting completion of installation and start-up, by the application of Exxon, Rust-Ban No. 392 or equal treatment.

1.9 TOOLS AND SPARE PARTS

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment as specified in Section 017700. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.
- B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.
- C. Furnish the following spare parts:
 - 1. one mechanical seal.
- D. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after start-up and final acceptance.
- E. Special tools and spare parts shall be furnished in accordance with Section 017700.

1.10 WARRANTY

- A. All equipment supplied under this Section of the Specifications shall be warranted for a period of one year from date of startup or 18 months from date of shipment, whichever occurs first. Warranty period shall commence on the date of Owner acceptance, as outlined in Division 00 and in Division 01.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed

PART 2 - PRODUCTS

2.1 GENERAL

- A. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, controls and appurtenances such as, but not limited to, couplings, guards and gauges.
- B. The pumps, motors, drives and controls shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation and without excessive vibration or strain. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be especially constructed

to meet the specified requirement. Ample room and facilities shall be provided for inspection, repairs, and adjustment.

- C. All necessary anchor bolts, nuts, and washers shall be furnished and shall be Type 316 stainless steel, and furnished by Contractor.
- D. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer's name and model number, serial number, rated flow capacity, head, speed and all other pertinent data. As a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors. Nameplate information shall include the manufacturer's name and serial number, input speed, voltage, current and frequency and horsepower at full load.
- E. The pumps shall conform to AWWA E-103, Horizontal and Vertical Line-Shaft Pumps Standard and ANSI/NSF 61 Annex G and/or ANSI/NSF 372 where not in conflict with the requirements specified herein.
- F. Coordinate the required pump pad size and reducer size with the selected pump manufacturer.

2.2 CONDITIONS OF SERVICE

- A. There shall be one type of pump provided – three (3) Large, VFD, High Service Pumps. The pumps shall be approved horizontal split case centrifugal pumps by Peerless.
- B. Each pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curves as appended.

Item Description	High Service Pump Design Conditions
Service	Finished Water
Number of Pumps (new/existing)	(3/2)
Maximum Motor Full Load Speed (FLS) (rpm)	1783
Maximum Allowable Motor (non-overloading throughout operating range) (HP)	200
Motor Design Voltage/Phase/Frequency	460V/3PH/60Hz
Maximum Anticipated Pump Fluid Temperature (degrees F.)	72
Minimum Pump Discharge Nozzle Size (inches)	8
Minimum Suction Nozzle Size (inches)	10
Pump Impeller Size (inches)	14.60
Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	220/225
Flow Rate at Secondary Operation Point (gpm)	2,200

Item Description	High Service Pump Design Conditions
Minimum TH at Secondary Operation Point (feet)	211
Minimum Efficiency at Secondary Operation Point (%)	79
Maximum NPSH3 at Secondary Operation Point (feet)	12
Intermediate (Design) Point Flow Rate (gpm)	3,000
Minimum TH at Intermediate (Design) Point (feet)	185
Minimum Efficiency at Intermediate (Design) Point (%)	86
Maximum NPSH3 at Intermediate (Design) Point (feet)	16
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	3,000/3,500
Minimum Efficiency at BEP (%)	86
Primary Operating Point TH (run-out) (feet)	127
Minimum Flow Rate at Primary Operating Point (run-out) TH (gpm)	4,450
Minimum Overall Efficiency at Primary Operating (run-out) TH (%)	79
Maximum NPSH3 at Primary Operating Point (run-out) (feet)	34.1
Pump Model Used for Design	Peerless Model 8AE-17Q (Matching existing Pump Nos. 5 and 6) (Serial # 728999 A)

- C. Where TH is referred to in conjunction with the specific discharge requirements, it shall be understood to consist of the sum of the pressure head plus the velocity head, in feet, at the discharge nozzle of the pump minus the pressure head and the velocity head at the suction nozzle of the pump. The efficiency of the pump shall be understood to be based upon TH as just defined.
- D. The top half of each case at the topmost part shall have a bossed pipe tap opening for mounting priming air chamber. Pipe taps shall not be less than ½-inch NPT.
- E. The pumps shall operate throughout the entire operating range, within the vibration limits specified in paragraph 1.5F above.
- F. Flow separation at the inlet of impeller shall not be permitted when it could result in damage to the impeller. Obvious, excessive hydraulic noise that is characteristic of flow separation shall be deemed as evidence that flow separation is occurring at the level that will cause damage.

2.3 PUMP CONSTRUCTION

- A. Casings shall be of cast iron conforming to ASTM A48, Class 35 of sufficient thickness and suitably ribbed to withstand all stresses and strains of service at full operating pressure. Casings shall be of the double or single volute type split on the horizontal center line with the side

suction and discharge nozzle cast integrally with the lower half. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges. Lifting eyes shall be cast into the upper casing. Flange and casings shall be designed for a working pressure of 175 psi. The casing shall be provided with tapped and plugged (removable) vent, drain and gauge connections. Suction and discharge connections shall be 125 lbs ANSI Standard flat-face flanges positioned as indicated on the Drawings.

- B. Impellers shall be of the enclosed double suction type of nickel aluminum bronze. Impellers shall be cast in one piece and shall be statically and dynamically balanced. Rotation of the impeller shall correspond to the pump discharge orientation as indicated on the Drawings. The impeller shall be keyed to the shaft and firmly held in place. The arrangement shall be such that the impeller cannot be loosened by torque from either forward or reverse rotation.
- C. Wearing Rings
 - 1. The pumps shall be provided with removable lead-free C89835 bronze wearing rings for the casing with the wearing surfaces parallel to the axis of rotation.
 - 2. Wearing rings shall be securely fastened to prevent any relative motion and designed for easy replacement.
- D. Pump Stuffing Boxes and Seals:
 - 1. The pump stuffing box shall be designed to accommodate mechanical seals. The boxes shall be satisfactory for 30 feet of positive head and 15 feet of negative head and shall be designed for external water flushing from the pump volute.
 - 2. Each pump shall be equipped with an A.W. Chesterton Type 155, John Crane, Type 5610/5611, or equal self-aligning, single inside mounted mechanical seal equipped with silicon carbide rotating seal face and carbon stationary seal face. All metal parts, including gland, and drive collar shall be constructed of 316 stainless steel. Springs shall be Hastaloy C, or Eligiloy. Elastomers shall be EPDM. The gland shall be drilled and tapped for venting back to suction or to supply seal cooling water from the volute (API Plan 11).
 - 3. Drip pockets shall be provided in the bearing brackets under the packing glands to catch any water dripping from pump stuffing boxes. These drip pockets shall be furnished with tapped drain connections.
- E. The pump bearings shall be of the heavy duty single row inboard and double row outboard anti-friction type arranged for grease lubrication with pressure device designed in accordance with ABMA Standards for a minimum L-10 life of 50,000 hours, without the addition of external cooling. Removable bearing housings shall be bolted and doweled to bearing brackets that are cast integral with the pump lower half casing.
- F. The pump shaft shall be LH steel with bronze shaft sleeves. Shaft shall be of sufficient size to transmit the full driver horsepower with a liberal safety factor, accurately machined over the entire length and free from harmful and damaging vibrations. The shafts shall be provided with 316 SS impeller nuts.
- G. The pump and its driving equipment shall be designed and constructed to successfully withstand a maximum turbinizing speed of the unit resulting from backflow through the pump of 125 percent of the design operating speed or the runaway speed that would occur at an applied head of 220-ft.

2.4 PUMP DRIVE SYSTEM

- A. Pumps shall be driven by a horizontal premium efficiency inverter duty ODP F1 motor. Motor horsepower shall be as specified in in Paragraph 2.2. The pump motors shall be furnished by the pump manufacturer. Motors shall meet all requirements of Division 26.
- B. The pump motors shall be suitable for driving the pumps continuously over the entire pumping range. The pump motors shall be furnished by the pump manufacturer. The motors shall be constructed and guaranteed to withstand runaway reverse speed equal to 125 percent of synchronous speed or the runaway speed that would occur at an applied head of 225-ft.
- C. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and ABMA standards where applicable. Motors shall conform to all requirements stipulated in PART 1 GENERAL of this Section of the specifications and with the specifications for motors included in Division 26.
- D. Bearings shall be anti-friction, grease lubricated type. Bearings shall have an ABMA L 10 life of 50,000 hours.
- E. Motor noise level shall not exceed 85 dBA measured 3 feet from the unit under free field conditions.
- F. Provide motor winding thermostats and motor space heaters per Division 26.
- G. Motor shall have stainless steel hardware, fasteners, drains and breathers.
- H. Motor shall be provided with the manufacturer's routine motor tests, motor efficiency test and certified reports.
- I. Grounding lugs shall be provided in all conduit boxes. Conduit boxes shall be oversized for ease of maintenance.
- J. Each pump shall be directly connected to its driver by means of a flex TB Wood's coupling or approved equal all metal flexible coupling, suitably sized to transmit the required driving torque and to accommodate unavoidable shaft misalignment.

2.5 VARIABLE FREQUENCY DRIVES

- A. The VFDs will be supplied by the VFD Manufacturer specified in Division 26 and shall be completely coordinated with the pump and pump driving motors by the Contractor.
- B. The speed control for variable speed pumps will be VFDs, as specified in Division 26, suitable for installation as shown on the drawings.
- C. The VFDs will conform to all requirements stipulated in this section and Division 26 - Electrical and will be designed for a speed range of 65% to 100% of full load motor speed.
- D. The VFDs will be compatible with the motors provided.
- E. VFD manufacturer shall provide all I/O signals and controls as described on the electrical elementary drawings and P&IDs.

2.6 BASE PLATES

- A. The pump and driving motor shall be mounted on an extended fabricated steel drip-rim base plate, with provision to collect leakage and shall be of sufficient size and rigidity to support the unit and prevent harmful or damaging vibration. A minimum 1/2-in drain tap and copper pipe nipple shall be provided. The steel base shall be anchored to the level surface of a concrete pad with suitably sized Type 316 stainless steel anchor bolts. Baseplate shall also include grout holes.

2.7 SHOP TESTING

- A. The Engineer shall have the right to inspect any equipment to be furnished under this Section, prior to shipment from point of manufacture.
- B. A complete test report for each pump, including certified characteristic curves of the pump, consisting of at least all information required in paragraphs 1.3 and 1.5 above, and certified copies of the hydrostatic test report, shall be submitted to and approved by the Engineer before the pumps are shipped.
- C. Each pump being furnished in this Section shall be factory tested in accordance with the latest edition of the Hydraulic Institute Standards. Certified copies of the Hydrostatic Test Report shall be supplied prior to conducting a pump performance test. Notification of such test and a list of test equipment and procedures shall be furnished to the Engineer at least ten working days before the schedule test date.
 - 1. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards, latest version. Flow rate, TH and Input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6-latest edition, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, acceptance grade 1U for the primary duty point. The five points shall include the points specified herein.
 - 2. All gauges and other test instruments shall be calibrated within 30 days of the scheduled test and certified calibration data shall be provided. All Venturi flow meters shall be calibrated within two years of the scheduled test and certified calibration data shall be provided.
- D. Pump motor tests as specified in Division 26 shall be submitted for approval by Engineer prior to shipping.

2.8 SURFACE PREPARATION AND SHOP PRIMING

- A. Each pumping unit, including pump, motor and base plate shall be prepared and shop-primed as specified in Section 099010 – Shop Priming. The shop primer shall be compatible with the finish paint. Field painting is included in Section 099100 – Painting.
- B. All internal coatings shall be Tnemec 141 and NSF61 approved.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate with pump supplier and other trades, equipment and systems to the fullest extent possible.
- B. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this contract. All pertinent data and dimensions shall be verified.

3.2 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations shown on the Drawings. Anchor bolts shall be set in accordance with the manufacturer's recommendations and setting plans.
- B. Qualified supervisory services, including manufacturer's engineering representatives, shall be provided to ensure that the work is done in a manner fully approved by the pump supplier. The SUPPLIER's representatives shall specifically supervise the installation and alignment of the pump with the driver, the grouting, and the alignment of the connecting piping. If there are difficulties in the start-up or operation of the equipment due to the manufacturer's design or fabrication, additional service by the pump supplier shall be provided at no cost to the Owner. Services of the pump supplier's representatives and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
- C. Connection of piping to pumps shall be done in presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.
- D. A certificate from manufacturer shall be submitted stating that the installation of their equipment is satisfactory, that the equipment is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit. Contractor shall also provide a certificate to Owner and Engineer that the high service pumping system is ready for operation.
- E. Alignment shall be performed by the Vendor or Contractor by certified personnel prior to grouting of base plate and vibration testing.

3.3 INSPECTION AND FIELD TESTING

- A. The Owner, Engineer, and Contractor shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these specifications, prior to their shipment from the point of manufacture.
- B. The manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment for a period of not less than three (3) days in two separate visits to inspect the installed equipment, supervise

the initial test run, and to provide instructions to the plant personnel. The first visit will be for checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test. At least one (1) of the three (3) days shall be allocated solely to the instruction of plant personnel in operation and maintenance of the equipment. This instruction period shall be scheduled at least ten days in advance with the Owner and shall take place prior to plant startup and acceptance by the Owner. The final copies of operation and maintenance manuals specified in 01730 must have been delivered to the Owner prior to scheduling the instruction period with the Owner.

- C. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing. All field tests shall be coordinated with the Contractor and Owner to allow for scheduling of downtime and to meet current water demands.
- D. In the presence of the Engineer, Contractor, assisted by Manufacturer, shall perform necessary tests to indicate that the pumps and motors generally conform to the operating conditions specified. The factory testing specified above will be the basis of performance acceptance. A 7 day operating period of the pumps will be required before acceptance. Facility acceptance is included in Section 017300 – Execution If a pump performance does not generally agree with the factory test results, corrective measures shall be taken or the pump shall be removed and replaced with a pump that satisfies the conditions specified. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval no fewer than 30 days prior to testing.
- E. All test procedures shall be in accordance with factory test procedures, and certified results of test shall be submitted.
- F. The pump supplier shall provide, calibrate, and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping.
- G. Motors:
 - 1. The motor windings shall be meggered before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor.
 - 2. Check the motor for correct clearances and alignment and for correct lubrication in accordance with the motor manufacturer's instructions. The pump supplier shall check direction of rotation of the motor and reverse connections if necessary.
- H. After installation of the pumps and as soon as conditions permit full speed operation including completion of Paragraph 3.2.E. and grouting, the Contractor shall retain the services of a qualified independent mechanical testing firm to perform a detailed vibration signature analysis of the unit(s), including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. A written report shall be submitted including a sketch of the units indicating thereon where and in which direction the vibration readings were taken and recorded showing (a) peak to peak displacement, in mils, (b) frequency, (c) velocity level, in inches per second RMS. The report shall contain a complete analysis of their findings, describing any problem encountered, if any, probable cause and specific recommendations for any required corrective action.

- I. If required, take corrective action and the units shall be retested to ensure full compliance with this Section. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

END OF SECTION 432359

SECTION 432427 CORROSION RESISTANT SUMP PUMPS AND FRP WETWELL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: biotrickling filter drain pump station.
- B. Furnish labor, materials, equipment and incidentals required for installation, startup, warranty and testing of the complete, fully functioning corrosion resistant sump pump station as shown on the Drawings and as specified herein. Sump pumps specified herein shall be of special corrosion resistant construction.
- C. Furnish and install necessary and desirable accessory equipment and auxiliaries, whether specifically mentioned in this Section or not, as required for an installation incorporating the highest standards for the type of service.
- D. System Includes:
 - 1. Fiberglass reinforced plastic (FRP) sump equipped with the following:
 - a. Two corrosion resistant vertical thermoplastic pumps
 - b. Prestressed concrete top slab
 - c. Aluminum hatch
 - d. Local control panel with weather proof enclosure
 - e. Instrumentation, wiring, and electrical components
 - f. All items as shown on the Drawings and as specified, and as required for a fully functioning system.
- E. This Specification gives a general description of system requirements, but does not cover all details, which will vary depending on manufacturer and requirements of application. It does cover the furnishing, delivery, installation supervision, startup, warranty, and field testing of materials, equipment and appurtenances for a complete corrosion resistant pump station as specified, whether specifically mentioned in this Section or not
- F. Related Requirements:
 - 1. Division 03, "Concrete" for concrete requirements as required for this Section.
 - 2. Section 055000, "Metal Fabrications" for fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
 - 3. Section 099010, "Shop Priming" for surface preparation and shop painting for equipment specified in this section.
 - 4. Division 26, "Electrical" for electrical requirements as required for this Section.

5. Division 40, "Piping" for piping requirements as required for this Section.
6. Division 40, "Instrumentation" for instrumentation requirements as required for this Section.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. Manufacturer: The term "manufacturer" as used in this specification will refer to the manufacturer of the corrosion resistant pump station or the manufacturer's authorized representative.
- C. OIT: Operator interface terminal.
- D. PLC: Programmable Logic Controller.

1.4 ACTION SUBMITTALS

- A. Section 013300, "Submittal Procedures" for submittals requirements.
- B. Product Data:
 1. Manufacturer information for system materials and component equipment.
 2. Pump Station and Operation Information: Performance criteria as specified in in PART 2 of this Specification.
 3. Descriptive literature, bulletins, and/or catalogs of the equipment.
 4. Instrumentation data.
 5. Electrical wiring diagrams.
 6. Complete operating description and programming control narratives, and a detailed list of inputs/outputs (I/O) wired to supplied control panel.
 7. Complete data on motors in accordance with Section 16150.
 8. Corrosion Resistant Pump (as required for startup): Data sheets with a description of proposed pump, pump size, type, performance curve, dimensional data, materials of construction, weight, motor horsepower, efficiency, motor type, power supply, anchor bolt locations and requirements, and accessories.
 9. Data on noise in accordance with Section 013300.
 10. Description of surface preparation and paint.
 11. Instrumentation, control, logic and power wiring diagrams. Sufficient detail to allow installation of the instrumentation, controls, and electrical components.
- C. Shop Drawings:
 1. Factory shop and erection drawings showing all important details of construction, dimensions and anchor bolt locations.
 2. Manufacturer's factory rating curves showing pump characteristics of head, brake horsepower, discharge, and required minimum submergence. Catalog sheets showing a family of curves will not be acceptable.
 3. The total weight of the equipment.
 4. A complete total bill of materials.

5. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, ceramic stationary washer and Viton V seal (or approved equal), etc., on the list. List the bearings by bearing manufacturer's part numbers only.
6. Control panel and instrument interior layouts and dimensions
7. Sufficient information to allow Engineer to check clearances, connections, and conformance with the specifications.

1.5 Informational Submittal:

- A. Manufacturer's Certificate: Products meet or exceed specified requirements.
 1. Statement that pump and pump materials are appropriate for a corrosive environment. Materials that are not corrosion resistant (e.g. carbon steel) are not permitted.
 2. Statement that all materials are appropriate for the fluids/streams that they come in contact with.
 3. A list of non-conforming aspects of this specification, with clear reasoning for deviation, requiring Engineer approval prior to equipment fabrication or ordering materials.
 4. Any revision during the submittal phase to meet the specification will come at no additional cost to the Owner.
- B. Manufacturer Instructions: Detailed instructions on installation requirements, including storage, lifting, and handling procedures.
- C. Mechanical Commissioning and Start-up, acclimation procedures and the layout for temporary piping required during the acclimation period.
- D. Source Quality-Control Submittals: Plans and results of factory tests and inspections.
- E. Field Quality-Control Submittals: Plans and results of Contractor-furnished tests and inspections.
- F. Manufacturer Reports: Certify equipment is installed according to manufacturer instructions. Statement will include the following:
 1. Installation of equipment is satisfactory.
 2. Units are satisfactorily tested, and ready for operation.
 3. Operating personnel have been suitably instructed in the operation and care of the units.
- G. Qualifications Statements:
 1. Qualifications for manufacturer, installer, and licensed professional.
 2. Manufacturer's approval of installer.
- H. Operation and Maintenance Data in accordance with Section 017823.

1.6 DELEGATED DESIGN SUBMITTAL

- A. Delegated Design Submittals: detailed dimensional Shop Drawings with design calculations and assumptions including the following.
 - 1. Design calculations for concrete ballast around wetwell.
 - 2. Design calculations and drawings for prestressed concrete top slab.

1.7 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures” for closeout submittals requirements.
- B. Equipment start-up and training documents for approval prior to commissioning.
 - 1. Mechanical commissioning procedures.
 - 2. Training program.
 - 3. Performance testing protocol.
 - 4. Reports as listed under “Informational Submittals” Article in PART 1.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017700, “Closeout Procedures” for maintenance materials requirements.
- B. Pack spare parts in sturdy containers with clear indelible identification markings, referencing the equipment that they are intended for, and will be stored in a dry, warm location until transferred to the Owner at the conclusion of the project. Provide complete ordering information including manufacturer, part number, part name and equipment for each part to be used.

1.9 QUALITY ASSURANCE

- A. Perform Work according to St. Johns County Utility Department standards.
- B. Maintain a copy of each standard affecting Work of this Section on Site.

1.10 QUALIFICATIONS

- A. Equipment provided, designed and furnished by a single manufacturer fully experienced, reputable and qualified in system and equipment specified. This Specification calls attention to certain features, but does not purport to cover all details entering into the design and construction of the equipment.
 - 1. Equipment offered may differ from what is specified if approved by the Engineer to be equivalent in performance.
 - a. Any revision in design or construction to accommodate equipment offered will be made at no additional cost to the Owner and approved by the Engineer.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products requirements.
- B. Deliver materials in coordination with installation of the pad, wiring, and piping by others. Contractor is responsible for ensuring that equipment is delivered after the installation of the pad.
- C. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of pipe and fittings. Do not drop pipe and fittings. All equipment and materials to be properly protected and maintained such that no damage will occur from the time of shipment until the completion of the installation.
- D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Equipment to be inspected and accepted by Owner and Contractor before unloading at installation site.
- E. Store and maintain materials on the project site in enclosures or under protective coverings in accordance with manufacturer's recommendations and as required by the Engineer.
- F. Protection: Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 1. Position the equipment as required by the Manufacturer.
 - 2. Provide additional protection according to manufacturer instructions.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Document field measurements on Shop Drawings.

1.13 WARRANTY

- A. Section 017700, "Closeout Procedures" for warranties requirements.
- B. Furnish one year manufacturer's warranty for corrosion resistant pump station and accessories.

PART 2 - PRODUCTS

2.1 DUPLEX SUMP PUMP

- A. Sump pump, wetwell, float controls, control panels and associated piping and hardware shall be provided by a single supplier. Packaged Sump Pump Station: Sump pumps shall Model SG-PY1200HA supplied by: Vanton Pump & Equipment Corporation Hillside NJ or approved equal.

- B. Duplex pump station shall be equipped with float controls, mounting hardware, and internal components for use in corrosive environments (pH2).
- C. Float controls for Low (OFF), Lead Start, Lag Start , and High (ALARM) resisting a liquid pH of 2.
- D. The pump shaft shall be polypropylene encapsulated outer and 304 stainless steel inner line shaft supported by flanged polypropylene machined bearing journals designed for flush water cooling. Each wet bearing shall be sleeve type constructed of Vanite outer and Ceramic cupped or locked inner. The journal shall be supported by its outer column of schedule 80 polypropylene construction.
- E. The Impeller shall be single design cast with stainless steel key way and star Viton o-ring seal to the pump shaft with polypropylene encapsulated sealing nut. The impeller housing shall be machined and incorporate a Viton seal o-ring with bolted upper and lower case housing and case cover. The case housing shall be threaded flanged fit to the outer column or welded construction. The pump discharge case shall be threaded and fitted with a schedule 80 polypropylene discharge pipe rising through the pump support plate and fitted with 150 B FF Flange. The Suction case is fitted with a polypropylene basket strainer. The pump column shall have heavy duty polypropylene welded gussets. There shall be at least three gusset per welded section.
- F. Pump mounting plate shall be fabricated of Polypropylene construction. The plate shall be machined to accept the motor mounting stand and discharge pipe. The plate shall have at least four mounting holes.
- G. The pump shall have a cast iron ASTM 45 class 30 motor mounting stand and shall incorporate designed for vapor containment using a ceramic stationary seat and a rotating vapor ring of Viton construction. The motor stand shall be complete with non-metallic OSHA coupling guards. The motor stand shall have an integral cast journal incorporating a grease lubricated steady support bearing system. The motor stand top plate shall be machined for register motor fit.
- H. The top cover plate and the motor stand shall be fitted with a plumbed 120 volt solenoid valve to allow for water cooling of line shaft sleeve type bearings. The solenoid valve shall be energized from the control panel through a time delay rely to feed the manifold. The motor call to run signal shall trigger the time delay relay to open solenoid introducing flushing water before motor starts.
- I. Pump shall be performance tested at the pump factory with the job motor and stamped by the factory test engineer as certified correct.
- J. Performance and Design Criteria:
 - 1. Quantity: Two (2) units
 - 2. Flowrate (gpm): 186
 - a. Designed for three biotrickling filters (two to be installed as part of this scope of work, one to be installed in the future under a separate contract)
 - 3. TDH (ft): 106
 - 4. Sump Pump Construction: Polypropylene
 - 5. Conditions: Suitable for pumping low pH (pH 2) wastewater

6. Wetwell Construction: FRP
7. Wetwell Dimensions (Min): 6-foot Diameter X 10-foot deep
8. Inlet: 3 inches
9. Outlet: 4 inches
10. Water Flush Manifold Solenoid: 120 Volt
11. Motor is TEFC enclosure and Corro Duty: 20HP 240/480 3 phase 60 Hz

2.2 SUMP WETWELL

- A. Wet well design, layout, and sump pump mounting to be in accordance with sump pump manufacturer's recommendations. Wet well shall contain a lockable hatch for maintenance accessibility. Provide floatation calculations. Wet well cover shall be complete with access inspection hatch rated for 300 PSF. Aluminum shall be checker no slip plate.
- B. Wet well shall be serial numbered and certified to be H-20 load rated and conform to ASTM D 3753 (latest version). Wet well shall be an integral, one-piece design with top flange, walls, bottom and anti-float flange all incorporated into a single watertight unit. To establish this H20 rating, the wet well shall not leak, crack or suffer other damage when load tested to 40,000 ft-lbs. Professional Engineer Certification shall be provided.
- C. The resin system shall be designed for atmospheres containing sulfuric acid, gases and liquids associated with wastewater collection systems. The resulting reinforced plastic material must meet the requirements of ASTM D 3753 specification and be suitable for the harsh wastewater environment. The exterior surface shall have a gray UV inhibitor resin coating- minimum of .125- inch thickness.
- D. The internal surface shall be smooth to prevent grease and scum from attaching to the walls. The use of corrugated material is not allowed. The bottom and any reinforcement necessary are to be completely enclosed with fiberglass lay up. Pump stub outs, electrical, service inlets and discharge lines shall be factory installed per ASTM D3299. Field inlets shall be installed by approved methods and with materials furnished by Technical Sales Corporation. The use of fiberglass pipe, tube or liner embedded into a concrete base does not meet ASTM D 3753 and will not be accepted.
- E. Hatch door shall have automatic hold open S/S safety arm and tamper proof S/S hinges.
- F. Field penetrations for inlet hubs and cutouts can be made with a hole or jigsaw and shall be sealed with waterproof epoxy kits and fused. Wet well inlets or "hubs" can be field fabricated with short pieces of PVC pipe, pipe coupling or a bell end of gasket joint PVC pipe.
- G. Concrete ballast shall be installed around the wet well to prevent floatation. The manufacturer shall size the concrete ballast and submit calculations to Engineer and Owner for review and approval.
- H. A prestressed concrete wet well top, as shown on the drawings, shall be provided and installed for the pump wet well. The manufacturer shall size the top sufficient to withstand an H20 wheel loading and submit calculation to the Engineer and Owner for review and approval.

2.3 MOTOR

- A. Motor shall be squirrel cage AC induction designed for continuous operation in corrosive environment.
- B. Enclosure:
 - 1. Motor shall be TEFC type enclosure with drains and breathers
 - 2. Motor shall be premium efficient and have Corrosive Duty feature.
 - 3. Motor shall be mounted with rain bonnet or as required by pump manufacturer.
- C. Power: Pump motors shall be 3 phase 60 hertz 480 volt class F insulation with B rise and a 1.15 service factor. The pump shall not require operation within the motor service factor.
- D. The motor shall have thermal protection and space heaters if permitted per frame size.
- E. The conduit box shall be design to include grounding lug.
- F. Motors shall have short commercial test. The motors shall be field megger by contractor prior to start up.
- G. Motor shall be manufacture by NIDEC/USEM.

2.4 PUMP STATION CONTROL PANEL

- A. Provide SJCUD standard lift station control panel and wet well level controls terminal box. Refer to Electrical Drawings and Details for the SJCUD standard lift station control panel requirements.
- B. The lift station control panel and terminal box shall be manufactured by a SJCUD approved lift station control panel manufacturer.
- C. The control panel shall be designed for 480 volt, 3 phase electrical service.

2.5 LEVEL SENSOR

- A. Float Switch, Mechanical, Chemical-Resistant to sulfuric acid, Switch Type Normally Open, Max. Amps Running 13, Voltage 115, Cord Length (Ft.) 30, Wire Gauge 16, Pumping Range Tether Length as required on drawings, Max. Temp. (F) 140, Includes Mounting Strap.

2.6 IDENTIFICATION

- A. Nameplate: Each unit of equipment shall be identified with a stainless steel corrosion resistant nameplate, securely affixed in a conspicuous place. Nameplate information shall include equipment model number, serial number, manufacturer's name, and location.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300, "Execution" for installation examination requirements.

3.2 INSTALLATION

- A. As indicated on Drawings and according to manufacturer's instructions.
- B. Initial Materials: Provide materials, grease, and oil as recommended by equipment manufacturers.

3.3 FIELD QUALITY CONTROL

- A. Inspection: Verify proper operation of equipment.
- B. Testing, Adjusting, and Balancing:
 - 1. Check control functions and adjust as required.
- C. Testing:
 - 1. Functional Testing: Prior to system startup, inspect components for proper alignment and connection and acceptable operation.
 - 2. Upon completion of installation, conduct tests, in the presence of the Engineer, to demonstrate that pump operation is in conformance with this Section and that the pumps operate without excessive noise, vibration, or overheating. Testing shall verify the specified head and capacity. Supply all electric power and water to conduct the field tests.
 - 3. If the pump performance does not meet the requirements specified, corrective measures shall be taken, or the pumps shall be removed and replaced with pumps which satisfy the conditions specified, at the Contractor's expense. The pumps shall then be retested.

3.4 MANUFACTURER SERVICES:

- A. Testing: The contractor with the manufacturers certified trained technician shall perform function test and record tested results, on the pump performance including the following:
 - 1. Un-coupled confirm rotation, no load motor amps and voltage, A-B, B-C, C-A.
 - 2. Perform functional test, as sump levels will permit, Isolating Sump and measuring liquid pump down rate over time to confirm each pump is pumping proper flow.
 - 3. Record discharge pressure using valved discharged and discharge pressure Gauge with Gauge Guard.
 - 4. Record ampacity at design flow and head. Record Voltage A-B, B-C, A-C.
 - 5. Record Tachometer speed at design flow.
 - 6. The bearings above grade and motor shall be recorded for temperature.

END OF SECTION 432427

This page intentionally left blank.

SECTION 432516 – VERTICAL TURBINE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide five (5) vertical turbine variable frequency driven transfer pumps, including their respective motors as shown on the Drawings and as specified herein.
- B. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, factory testing, delivery and complete installation and field testing of all materials, equipment and appurtenances for the complete pumping units as herein specified, whether specifically mentioned in these Specifications or not.
- C. The work under this Section includes supervisory services during installation and field testing of each unit and instructing the regular operating personnel in the proper care, operation and maintenance of the equipment.
- D. The pump manufacturer (Manufacturer) shall coordinate the design of the pump and motor with the variable frequency drives, as specified in Division 26.

1.3 RELATED WORK

- A. Concrete work and the installation of anchor bolts are included in Division 03; however, anchor bolts for these units as recommended by the pump manufacturer (Manufacturer) shall be furnished by the Contractor under this Section.
- B. Instrumentation and control work, except as specified herein, is included in Division 40. Instrumentation and controls provided in this section shall adhere to Instrumentation and Control Specifications Sections in Division 40.
- C. Valves, mechanical piping and appurtenances and pipe hangers and supports are included in Division 40.
- D. Electrical work except as hereinafter specified is included in Division 26.

1.4 DEFINITIONS

- A. Design, manufacturing and assembly of elements of the equipment specified herein shall be in accordance with the following, where applicable:

1. American Concrete Institute (ACI).
2. American Gear Manufacturers Association (AGMA).
3. American Institute of Steel Construction (AISC).
4. American Iron and Steel Institute (AISI).
5. American Society of Mechanical Engineers (ASME).
6. American National Standards Institute (ANSI).
7. American Petroleum Institute (API).
8. American Society for Testing Materials (ASTM).
9. American Water Works Association (AWWA).
10. American Welding Society (AWS).
11. American Bearing Manufacturers Association (ABMA).
12. Hydraulic Institute (HI) Standards.
13. Institute of Electrical and Electronics Engineers (IEEE).
14. International Organization for Standardization (ISO).
15. National Electrical Code (NEC).
16. National Electrical Manufacturers Association (NEMA).
17. National Sanitation Foundation (NSF).
18. Occupational Safety and Health Administration (OSHA).
19. The Society for Protective Coatings (SSPC).
20. Underwriters Laboratories (UL).

- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 SYSTEM DESCRIPTION

- A. The vertical turbine pumps will pump raw chlorinated water from Clearwell Complex Nos. 1 and 2 to the ground storage tanks. The on/off pump operation will be controlled by the corresponding on/off water surface levels within the clearwells. The equipment to be furnished under this Section shall include five vertical turbine raw water pumps, sole plates, motors, and accessories, all as specified herein and as shown on the Drawings. Refer to Division 26 for coordination with variable frequency drive motors and system description and control narratives. Contractor shall coordinate and be fully responsible for proper operation and compatibility between items in this scope of work and items in Division 40 scope.

1.6 QUALIFICATIONS

- A. To assure unity of responsibility, the motors, temperature monitoring and supporting sole plates for wet well mounted pumps shall be furnished and coordinated by the Manufacturer. The Contractor shall assume responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, variable frequency drives and sole plates as specified. Variable frequency drives are covered in Division 26.
- B. The equipment covered by this Section is intended to be standard pumping equipment of proven ability as manufactured by companies having extensive experience in the production of such equipment similar to the applications stated in Articles 1.4, 2.2 and 2.3. Units specified herein shall be furnished by a single manufacturer. The equipment provided shall be designed, constructed and installed to operate satisfactorily when installed as shown on the Drawings or as approved by the Engineer.

- C. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except where otherwise specified.
- D. The Manufacturer shall be fully responsible for the design, arrangement, and operation of all connected rotating components of the assembled pumping unit mounted on a fabricated steel baseplate to ensure that neither harmful nor damaging vibrations occur at any speed within the specified operating range.
- E. The Manufacturer or its representative shall have an authorized warranty center within a 300-mile radius of the job site, fully staffed with factory trained mechanics, and equipped with a stock of strategic spare parts for each model of pump furnished under this contract. The service facility and strategic spare parts shall be established prior to delivery of equipment for this project.
- F. All equipment furnished under this Specification shall be new and unused, shall be the standard product of manufacturers having a successful record of manufacturing and servicing similar equipment and systems to that specified herein for a minimum of five years.
- G. The pumping equipment shall be furnished complete with accessories required and shall meet the detailed requirements of the Specifications.
- H. The Manufacturer shall be certified to the ISO 9001 standard for design and manufacture of vertical turbine pumps.
- I. Welding of pressure-containing fabrications shall be by welders qualified to ASME Code Section 9 or AWS D1.1 Structural Welding Code – Steel.
- J. Prior to manufacture, a submittal must be forwarded to the Engineer indicating that the required vibration analyses outlined herein have been performed and that the specified limitations will be met. For the dynamic vibration analysis described, maximum operating speeds will be in accordance with the operating speeds required to satisfy the conditions of operation specified in Article 2.2. The dynamic vibration analysis required by the following paragraphs shall be performed by Mechanical Solutions Inc. (MSI) of Whippany, NJ, or Engineering Dynamics Inc. (EDI) of San Antonio, TX, or approved equal or alternatively by the Manufacturer if Manufacturer's demonstrated, successful, vibration analysis experience, in at least ten projects similar in scope, with proposed personnel involved, may be acceptable to the Engineer with analyses in accordance with the specified requirements.
 - 1. Structural dynamic analysis of the combined pump/motor system including the nearby foundation and the piping out to the first pipe restraint or expansion joint. Analysis shall not simply assume the foundation is rigid rather it shall incorporate foundation design shown on the Drawings. The structural dynamic analysis shall predict that no first or second bending mode frequencies will exist within 25 percent above maximum operating speed.
 - 2. A lateral rotordynamic analysis of the pump rotating system (i.e., motor rotor, line shafting, couplings, bowl shafting and impellers, etc.) shall identify and predict that the first lateral critical speed shall have a separation margin of at least 25 percent above the maximum pump speed. If a design modification (i.e., such as changing the bearing span or shaft diameter) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to demonstrate that the pump will function properly over the speed range.

3. A torsional rotordynamic analysis of the complete rotating system (pump, motor, intermediate shafting, and coupling) shall identify and predict that no torsional natural frequencies occur within a separation margin extending from 25 percent below to 25 percent above the specified pump operating speed range. Additionally, no natural frequencies shall be +/- 10% of 2x times running speed, line frequency, 2x line frequency, and vane pass frequency. If a design modification (i.e., such as a shaft diameter change or different coupling arrangement) cannot resolve a separation margin deficiency or is not practical, a forced damped response analysis shall be performed to show that infinite life will be achieved with a safety factor of at least two.
4. Campbell diagrams shall be submitted, documenting the structural lateral, rotating component lateral, and torsional analysis results, graphically demonstrating the separation margins specified above.
5. Maximum vibration velocity in inches per second RMS, measured in the field, shall conform to the requirements of ANSI/HI 9.6.4. In addition, for operating motor full load speeds less than or equal to 600 rpm, field vibration displacement in mils peak-to-peak shall conform to the requirements of ANSI/HI 9.6.4.

1.7 SUBMITTALS

- A. Submit, in accordance with Section 013300, copies of all materials required to establish compliance with the specifications. In the event that it is not practical to conform to certain details of the specifications because of different manufacturing techniques, describe completely all nonconforming aspects. Submittals shall include the following:
 1. Certified dimensional drawings showing all important details of pump construction and auxiliary apparatus.
 2. Baseplate, sole plate and pump support design details showing anchor bolt locations and sizing information.
 3. Literature and drawings describing the equipment in sufficient detail, including materials of construction, to indicate full conformance with the detail specifications.
 4. Schematic electrical wiring diagram and other data as required for complete pump installation.
 5. The total weight of the equipment including the weight of the single largest item.
 6. A complete materials table for all equipment establishing compliance with these specifications.
 7. A list of the Manufacturer's recommended spare parts with the Manufacturer's current price for each item. Include gaskets, packing, etc. on the list. List all bearings by the bearing manufacturer's numbers only.
 8. All information required by Division 01.
 9. A statement and supporting data indicating motor bearing life meets or exceeds specified value.
 10. Complete data on motors in accordance with Division 26.
 11. Complete description of surface preparation and shop painting for pumps and motors.
 12. Critical speed analyses report submittal including backup documentation and a statement of guarantee that the critical speed analyses as required in Paragraph 1.6 J of this Section have been completed and that the specified limitations will be met.

B. Design Data:

1. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves to ANSI/HI 14.6 acceptance grade 1U for all specified points, based on actual factory tests of similar units, which show that they meet the specified requirements for head, flow rate, efficiency, guaranteed maximum net positive suction head required (NPSH3), submergence and horsepower. Curves shall be submitted on 8 1/2-inch by 11-inch sheets, at as large a scale as is practical. Curves shall be plotted from zero flow at shut off head to pump flow rate at minimum specified total head (TH). The POR and AOR (refer to ANSI/HI 9.6.3) shall be clearly shown on the curves. This information shall be prepared specifically for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.

C. Test Reports:

1. Certified motor test data as described in Division 26.
2. Tabulated data for the drive motors including rated horsepower, full load rpm, power factor and efficiency curves at 1/2, 3/4 and full load, service factor and kW input, including when the pump is at its design point. Submit a certified statement from the motor manufacturer that the motors are capable of continuous operation on the power supply from the variable frequency drives without affecting their design life for bearings or windings.
3. Description of proposed pump factory test procedures and equipment.
4. Factory and field performance test data as specified in PART 2 and PART 3.
5. A schedule of the date of factory testing and delivery of the equipment to the job site.

D. Instructions, Certifications, and Reports:

1. Manufacturer's Installation Instructions.
2. Manufacturer's certification of installation meeting Manufacturer's installation, operation and maintenance manuals and as specified in PART 3.
3. Manufacturer's field report as specified in PART 3.
4. Submit warranty information to demonstrate conformance to Article 1.10.
5. Identify the entity and experienced individual who will inspect the installation in accordance with Article 1.8.
6. Welder certifications.

E. Project Record Documents.

1.8 MANUFACTURER SERVICES INCLUDING OPERATION INSTRUCTIONS

A. Operating and Maintenance Manual:

1. Operating and maintenance manual shall be furnished by the Manufacturer to the Engineer as provided for in Section 017823. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, description, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment. The maintenance instructions shall include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

B. Installation Inspection and Startup:

1. The Contractor shall include in his bid price the services of a Manufacturer's factory representative who has complete knowledge of proper operation and maintenance shall be provided to instruct representatives of the Owner and the Engineer on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and start-up. If there are difficulties in operation of the equipment because of the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. The listed service requirements are exclusive of travel time, and shall not limit or relieve the Contractor of the obligation to provide sufficient service necessary to place the equipment in satisfactory and functioning condition.
2. Installation inspection: Complete review of installation in accordance with Section 017700. Provide written certification that the installation is complete and operable in all respects, and that no conditions exist which may affect the warranty. The Manufacturer shall supply the installation inspection services of an experienced Manufacturer's factory representative to verify the proper pump installation. The Manufacturer's factory representative shall specifically approve the installation and alignment of the pump with the motor, the grouting, and the alignment of the connecting piping and the installation of the field installed packing or mechanical seal. If there are difficulties in the start-up or operation of the equipment due to the Manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner. Services of the Manufacturer's factory representative and training shall be provided when the first pump is started, with follow-up visits upon start-up of each subsequent pump.
 - a. Minimum time on-site shall be one 8-hour day per station.
3. Start-Up: Provide written report, summarizing test procedures, tested and measured variables (flow rates, total heads, shaft-speed, vibration testing, alignment check, etc.):
 - a. Minimum time on-site shall be one 8-hour day per station.

C. Training:

1. Field and classroom instruction on operation and maintenance of the equipment, including start-up, shut-down troubleshooting, lubrication, maintenance and safety.
2. The Manufacturer shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.

D. The Contractor alone shall be responsible for requesting these services, and shall coordinate these requests with all other relevant trades, to ensure the effectiveness of the Manufacturers' service. In the event that the lack of coordination by the Contractor results in the need to recall the Manufacturer's factory representative, the lost time shall not be counted against the above days.

1.9 TOOLS AND SPARE PARTS

- A. Furnish all special tools and test equipment required for the proper servicing of all equipment as specified in Section 017700. All such tools and test equipment shall be furnished in a suitable steel tool chest complete with lock and duplicate keys.

- B. All spare parts shall be properly protected for long periods of storage and packed in containers that are clearly identified with indelible markings as to contents.
- C. Furnish the following spare parts:
 - 1. Two total mechanical seals.
- D. Provide to the Owner a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after start-up and final acceptance.
- E. Special tools and spare parts shall be furnished in accordance with Section 017700.

1.10 PRODUCT HANDLING

- A. Delivery, storage and handling of equipment shall be in accordance with Section 016000 and as specified herein.
- B. All equipment and parts must be properly protected against any damage during shipment. Store the equipment in accordance with Manufacturer's recommendations.
- C. All completely assembled units shall be off loaded by the use of a primary and "tail" crane system. Additionally, when lifting the units from a horizontal position to a vertical position, the use of a primary and "tail" crane system shall be used.
- D. Long-Term Storage:
 - 1. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of fabrication, including storage in accordance with Manufacturer's requirements, until the unit and equipment are ready for operation.
 - 2. If long-term storage is required on-site, Contractor shall follow Manufacturer's detailed recommendations for long term storage.
 - 3. If the pumps are delivered and stored on-site in a horizontal position and left for an extended period of time, rubber line-shaft bearings may become deformed and the shafts may take on a permanent "sag". The Contractor shall be responsible for rotating the shafting so that damage does not occur.
- E. Factory assembled parts and components less than 25 feet in length shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- F. For units greater than 25 feet in length that are shipped unassembled, all connecting parts shall be "match-marked" by the Manufacturer to ensure correct assembly on-site by the Contractor.
- G. The finished surfaces of all exposed flanges shall be protected by wooden or equivalent blank flanges, strongly built and securely bolted thereto.
- H. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.
- I. No shipment shall be made until approved by the Engineer in writing.

- J. For protection of bearings during shipment and installation, the bearing shall be properly processed. Anti-friction bearings, if pre-lubricated, shall be protected in accordance with the bearing manufacturer's recommendations against formation of rust during a long period of storage while awaiting completion of installation and start-up of the machine in which they are used. Anti-friction bearings which are not pre-lubricated shall be properly treated in accordance with the bearing manufacturer's recommendation against formation of rust during a long period of storage while waiting completion of installation and start-up by the application of an appropriate rust preventative treatment.

1.11 WARRANTY

- A. All equipment supplied under this Section of the Specifications shall be warranted for a period of one year from date of startup or 18 months from date of shipment, whichever occurs first. Warranty period shall commence on the date of Owner acceptance, as outlined in Division 01 and in Division 00.
- B. The equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the Owner.
- C. The Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed

PART 2 - PRODUCTS

2.1 GENERAL

- A. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, and appurtenances such as, but not limited to, couplings, and guards. Ample room shall be provided for inspection, repairs and adjustments.
- B. Discharge head lifting lugs or eye bolts shall be provided by the Manufacturer.
- C. The pumps, motors, and vibration and temperature monitoring equipment shall be designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, excessive vibration or strain.
- D. Pump sole plates and baseplate shall be rigidly and accurately anchored into position, precisely leveled and aligned, so that the completed installation is free from stress or distortion. The baseplate shall be proportioned to support each entire pump/motor assembly and the loads to which it may be subjected during operation. All necessary anchor bolts, plates, nuts and washers shall be furnished as specified herein and installed and supplied by the Contractor and conform to the recommendations and instructions of the Manufacturer.
- E. The pump sole plate shall be bolted to the concrete foundation with Type 316 stainless steel anchor bolts and washers. Nuts on stainless steel anchor bolts shall be monel. Anchor bolt configuration and installation shall be in accordance with API RP 686 and ACI 318-08 where not in conflict with the specific requirements contained herein. An anti-seize compound of

molybdenum disulfide base such as Molycoat G or approved equal, shall be used on the anchor bolt threads. All skims, bolts, and nuts for mounting and anchoring shall be supplied by the Contractor.

- F. The pump support/anchors and associated accessories shall conform to the following:
1. Support pump on sole plate and anchored with Type 316 stainless steel bolts and monel nuts, where nuts used and located as shown on the Drawings. Special slings, strongbacks, or other devices necessary to handle the pump during loading, unloading, erection, installation, and subsequent disassembly and assembly shall be furnished by the Contractor.
 2. Sole plate shall be provided under pump baseplate. The sole plate shall be installed, leveled and grouted in accordance with API RP 686, Chapter 5 – Mounting Plate Grouting. Jacking bolts and Five Star non-shrink epoxy grout as specified below shall be provided for leveling pump baseplate assembly.
 3. An anchor bolt layout shall be provided to aid in placement of anchor bolts. All leveling jacking bolts shall be backed off after grouting so that they do not support any of the load. The use of shims or leveling nuts on anchor bolts is specifically prohibited.
 4. The grout for use in grouting under the sole plate supported by jack bolts shall be Five Star DP Epoxy Grout which is an expansive, non-shrink, low exothermic epoxy system, or approved equal, mixed and applied according to the manufacturer's directions to a thickness as noted in the Manufacturer's IOM.
 5. The presence of the Manufacturer's representative during the pouring of the epoxy grout as well as the use of rigid non-absorbing formwork and a head box are mandatory. The surface of the formwork in contact with the epoxy grout shall be covered with a layer of paste wax to facilitate removal. Clearance between the concrete surface and the bottom surfaces of the sole plate shall be per Manufacturer's recommendation.
 6. The concrete surface to be in contact with the epoxy grout shall be chipped to present a slightly rough surface and remove the laitance. The surface shall then be cleaned of all dust, moisture and oil. A 1-inch minimum diameter by 1/4 inch thick stainless steel disk, with full radiused edges shall be placed under each jack bolt. A thin layer of leveling grout shall be placed under metal discs on which the jack bolts shall bear. All metal edges in contact with the epoxy grout shall be radiused to a minimum 1/2 inch radius in order to prevent stress risers in the epoxy grout. Plastic vent tubes, sized and spaced per Manufacturer's recommendation, shall be placed under the sole plate to vent air during grouting and prevent voids in the epoxy grout.
 7. The annular space between the anchor bolts and the anchor bolt sleeve shall be filled with expanding urethane foam. The threads of both the anchor bolts and jack bolts in contact with the grout shall be covered with paste wax and a layer of duct tape. After all alignment tolerances are met, the anchor bolts shall be tightened snug to prevent movement during the pour. The epoxy grout shall not be allowed to extend above the top edge of the sole plate. After the epoxy grout has fully cured, within 24 to 48 hours after pouring, the jack bolts shall be removed and the anchor bolts tightened to the torque levels as recommended by the Manufacturer.
 8. The threaded jack bolt holes shall be coated with grease and the jack bolts cleaned of the paste wax and duct tape then reinserted and secured in position with a lock nut to within 1/4 inch of the bottom of the hole. After grouting, edges shall be chipped and patched to present a smooth finish.
- G. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. At a minimum, the nameplate

for the pumps shall include the Manufacturer's name and model number, serial number, rated flow rate, head, and speed. At a minimum, nameplates for motors shall include the manufacturer's name and model number, serial number, horsepower, speed, input voltage, amps, number of cycles and power and service factors.

- H. The pump and its driving equipment shall be designed and constructed to prevent reverse rotation using a non-reverse ratchet installed in the electric motor. As an alternate, the pump and motor shall be designed and constructed to successfully withstand a maximum turbining speed of the unit resulting from backflow through the pump. Manufacturer shall determine maximum potential reverse rotational speed for design.
- I. The maximum sound pressure level from one pump/motor when operating on utility power measured 3 feet from the equipment and 5 feet above the floor shall be 85 dBA.
- J. The nameplate ratings of the motor shall not be exceeded, nor shall the design service factor be reduced when the pump is operating at any point on its performance curve within the specified operating range at maximum speed.
- K. Mechanical equipment, including electric motors shall be supplied and installed in accordance with applicable OSHA regulations. The Contractor's attention is drawn to the requirement for guards on all rotation assemblies.

2.2 CONDITIONS OF OPERATION

- A. The pumps shall be 15EBM-1 Stage by Flowserve; or Model 16HXB by Peerless. The pumps shall be identical in every respect with all parts interchangeable.
- B. Each pump shall be designed for the conditions of service tabulated as follows and shall operate within the system head curve envelope as appended. All pumps shall have a continuously rising (from runout toward shutoff) head-flow rate performance curve for stable pump operation within the AOR.
- C. The pumps shall operate throughout the specified operating range.

TABLE 11214-1
PUMPING UNIT DESIGN REQUIREMENTS

Item Description	Design Conditions
Service	Raw Water
Number of Pumps	5
Maximum Motor Full Load Speed (FLS) (rpm)	1,185
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	25
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	72
Minimum Pump Discharge Nozzle Size (inches)	10
Minimum Pump Column Diameter (inches)	10
Pump Shut-Off Head at Motor FLS Acceptable Range (minimum) (feet)	48.5
Flow Rate at Secondary Operation Point (gpm)	3350

Item Description	Design Conditions
Minimum TH at Secondary Operation Point (feet)	13
Minimum Bowl Efficiency at Secondary Operation Point (%)	72
Maximum NPSH3 at Secondary Operation Point (feet)	17
Intermediate (Design) Point Flow Rate (gpm)	2,100
Minimum TH at Intermediate (Design) Point (feet)	32
Minimum Bowl Efficiency at Intermediate (Design) Point (%)	78
Maximum NPSH3 at Intermediate (Design) Point (feet)	33.4
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	2,500/2,750
Minimum Bowl Efficiency at BEP (%)	81
BEP Location Relative to Intermediate Design Point	Right
Primary Operating Point TH (feet)	34
Minimum Flow Rate at Primary Operating Point (gpm)	1,775
Minimum Bowl Efficiency at Primary Operating Point (%)	71%
Maximum NPSH3 at Primary Operating Point (feet)	9
Minimum Submergence Above Pump Suction Bell (feet)	2

2.3 PUMP CONSTRUCTION

- A. Vertical turbine line-shaft pumps shall be lubricated via pumped process water for the line-shaft bearings and inter-bowl bearings as specified below. The pump will be complete with motor support and discharge head and shall conform to AWWA E 103, Horizontal and Vertical Line-Shaft Pumps, and ANSI/NSF 61 and ANSI/NSF 372 where not in conflict with the requirements contained herein. All pump assemblies shall be evaluated by the Manufacturer for galvanic corrosion potential and zinc anode protection systems provided where required.
- B. Pump bowls, including suction bell, shall be ASTM A48, Class 30 cast iron, flanged and bolted construction with bearings as specified below. All bowl hardware shall be Type 316 stainless steel with monel nuts. Bowls shall be equipped with Type 420 stainless steel wear rings.
- C. Impeller shall be enclosed type of nickel aluminum bronze ASTM B148 Alloy C95800 or CF8M cast stainless steel, two-plane dynamic balanced in accordance with ISO 1940-1 quality grade G2.5. Enclosed type impeller design shall include adequate material so as to provide for the future addition of wear rings to restore impeller efficiency.
- D. Impeller shafts and couplings shall be Type 316 stainless steel. Collets and locknuts shall be Type 316 stainless steel.
- E. Bowl bearings shall be product lubricated bismuth tin bronze (ASTM B505 Alloy C89835) and lineshaft bearings shall be cutlass rubber mounted in bronze or stainless steel bearing supports supported between column flanges.
- F. Discharge columns shall be fabricated steel, flanged and bolted construction in lengths not exceeding 10-ft. All flange hardware shall be Type 316 stainless steel with monel nuts. The minimum wall thickness shall be in accordance with Table E-1 of AWWA E-103.

G. Pump Discharge Heads:

1. Provide above-base L-Type discharge head with flanged spacer couplings and an integral circular baseplate of fabricated carbon steel with 150 lb ASME B16.5 or B16.47 flanged connections specifically designed to elevate the discharge head natural frequency above the operating speed plus specified separation margin. The base of the discharge head shall be machined to match the drilling of the can top flange or adaptor flange if can is oversized as selected by the Manufacturer or as shown on the Drawings complete with all Type 316 stainless steel bolts and washers and monel nuts. The pump shall be equipped with a 1 inch (25 mm) tapped vent in the pump baseplate with a 1 inch (25 mm) 316 stainless steel nipple, 316 stainless steel ball valve, and J-tube for the removal of air from the can. A can top flange shall be welded to the suction can at the location shown on the Drawings and as specified below.
2. Motor mounting flange for the vertical driving motor shall be of standard NEMA dimensions for commercially available motors.
3. The top of the discharge head shall have a registered fit for mounting the driving motor.
4. The discharge head shall include a stuffing box and have large openings for pump adjustment and seal maintenance. Provide suitably sized drain connection and tap for pressure gauge at discharge nozzle, complete with 1/4-in brass pipe nipple and stainless steel ball valve by installing Contractor. Stuffing box must be located and accessible above pump baseplate.

H. Stuffing box/seal box sealed with cartridge type mechanical seal: The discharge head shall be fitted with a mechanically sealed type stuffing box. Stuffing box shall be equipped complete with a T-21 (Materials: B F50 1 O15 1) cartridge type mechanical seal as manufactured by John Crane, Flowserve type ISC2 seal, or equal. Each seal shall be hydraulically balanced, have self-aligning faces and a threaded port for flushing/venting. The seal must be a stationary design and capable of handling 200 psi at shutoff. Small diameter drain piping shall be secured to the pump column and be armored to prevent damage during installation and removal. System shall be configured in accordance with API Plan 13.

1. O-rings shall be compatible with the fluid being pumped. The gland shall be of a universal design to fit varied bolt sizes and circles. The gland shall have a minimum of one tapped flush/by-pass port that can be rotated 360 degrees to accommodate flush piping.
2. The Pump Manufacturer shall install a throat bushing in the bottom of stuffing box to throttle flow into seal area. The throat bushing shall be nickel aluminum bronze.

I. Vortex suppressor: A pump suction bell mounted “basket” style vane type vortex suppressor, or other pre-approved device shall be furnished and installed to reduce the possibility of vortices entering the pump. The dimensions of the device shall be as recommended by the Manufacturer or Flow Optimizers, LLC.

J. The construction of the pumps, position and number of column pipe flanges shall be such that the pumps can be readily installed and removed for repairs within the crane vertical lift limitations using normal methods of operation and handling without undue difficulties.

K. Line-shafts and couplings shall be vertical hollow shaft, Type 316 stainless steel and shall be field replaceable. Maximum shaft lengths shall be 10-ft. Material for vibration isolation devices shall be consistent with materials used on other wetted components.

2.4 MOTOR TO PUMP COUPLING

- A. Pump shafting shall be directly connected to the motor by means of a flanged adjustable spacer coupling, suitably sized to transmit the required driving torque, axial thrust and be easily accessible for impeller adjustment or mechanical seal replacement:

2.5 MOTORS

- A. Each pump shall be driven by a vertical solid shaft inverter duty rated squirrel cage induction electric motor with a maximum horsepower and speed as specified under Article 2.2 above and with totally enclosed fan-cooled (TEFC) enclosure with rain shields, winding temperature detectors and shall meet all the requirements of Division 26 and include a thrust bearing capable of handling both the mechanical and hydraulic thrust of the pump.
- B. The pump motors shall be suitable for driving the pumps continuously over the entire pumping range. The pump motors shall be furnished by the Manufacturer. A non-reverse ratchet shall be installed in the motor to prevent reverse rotation.
- C. Non-reverse ratchet:
 - 1. The non-reverse ratchet shall provide immediate protection against reversing due to phase reversals or from backspin at shutdown.
 - 2. The non-reverse ratchet shall be a shaft mounted mechanical device configured with an outer rotating component equipped with a series of holes bored at angles. The holes shall house hardened steel balls. The inner stationary component shall consist of a series of flutes to receive the balls, with one of which shall engage in the locked position the instant the motor stops running. The number of flutes shall differ from the number of balls to increase the number of possible locking positions.
 - 3. In cases of conflict with the motor specification this Section shall control.
 - 4. The non-reverse ratchet shall be robust enough to withstand the motor torque developed during accidental reverse rotation.
 - 5. The non-reverse ratchet shall disengage due to normal rotation speed of no more than 20% of full speed.
- D. All lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards, or without creating falling hazards. Fittings shall be buttonhead type. Lubrication fittings shall be mounted together wherever possible. Pressure grease-lubricated fittings shall be the "Zerk Hydraulic" type or the "Alemite" type. Housings of grease-lubricated bearings shall be automatically exhausted to the atmosphere to prevent excessive greasing.
- E. Motors shall be mounted to the top of the pump discharge head motor stand with Heavy Hex Grade 8 bolts, nuts and washers torqued to the Manufacturer's recommended value.
- F. Refer to Division 26 for additional motor requirements.

2.6 SHOP PAINTING

- A. Each piece of equipment in the pumping system including pump, support system, motor and associated equipment shall be prepared, shop-primed and finished-coated in accordance with Division 09. Finish coating shall be field applied by Contractor. Colors shall be per St. Johns County Utility Department standards. Adequate supply of touch-up paints shall be supplied by the Manufacturer.
- B. All interior and exterior wetted surfaces of pump columns and discharge heads and the exterior of the bowl assemblies shall be cleaned of all rust and mill scale, grease, dirt, other foreign matter and supplied with Manufacturer's standard NSF61 approved epoxy coatings.
- C. All nameplates shall be properly protected during painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Take all necessary measurements in the field to determine the exact dimensions for all work and the required sizes of all equipment under this Contract. All pertinent data and dimensions shall be verified.
- B. Installation shall be in strict accordance with the Manufacturer's instructions and recommendations in the locations shown on the Contract Documents and pump shop drawings. Refer to Article 1.7 for additional requirements. The Contractor shall furnish all required oil and grease for initial operation, if required, in accordance with the Manufacturer's recommendations. Anchor bolts shall be set in accordance with the Manufacturer's recommendations and setting plans.
- C. If the Contractor does not provide qualified installation staff on the job during the pump installation, the Engineer may direct the Contractor to provide the services of a Manufacturer's factory representative to give the necessary instructions to ensure a proper installation.
- D. Refer to Article 2.1 for additional installation (sole plate temporary support, grouting, etc.) requirements. Connection of piping to pumps shall be done in the presence of the Engineer. All piping connections to the pump shall be done without bending and/or twisting the piping to mate with the pump flange connections.
- E. A certificate from the Manufacturer shall be submitted stating that the installation of their equipment is satisfactory, that the equipment is ready for operation, and that the Owner's operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.2 INSPECTION AND TESTING

- A. General:
 - 1. The Engineer shall have the right to inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.

2. Field tests shall not be conducted until such time that the pumping system, including controls, is complete and ready for testing.

B. Factory Pump Testing:

1. Each pump shall be non-witnessed factory tested as described in ANSI/HI 14.6, American National Standard for Rotodynamic Pumps for Hydraulic Performance Acceptance Tests, as specified herein.
2. The Manufacturer shall perform hydrostatic test on the pressure-containing parts in accordance with ANSI/HI 14.6. Test shall be conducted on each pump prior to shipment.
3. Cast surfaces of all components shall be examined by visual inspection per MSS SP-55.
4. Factory pump tests shall be the basis of acceptance of the hydraulic performance of the pumps. The Manufacturer shall factory test all pumps prior to shipment in accordance with the Hydraulic Institute standards. Flow rate, total head, efficiency and input KW shall be tested and recorded for at least five points on the pump performance curve. Test shall be performed to demonstrate that the pumps meet ANSI/HI 14.6, acceptance grade 1U for the design point. The five points shall include the points specified in Article 2.02. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the flow rate, head or efficiency requirements for any of the conditions listed in Article 2.2 of this specification and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with a unit(s) that meets the specified requirements.
5. Certified pump performance curves shall be submitted, including total head, flow rate, bowl efficiency and total brake horsepower for each pump supplied. Test data shall be submitted for approval by the Engineer prior to shipment.
6. If the Manufacturer does not have historical records for NPSH3 at the specified design pump speed, one pump shall be tested to demonstrate NPSH3 versus flow rate.
7. All meters, gauges, and other test instruments shall be calibrated within the manufacturer's established time period prior to the scheduled test and certified calibration data shall be provided. If the Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards shall govern.
8. In lieu of testing with all job equipment, job pump bowls may be tested with a laboratory column pipe and discharge head of the same size to that furnished for final installation. The length of column pipe shall be the same as will be required to set the bowl in the field.
9. The pumps shall be tested at 100 percent of the design speed. Reduced speed curves will be determined using affinity laws.

- C. Pump motor tests, including physical testing after manufacture and before shipment to determine actual motor reed critical frequency of each motor, in two perpendicular planes denoted relative to the conduit box, at the motor manufacturer's facility, as specified in Division 26 shall be submitted for approval by the Engineer prior to shipment.

D. Field Testing:

1. In the presence of the Engineer, necessary tests shall be performed to indicate that the pumps and motors generally conform to the operating conditions specified. The factory testing specified above will be the basis of performance acceptance. A 7-day operating period of the pumps will be required before acceptance. If a pump performance does not generally agree with the factory test results, corrective measures shall be taken or the pump shall be removed and replaced with a pump that satisfies the conditions specified.

- Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval no fewer than 30 days prior to testing.
2. After installation and as soon as conditions permit full speed operation, the Contractor shall retain the services of a fully experienced independent mechanical vibration testing and analysis firm, either Mechanical Solutions Inc. (MSI) Whippany, NJ, or Engineering Dynamics Inc. (EDI) San Antonio, TX or pre-approved equal, to perform a detailed vibration signature analysis of each unit(s) in accordance with ANSI/HI 9.6.4, including both "Bump Tests" and X-Y vibration profiles, to (a) prove compliance with the specified vibration limitations and (b) prove there are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range. Testing shall occur at the design full speed, design minimum speed, and at a maximum of 3 Hz increments between minimum and full speed. A written report shall be submitted including a detailed schematic drawing of the units indicating thereon where and in which direction the vibration readings were taken and recorded showing (a) peak-to-peak displacement, in mils, (b) frequency spectrum, (c) peak velocity level, in inches per second, (d) velocity level, in inches per second RMS. The report shall contain a complete analysis of their findings, describing any problem encountered, if any, probable cause and specific recommendations for any required corrective action.
 - a. If required, take corrective action: Retested units to ensure full compliance with this Section. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.
 3. Motor tests:
 - a. Prior to any pump mechanical test, the Contractor shall megger each motor winding before energizing the motor, and, if insulation resistance is found to be low, shall notify the Engineer and shall not energize the motor.
 - b. Prior to any pump mechanical test, the Contractor shall check all motors for correct clearances and alignment and for correct lubrication in accordance with the motor manufacturer's instructions. The Contractor shall check direction of rotation of all motors prior to any pump mechanical test and reverse connections, if necessary.
 - c. The Contractor shall meet all the testing requirements of Division 26.
 - d. If required, take corrective action and have the units retested to ensure full compliance with the specified requirements. All costs associated with the field tests or any required corrective action shall be borne by the Contractor.

END OF SECTION 432516

SECTION 443133 – BIOTRICKLING FILTER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Biotrickling filter system equipment.
- B. Furnish labor, materials, equipment and incidentals required for the installation, startup, warranty and testing of the complete, fully functioning biotrickling filter system as shown on the Drawings and as specified.
- C. System Includes:
 - 1. Fiberglass reinforced plastic (FRP) biotrickling filter vessels: Two equipped with the following:
 - a. Exhaust stack.
 - b. Media.
 - c. Mist eliminator.
 - d. Instrumentation, wiring, electrical components, and local control panel.
 - e. Automatic irrigation system including recirculation for startup, supplemental nutrient supply equipment, and nutrient tank.
 - f. Local Control Panel and Local Control Station.
 - g. All items as shown on the Drawings and as specified, and as required for a fully functioning system.
- D. Contractor's Responsibilities:
 - 1. Install a fully functioning system and coordinate with biotrickling filter manufacturer to meet requirements specified and shown on the Drawings.
 - 2. Furnish proper functioning internal piping and appurtenances.
 - 3. Furnish water, drain and interconnect piping.
 - 4. Furnish connecting ductwork and dampers.
 - 5. Power and control wiring to biotrickling filter system, including power and control wiring between the biotrickling filter system electrical control panel and the water panel.
 - 6. The manufacturer to furnish and be responsible for integral electrical components i.e. transformers, control panels and circuits, interlocks, instrumentation, etc. required for proper functioning of the system.
- E. This Specification gives a general description of system requirements, but does not cover all details, which will vary depending on manufacturer and requirements of application. It does cover the furnishing, delivery, installation supervision, startup, warranty, and field testing of

materials, equipment and appurtenances for a complete biotrickling filter system as specified, whether specifically mentioned in this Section or not.

F. Related Requirements:

1. Division 3, "Concrete" for concrete requirements as required for this Section.
2. Section 055000, "Metal Fabrications" for fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
3. Section 099010, "Shop Priming" for surface preparation and shop painting for equipment specified in this section.
4. Section 233116, "Fiberglass Ductwork and Accessories"
5. Division 26, "Electrical" for electrical requirements as required for this Section.
6. Division 40, "Piping" for piping requirements as required for this Section.
7. Division 40, "Instrumentation" for instrumentation requirements as required for this Section.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.
- B. H₂S: Hydrogen Sulfide.
- C. Manufacturer: The term "manufacturer" as used in this specification will refer to the manufacturer of the biotrickling filter system or the manufacturer's authorized representative.
- D. OIT: Operator interface terminal.
- E. PLC: Programmable Logic Controller.
- F. Scfm: Standard cubic feet per minute.
- G. Ppm: Parts per million.

1.4 ACTION SUBMITTALS

- A. Section 013300, "Submittal Procedures" for submittals requirements.
- B. Product Data:
 1. Manufacturer information for system materials and component equipment.
 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
 3. Biotrickling Filter Design and Operation Information: Performance criteria as specified in in PART 2 of this Specification.
 4. Nozzle Data: Construction details, water distribution pattern, and attachment to vessel.
 5. Media Data Including, but not Limited to the Following:
 - a. Media physical characteristics.
 - b. Liquid hold up data.
 - c. Media layout, and supports.
 - d. Pressure drop through media.

- e. Descriptive information of packing media, including height of transfer units for gas and liquid loading rates specified and packing supports.
 - f. Media replacement instructions.
 6. Complete data on the operating headloss for air flow through the vessels (including media, and exhaust stack) at design air flow rate, including initial and maximum.
 7. Materials of Construction: FRP resin, and laminate sequence.
 8. Details of Vessel Construction:
 - a. Include thickness of each layer.
 - b. Glass fiber type and percent by weight.
 - c. Resin type and percent by weight.
 - d. Percent antimony trioxide and UV stabilizers.
 - e. Statement from manufacturer that materials and resins used are suitable for the intended service.
 9. Recirculation Pump (as required for startup): Data sheets with a description of proposed pump, pump size, type, performance curve, dimensional data, materials of construction, weight, motor horsepower, efficiency, motor type, power supply, anchor bolt locations and requirements, and accessories.
 10. Instrumentation data.
 11. Complete operating description and programming control narratives, and a detailed list of inputs/outputs (I/O) wired to supplied control panel.
 12. Electrical wiring diagrams.
 13. Complete description and data of surface preparation and shop prime painting.
 14. Instrumentation, control, logic and power wiring diagrams. Sufficient detail to allow installation of the instrumentation, controls, and electrical components. Include the following:
 - a. Panel heat load calculations.
 - b. UPS runtime and sizing calculations.
 - c. PLC/OIT control descriptions.
 - d. OIT screen shots of graphic screens, and PLC database.
- C. Shop Drawings:
 1. Certified shop and erection drawings including important details of construction and dimensions for entire system, including fans, dampers, inlet duct manifolds, duct supports on the equipment pad, control panels, pumps, storage tanks, and interconnecting piping.
 2. Operating weight of all equipment.
 3. Installation and anchoring requirements, fasteners, and other details.
 4. Foul air duct, drainage piping, and layouts and dimensions.
 5. Control panel, water panel and instrument interior layouts and dimensions.
 6. Process and piping diagram, with instrumentation list, cut sheets, and spare parts list. Bill of Materials for equipment.
 7. Spare parts list.
 8. Special tools list.
 9. Sufficient information to allow Engineer to check clearances, connections, and conformance with the specifications.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Products meet or exceed specified requirements.
 - 1. Statement from the resin and vessel manufacturer that materials and resin meet specifications stipulated in this section and are suitable for this installation including UV, acid, and corrosivity resistance.
 - 2. Statement that all equipment and materials are appropriate for an outdoor and corrosive environment at water treatment facility. Materials that are not corrosion resistant (e.g. carbon steel) are not permitted.
 - 3. Statement that all materials are appropriate for the fluids/streams that they come in contact with.
 - 4. A list of non-conforming aspects of this specification, with clear reasoning for deviation, requiring Engineer approval prior to equipment fabrication or ordering materials.
 - 5. Any revision during the submittal phase to meet the specification will come at no additional cost to the Owner.
- B. Manufacturer Instructions: Detailed instructions on installation requirements, including storage, lifting, and handling procedures.
- C. Mechanical Commissioning and Start-up, acclimation procedures and the layout for temporary piping required during the acclimation period.
- D. Source Quality-Control Submittals: Plans and results of factory tests and inspections.
- E. Field Quality-Control Submittals: Plans and results of Contractor-furnished tests and inspections.
- F. Manufacturer Reports: Certify equipment is installed according to manufacturer instructions. Statement will include the following:
 - 1. Installation of equipment is satisfactory.
 - 2. Units are satisfactorily tested, and ready for operation.
 - 3. Operating personnel have been suitably instructed in the operation and care of the units.
- G. Qualifications Statements:
 - 1. Qualifications for manufacturer, installer, and licensed professional.
 - 2. Manufacturer's approval of installer.
- H. Operation and Maintenance Data in accordance with Section 017823.

1.6 DELEGATED DESIGN SUBMITTAL

- A. Delegated Design Submittals: detailed dimensional Shop Drawings with design calculations and assumptions including the following.
 - 1. Scrubber vessel construction, hold down lugs, anchoring, bracket and vessel flange thicknesses, scrubber vessel anchor size requirements and locations where anchor bolts must be placed.

2. Scrubber vessel, stacks, and applicable appurtenances can withstand the wind load and live load design criteria specified herein.
3. Complete description of surface preparation and shop prime painting.

1.7 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures” for closeout submittals requirements.
- B. Equipment start-up and training documents for approval prior to commissioning.
 1. Mechanical commissioning procedures.
 2. Acclimation procedures.
 3. Training program.
 4. Performance testing protocol.
 5. Reports as listed under “Informational Submittals” Article in PART 1.
- C. Project Record Documents: Record actual locations of installed biofilters.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017700, “Closeout Procedures” for maintenance materials requirements.
- B. Spare Parts:
 1. Nutrient Metering Pump:
 - a. Diaphragm Assemblies: One.
 - b. Check Valve Assemblies Consisting of Check Valves, Valve Seats, and Gaskets: One.
 - c. Sets of Piston Seals and Shaft Oil Seals: One.
 2. Scrubber:
 - a. Gaskets for Gasketed Covers and Connections: Two sets.
 - b. Spray Nozzles: One Set.
 3. Instrumentation:
 - a. Surge Protectors: One for each type and voltage provided.
 - b. Pressure Transmitter: One replacement pressure transmitter.
 - c. Flow Switches: One replacement flow switch for each type provided.
 - d. Miscellaneous: Calibration standards, as needed, to operate and maintain furnished equipment.
 4. Control Panel Spare Parts:
 - a. Timers and Sockets: 2 of each type installed.
 - b. Relays and Sockets: 2 of each type installed.
 - c. Fuses and Circuit Breakers: 10 percent of each type and size installed. Minimum of 10 fuses and 2 circuit breakers.

- d. Light Bulbs: 10 percent of each type and size installed. Minimum of 10.
 - e. LED Lights: 5 percent of each color installed. Minimum of 3.
 - f. Panel Mounted Power Supplies: One of each type installed.
 - g. Selector Switches and Pushbuttons: Two of each type installed including contact blocks.
- C. Pack spare parts in sturdy containers with clear indelible identification markings, referencing the equipment that they are intended for, and will be stored in a dry, warm location until transferred to the Owner at the conclusion of the project. Provide complete ordering information including manufacturer, part number, part name and equipment for each part to be used.
- D. Manufacturer will furnish special tools that are required to assemble, disassemble, repair, and maintain any item of mechanical equipment, with respective equipment. Special tools will include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance. When special tools are provided they will be marked or tagged, and a list of such tools will be included with maintenance and operation instructions describing use of each marked tool. Additional requirements will be included with individual items of equipment.

1.9 QUALITY ASSURANCE

- A. Perform Work according to St. Johns County Utility Department standards.
- B. Maintain a copy of each standard affecting Work of this Section on Site.

1.10 QUALIFICATIONS

- A. Equipment provided, designed and furnished by a single manufacturer fully experienced, reputable and qualified in system and equipment specified. This Specification calls attention to certain features, but does not purport to cover all details entering into the design and construction of the equipment.
 - 1. Equipment offered may differ from what is specified if approved by the Engineer to be equivalent in performance.
 - a. Any revision in design or construction to accommodate equipment offered will be made at no additional cost to the Owner and approved by the Engineer.
- B. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience fabricating substantially similar equipment using the same media and irrigation system specified herein.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products requirements.

- B. Deliver materials in coordination with installation of the pad, wiring, and piping by others. Contractor is responsible for ensuring that equipment is delivered after the installation of the pad.
- C. Exercise care during loading, transporting, unloading, and handling to prevent damage of any nature to interior and exterior surfaces of pipe and fittings. Do not drop pipe and fittings. All equipment and materials to be properly protected and maintained such that no damage will occur from the time of shipment until the completion of the installation.
- D. Ship vessel in the vertical or horizontal position. Multiple shipments are acceptable.
 - 1. Manufacturer is responsible for any damage to the shape of the unit.
 - 2. Contractor must orient the vessel vertically upon offloading the vessel.
 - 3. Lifting lugs (minimum of three) provided for use in transporting and placing the vessel.
- E. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Equipment to be inspected and accepted by Owner and Contractor before unloading at installation site.
- F. Store and maintain materials on the project site in enclosures or under protective coverings in accordance with manufacturer's recommendations and as required by the Engineer.
- G. Protection: Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 1. Position the equipment as required by the Manufacturer.
 - 2. Provide additional protection according to manufacturer instructions.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Document field measurements on Shop Drawings.

1.13 WARRANTY

- A. Section 017700, "Closeout Procedures" for warranties requirements.
- B. Furnish two year manufacturer's warranty for biotrickling filter system and accessories.
 - 1. Vessel Degradation: As a result corrosion or UV barrier failure. Structural failure (cracking) of flanged connections or connections of hold down lugs.
- C. The Manufacturer must warrant the suitability of the biological reactor media for a period of 10 years, provided that system is operated in accordance with the manufacturer's Operation and Maintenance Manual. In the event of a failure of the media within the 10-year warranty period, the manufacturer will replace the media at no expense to the Owner or Contractor and the 10 year warranty reinstated for the replacement media.

1. Media Failure: As a result of compaction and/or fouling resulting in pressure drop in excess of 5 times the pressure drop at start-up. Diminished performance as a result of preferential pathways developing in the media (channeling).

PART 2 - PRODUCTS

2.1 BIOTRICKLING FILTERS

- A. BioAir Solutions was used as the basis of design for the biotrickling filter system. Approved Manufacturers are as follows:
 1. BioAir Solutions.
 2. Biorem Technologies.
- B. Description:
 1. Biotrickling Filter System: Continuously and automatically treat and effectively remove hydrogen sulfide, and eliminate odors in the air exhausted from the degasification system as shown on the Drawings and as specified. Odorants are removed by microbial action within media in the biotrickling filters.
 2. Type: Vertical tower including media, irrigation system, pumps (as required for startup), controls, ductwork, etc..
 3. Operating Condition: Pressure.
- C. Performance and Design Criteria:
 1. Scrubber system to meet all applicable OSHA and local safety requirements.
 2. Total Air Flow Rate: 27,000 scfm .
 3. No. of Parallel Vessels: Two.
 4. Capacity per Train: 13,500 scfm.
 5. Maximum Pressure Drop from entrance of odor control vessel to outlet stack: 7-inch wg.
 6. Minimum Empty Bed Residence Time (EBRT): 8 seconds.
 7. Hydrogen Sulfide Concentration (Single System):
 - a. Average Inlet: 50 ppm.
 - b. Peak Inlet: 80 ppm.
 - c. Outlet: Average hydrogen sulfide removal efficiency to be equal to or greater than 99 percent OR average outlet H₂S concentration not to exceed 0.5 ppm, whichever is less stringent.
 8. Components of system must be compatible with the conditions and constituents to which they will be subjected to during normal operation. Compounds with which the materials of construction must be compatible with include, but are not limited to:
 - a. Hydrogen Sulfide.
 - b. Sulfuric Acid.
 9. Ambient Temperature: 28 degrees F to 105 degrees F.

10. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
11. Irrigation and water requirements as specified below.
12. Dimensional and weight requirements as specified below.
13. Seismic requirements as specified herein.
14. Manufacturer is responsible for providing a fully functioning system as required under the environmental conditions specified.
15. Any additional equipment will come at no additional cost to the Owner.

D. Irrigation:

1. Total Instantaneous Maximum Water Flow Rate Available: 124 gpm.
2. Total System Water Consumption: 41,000 gallons/day.
3. Available Water Pressure: 70 psi at the water panel.
 - a. Contractor to confirm existing plant pressure conditions. If water pressure conditions are not sufficient for the biotrickling filter system, manufacturer will provide a booster pump at no additional cost to Owner.
4. Water Quality:
 - a. Total Chlorine: < 2 mg/L.
 - b. Hardness: 200 mg/L.
 - c. Total Suspended Solids: < 5 mg/L.
 - d. Total Kjeldahl Nitrogen: 1 to 2.5 mg/L.
 - e. Total Phosphorus: 0.1 to 2 mg/L.
5. Contractor to confirm water quality and pressure conditions with manufacturer prior to ordering of materials and system fabrication.
 - a. Manufacturer is responsible for providing a fully functioning system as required using the service water available.
 - b. Any additional equipment will come at no additional cost to the Owner.
 - c. Any revision in layout will require approval by the Engineer.

E. Nutrients:

1. Total System Nutrient Consumption: 534 gallons/month.
2. Nutrient Tank Volume: 30-day capacity 550 gallons.
3. Nutrient Tank: HDPE construction suitable for outdoor conditions. Construct to same standards as the vessel, and have 316 stainless steel hold-down lugs.

F. Vessel:

1. Maximum Diameter: 13 ft.
2. Maximum Vessel Straight Wall Height (not including stack): 27 ft.
3. Maximum Vessel Operating Weight: 50,000 lb.
4. Structural Requirements:
 - a. Roof Live Load: 20 psf uniform.
 - b. Design wind speed as listed on the structural drawings.

- c. Minimum Wall Thickness: Per structural calculations but no less than 3/8 inch for all vessels.
 - 1) External circumferential reinforcing ribs and bottom knuckle reinforcement as dictated by the design and ASTM D3567.
 - a) Knuckle: Seamless having a minimum radius of 1-1/2 inch.
 - 2) Flat Bottom of Rectangular and Cylindrical Vessels: Constructed integral to the straight sides off of a singular mold with no seams.
 - 3) Laminating flat bottom to vertical sides will not be accepted.
 - d. Minimum Structural Safety Factor: Pressure: 10:1.
5. Fiberglass Reinforced Plastic Vessel: All parts of vessel proportioned to have liberal strength and stiffness and especially adapted for work to be done.
- a. Ample Room and Facilities: Provided for access.
 - b. Designed to support required number of media layers and treatment stages.
 - c. Reactor Vessel: Constructed of corrosion resistant, UV resistant fiberglass reinforced plastic.
 - d. All materials of construction to be corrosion resistant, including any non-FRP components.
 - 1) Treat Vessel interior with vinyl ester corrosion barrier for maximum corrosion resistance.
 - 2) Vessel Exterior: Incorporate a surface veil for superior durability.
 - e. Equipment to meet the following requirements:
 - 1) ASTM D3299 for filament wound tanks.
 - 2) ASTM D4097 for contact molded tanks.
 - 3) ASTM 3982 for contact molded duct.
 - f. Resins: Factory-fabricated fiberglass-reinforced resin used to be resistant to corrosion by wet hydrogen sulfide.
 - 1) A single fire retardant resin is to be used throughout.
 - 2) Flame Spread Ratio: 25 maximum, when tested in a Steiner Test Tunnel per ASTM E84.
 - 3) Antimony or NYACOL additives are not to be used to achieve flame spread index.
 - 4) Acceptable products:
 - a) Derakane 510-B-400.
 - b) Cor VE 8401.
 - c) AOC Vipel K022.
 - d) Reichold's Dion Impact 9303-54; Hetron 998-35.

- g. Shell: An interior layer, a corrosion barrier, a structural layer and an exterior layer.
 - 1) Interior Layer: Minimum 20 mil thick single-layer Nexus or C-glass surface veiling in a resin rich surface.
 - a) Resin Content: Approximately 90 percent.
 - 2) Corrosion Barrier: Minimum 100 mil thick Type E glass strand mat, applied in two layers of equal thickeners.
 - a) Resin Content: Approximately 70 percent.
 - b) No thixotropic agents may be used in the corrosion barrier.
 - 3) Structural Layer: Alternating layers of Type E glass, reinforced by interweaving of chopped strand mat and woven roving continuous helically filament winding glass.
 - a) Resin Content: Approximately 60 percent.
 - b) Chemically resistant construction suitable for the service, providing the additional strength necessary to meet the tensile and flexural requirements.
 - c) Where separate layers such as matt, cloth, or woven roving are used, layers must be lapped a minimum of 1 inch.
 - d) Laps: Staggered as much as possible.
 - e) If woven roving or cloth is used, the layer of chopped strand glass must be placed as alternate layers.
 - f) Filament Wound Structural Layers: Per ASTM D2996.
 - g) Handwork is acceptable, but enough resin must be present to prevent fiber show.
 - 4) Reinforcing Material: Commercial grade glass fiber containing a coupling agent to produce a suitable bond with the resin used.
 - 5) Exterior Layer: Paraffinated gel coat with UV inhibitors. There is to be no pigmentation added to the exterior layer.
- h. All Surfaces: Finished so as to obtain complete cure of resin without air inhibition.
 - 1) Finished Laminate: Free as commercially practicable from visual defects; foreign inclusions, dry spots, air bubbles, pinholes and pimples.
 - 2) Post cure vessel per resin manufacturer's recommendations and conform to resin manufacturer's minimum standard for Barcol hardness.
- i. Inner Surface:
 - 1) Interior layer to meet visual acceptance criteria in Table 5 ASTM C582 process side.
 - 2) Free of cracks and crazing with a smooth finish.
- j. Exterior Surface:
 - 1) Meet the referenced criteria for the non-process side.

- 2) Relatively smooth with no exposed fibers or sharp projections.
 - k. Any Grinding, Repair, or Sanding of Interior Surfaces: Covered with a laminate duplicating the inner corrosion liner and paraffinated top coat.
 - l. Exposed Edges: Sealed with same resin as used on vessel and be fully post cured.
 - m. No longitudinal joints in axial direction of the cylindrical shell.
 - n. Entire Shell Thickness: Built up prior to removal of the shell from the mandrel.
6. Hold-Downs (minimum of four): Consisting of fiberglass-reinforced polyester gusseted hold-down lug laminated to vessel sidewall with a Type 316L stainless steel anchor clip.
 - a. Use anchor clip for anchor bolting to the concrete foundation and clamping to the hold-down lug.
 - 1) Hold-Down Systems: Sufficient strength to hold vessel and any exhaust duct the vessel supports against all loads.
 - b. Vessel manufacturer to provide to the Contractor, anchor requirements and locations where anchor bolts must be in place when the support pad is poured.
 - c. Anchor bolts to be provided by the Contractor.
 - d. Piping, Instrumentation, and Ductwork Connections: As indicated on Drawings and as specified.
 - e. Piping Supports: As indicated on Drawings and as specified.
- G. Flange Nozzles and Accessways: Flanges compatible with connecting piping and duct work.
 1. Comply with ASTM D3299 and ASTM D3982.
 2. Liquid nozzles: ANSI Class 150 rated flanged nozzles.
 - a. Press molded, or compression molded flanged nozzles will not be accepted.
 - b. Nozzles 6 inch Diameter and Smaller: Blade gusseted configuration meeting strength requirements of 1500 ft-lbs of bending and 2000 ft-lbs torque.
 3. Flanges: Manufactured by hand lay-up method and conform to ANSI Class 150 standard dimensions for bolting.
 - a. Area on the Back of All Flanges Around Bolt Holes: The diameter of a standard washer, flat and parallel to the flange face. Spot face, if necessary, to meet this requirement.
 4. Blind Flanges and Access Doors: The same thickness and material as flanges to which they are attached. Flatness tolerances to be the same as for flanges.
 5. Manway and Duct Flanges: Per ASTM 3982
 6. Access Doors and Bolted Attachments:
 - a. Provided with 1/8 inch thick EPDM gaskets and 316 stainless steel nuts, bolts and washers.
 - b. Construct Access doors of industrial grade, clear polycarbonate that will not structurally deteriorate or cloud. Thickness: 1/2 inch minimum.

7. Supports: Suitably attached to outer vessel walls as necessary supporting vessel piping and interconnecting FRP ductwork. Meet loading criteria as specified.
 8. Threaded Couplings: Not allowed below the liquid level.
- H. Mist Eliminator: Capable of removing greater than 99 percent of droplets 10 microns in diameter and larger at design air flow rate.
1. Minimum Depth: 6 inches.
 2. Quick connect for access and cleaning mist eliminator.
 3. Materials:
 - a. Mesh: Polyethylene (PE).
 - b. Supports: FRP.
- I. Spray Nozzles: The reactor vessel to be configured with sufficient fluid spray nozzles to provide sufficient and well distributed irrigation. System using an array of nozzles shall not be accepted.
1. Type: Full cone.
 2. Material: 316 stainless steel.
- J. Exhaust Sample:
1. Locate exhaust sample location and necessary fittings as shown on the Drawings.
 2. Sample Pipe: 1/4 inch exhaust sample polyethylene tubing inside the 3/4 inch PVC pipeline that is connected to the exhaust stack.
 - a. The 3/4 inch port to have an internal air trap ensuring that when open, the polyethylene sample connection will capture free-flowing air.
 - b. Manufacturer to provide supports for along the vessel for exhaust sample as shown on the Drawings.
- K. Synthetic Media:
1. Media: Structured or random synthetic, chemically resistant and able to withstand the foul air characteristics specified, for the life of the media.
 - a. Designed to not foul or plug and be resistant to shrinking or swelling with varying moisture content.
 2. Organic Media and Non-Synthetic Inorganic Media: Not to be allowed.
 3. Media Layers: Easily removable from the top of the vessel single media sections or randomly dumped. Media that requires entry into the vessel for inspection or removal shall not be allowed.
 - a. Treatment Layers: Designed not to short circuit, collapse, or be subject to channeling under operating conditions.
 4. Manufacturer is responsible for providing the minimum media to comply with the minimum residence time specified and to ensure system meets specified performance.

2.2 RECIRCULATION PUMPS

- A. Recirculation pumps are to be used during startup only. System shall be capable of operating continuously without recirculation pumps after startup.
- B. The recirculation pumps and associated piping and connections shall be provided to the Owner after successful startup of the biotrickling filter system.
- C. Description: Provide based on manufacturer's recommendation and proposed system.
 - 1. Number of Pumps: as required for startup.
 - 2. Operation: Pump low pH liquid from the vessel's sump to the spray header.
 - 3. Type: Seal-less, magnetically driven (rare earth, high performance magnets), horizontal, single-stage, base-mounted, end suction centrifugal configuration.
 - a. Manufactured in accordance with ANSI Horizontal End Suction Pumps for Chemical Process.
- D. Performance:
 - 1. Capacity: Adequate to meet necessary irrigation pressure and flow requirements. Capacity may be revised as necessary to provide a fully functional system.
 - 2. Maximum Horsepower: 5 hp.
 - 3. Motor: Horizontal, TEFC, rated for severe duty, squirrel cage induction type, 460V/3/60Hz with Class F insulation and a minimum 1.15 service factor, suitable for continuous and intermittent constant speed operation. Refer to Section 260550 for additional requirements.
 - a. Pump motor to be non-overloading and not exceed its rated horsepower for the entire curve range.
 - 4. Classification: Class 1, Division 2, Group D environment.
- E. Materials: Certified by manufacturer to handle low pH liquid and to withstand outdoor elements.
 - 1. Pump and Outer Shell: Designed to sit outside without degradation and be exposed to sunlight and hot ambient temperatures as specified.
 - a. Electrically non-conductive containment shell resistant to corrosion from low pH process liquid.
 - 2. Suction and Discharge: Class 150 standard ANSI flanges.
 - 3. Pump Casings: Polypropylene, suitable for pressures at least 1.5 times the shutoff head.
 - 4. Impellers: Polypropylene, fully open with contoured passages and balanced for high efficiency.
 - 5. Shafts: Type 316 stainless steel designed for minimal deflection.
 - a. Shafts are directly exposed to liquid being pumped. Protect shaft with polypropylene shaft sleeves.

6. Provide the connection of water supply to the water panel and 316 stainless steel supports.

B. Local Electrical Control Panel (LCP):

1. Control Logic Circuits for Biotrickling Filter Panel: Mounted in a single Local Control Panel (LCP) enclosure provided by the manufacturer.
2. Located outdoors near the biotrickling filter system as specified and shown on the Drawings.
3. Contain controls, timers, switches and relays, PLC, OIT, main circuit breaker, and motor starters for manual and automatic starting, stopping, and sequencing of the biotrickling filter system, including, but not necessarily limited to, the following (Refer to P&ID):
 - a. Main Hand/Off/Auto Switch: Auto System Start/Stop
 - 1) Individual Red running lights.
 - 2) Amber fault light.
 - b. Nutrient Pump: Hand/Off/Auto.
 - 1) Individual Red running light.
 - 2) Amber low flow light.
 - c. Booster Pump (if applicable): Hand/Off/Auto.
 - 1) Individual Red running light.
 - 2) Amber fault light.
 - 3) Booster pump run timer.
 - d. Recirculation Pump: Hand/Off/Auto.
 - 1) Individual Red running light.
 - e. Irrigation timer.
 - f. Control transformer.
4. Material: Type 316 stainless steel, remote mounted 316 stainless steel supports.
5. NEMA Type 4X UL certified.
6. PLC: Allen Bradley
 - a. Pushbuttons, switches and indicator lights.
7. Manufacturer to supply necessary ventilation and cooling to maintain interior temperature between 40 and 80 degrees F under all conditions. Measures to include: Air conditioning Sun Shields and Ventilators.
8. Necessary power conditioning and DC power supplies to be furnished inside each LCP for proper equipment operation.
9. LCP to include intrinsically safe barriers for termination of any signals to/from hazardous Class 1, Div. 1 and Class 1, Div. 2 areas.

- a. Provide 2 inch separation or barriers between conductors of intrinsically safe circuits and non-intrinsically safe circuits meeting the requirements of NEC 504.30.A.2.
 10. Related Requirements: LCP to meet requirements of Division 26. Motor starters to meet the requirements of Division 26.
 11. Door: Padlock attachment.
 12. Single-Point Power Connection and Grounding Lug: 480V/3/60Hz. LCP to contain all power transformers.
 - a. LCP to be provided with a surge protection unit on the load side of 120 V control power transformer.
 - b. Control Power Transformer: To have both primary and secondary overcurrent protection and to be sized by the biotrickling filter system supplier.
 13. Provide other appurtenances required for a complete and fully operational control panel.
 14. General Lightning Protection: Provided to protect the electronic instrumentation systems from induced surges propagating along the signal and power supply lines.
 - a. The protective level is not to interfere with normal operation, but be lower than the instrument surge withstand level and be maintenance free and self-restoring.
 - b. House instruments installed in exposed locations (outdoors) in properly grounded, suitable metallic cases.
 - c. Connect ground wires for surge protectors to a good earth ground.
 - d. Where practical, run each ground wire individually and insulated from each other. Protection for all 120 VAC instrument power supply lines.
 - e. Cabinets, Panels and Groups of Field Instruments: Protect by surge suppressors.
 - f. Units to be equal to Transtector No. ACP-100W, AC surge suppressor.
 - g. Individual Field Instruments: Protected by General Electric, Model 9115CCB007; Approved Lightning Protection Company; Zeus, Catalog No. SA-20; Joslyn, Series 1200 or equal.
- C. Instrumentation Specifications:
1. Electrical and electronic equipment located within three feet of a biotrickling filter tower or duct to be suitable for installation in a Class 1 Division 2 environment.
 2. Materials and Equipment used to be UL approved wherever such equipment and materials are available.
 - a. Outputs of equipment that are not standard signals as outlined, must have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
 - b. Instruments to be provided with mounting hardware for floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.
 - c. Electronic equipment must be of manufacturer's latest construction, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus.
 - 1) Solid state components to be conservatively rated for their purpose, assuring optimum long-term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity.

- 2) Equipment provided with suitable housings preclude the detrimental effects of sunlight on screens or operator interface for its location.
3. Flow Meter: Flow rate to be measured by a paddlewheel turbine.
 - a. Function/Performance:
 - 1) Operating Temperature: Process liquid temperatures of 0 to 140 degrees Fh or greater dependent upon liner and an ambient of minus 30 to 150 degrees F.
 - 2) Pressure Rating: Equal to piping system where meter is installed.
 - 3) Meter must be capable of running empty indefinitely without damage to any component.
 - b. Physical:
 - 1) Material: Polypropylene or Polyvinylidene Fluoride (PVDF).
 - 2) Rotor Pin: PVDF or Hastelloy-C.
 - 3) Power Requirements: Meter to be self-powered.
 - c. Accessories and Documentation Required:
 - 1) Factory calibration: Meters to be factory calibrated. A copy of calibration report to be included in the O&M manual.
 - 2) For meters with remote mounted transmitters, signal cable for installation between the flow tube and the transmitter. Length will be as required by installation as indicated on the Drawings.
 - d. Model: 515 Signet Rotor-X Paddlewheel or Engineer approved equivalent.
4. Flow Converter/Transmitter: Micro-processor based, intelligent transmitter compatible with flow meter provided.
 - a. Integral mount or mounted remote from the flow tube as shown on the Drawings or as required by the physical location.
 - b. Functional/Performance:
 - 1) Accuracy (including flow tube): Plus or minus 0.5 percent of flow rate or better.
 - 2) Operating Temperature: Minus 20 to 140 degrees F.
 - 3) Output: Isolated 4 to 20 mA with HART protocol. Current output adjustable over the full range of the instrument. Provide a dry contact to indicate reverse flow.
 - 4) Diagnostics: Self diagnostics with on screen display of faults.
 - 5) Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.
 - c. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow to be displayed.
 - d. Empty Tube Zero: The transmitter to include a feature that locks the output at zero when no flow is detected. The empty tube zero feature will be enabled

- automatically when transmitter detects no flow or manually through a contact input.
- e. Provide electrode cleaning unit to match flow element requirements.
 - f. Physical:
 - 1) Transmitter: Suitable for surface or pipe stand mounting.
 - 2) Enclosure: NEMA 4X (IP65).
 - g. Power Requirements: Transmitter: 120 VAC powered instrument.
 - h. Accessories/ Required:
 - 1) Keypad where required for transmitter configuration.
 - i. Model: Signet 9900 Transmitter or equal.
5. High Level Switch: Point level switch, Echotel Model 961/962 Ultrasonic Level Switch from Magnetrol or approved equivalent.
6. Flow Switches: Vane or disc actuated with Form C snap action.
- a. Hermetically sealed.
 - b. Rating: 10 A, 125/250 VAC.
 - c. Switches for Pipe Sizes 3/4 to 1-1/2: Flow body.
 - d. Switches for Pipe Sizes Greater than 1-1/2: Installed directly into field piping.
 - e. Flow Body and Wetted Parts: 316 stainless steel.
 - f. Switch Housing: NEMA 4X.
 - g. Manufacturer: Magnetrol F50 and F10 or Engineer approved equivalent.
7. Gauge Pressure Transmitters
- a. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - 1) ABB 266HRH.
 - 2) Foxboro IGP20.
 - 3) Rosemount 3051CG.
 - 4) Siemens Sitrans P DS III.
 - 5) Smar LD301M.
 - 6) Or equal.
 - b. Capacities and Characteristics:
 - 1) Microprocessor based, intelligent type.
 - 2) Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
 - 3) Accuracy: 0.075 percent of span.
 - 4) Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28 degrees C temperature change.
 - 5) Stability: 0.05 percent of upper range limit for 1 year.
 - 6) Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
 - 7) Output: Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.

- 8) Operating Temperature Range: -20 to 80 degrees C.
- 9) Response Time: Less than 1 ms.
- c. Display:
 - 1) Digital indicator displaying pressure in PSI.
- d. Diagnostics:
 - 1) Self-diagnostics with transmitter failure driving output to above or below out of range limits.
 - 2) Simulation capability for inputs and loop outputs.
 - 3) Test terminals available to ease connection for test equipment without opening the loop.
 - 4) Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to shall be available.
- e. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored by the instrument.
- f. Materials
 - 1) Enclosure:
 - a) NEMA 4X (IP66), explosion proof
 - b) Approved for Class I, Division 1, Groups C and D.
- g. Process Wetted Parts:
 - 1) Isolating diaphragm and other wetted metal parts of Type 316L stainless steel, unless otherwise indicated in the device schedule.
 - 2) Gaskets and O rings shall be Teflon.
8. Thermal Dispersion Flow Switches – Flow/No Flow Alarm on Air Flow Piping
 - a. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - 1) Fluid Components International (FCI) – FLT-93.
 - 2) Magnetrol – TD-2.
 - b. Type:
 - 1) Thermal dispersion flow switch with integral electronics enclosure .
 - 2) Insertion type with twin tip sensor design for air flow.
 - c. Function/Performance:
 - 1) Range: 1 to 125 feet/second in air.
 - 2) Process Operating Temperature: -40 to 250 degrees F
 - 3) Operating Temperature for Electronics: 0 to 140 degrees F.
 - 4) Accuracy: Plus or minus 5 percent of reading.
 - 5) Repeatability: Plus or minus 0.5 percent of reading.
 - 6) Output: DPDT contacts rated 6 A at 120 VAC adjustable over the range of the instrument.

- d. Physical:
 - 1) Wetted parts to be Type 316 stainless steel.
 - 2) Electronics head to be NEMA 4X (IP65) for non-hazardous process gases and explosion proof approved for Class 1, Division 1, Groups C and D for hazardous process gases or where located in a hazardous area.
 - e. Power Requirements:
 - 1) 120 VAC powered instrument
9. Differential Pressure Gauge/Indicator
- a. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - 1) Dwyer – Series 4000 Capsuhelic.
 - b. Type:
 - 1) The differential pressure gauge shall be connected to the high and low pressure ports on the biotrickling filter to measure the differential across the filter media.
 - c. Function/Performance:
 - 1) The differential pressure being measured shall be held within a chamber, which is an integral part of the gauge. The low pressure connection is directed to the rear of the diaphragm, and the high pressure connection is directed to the front of the diaphragm. The silicon rubber diaphragm shall be provided with an integrally molded "O" ring, sealed between the case and back plate. The calibrated range spring shall be a flat leaf stainless steel thin plate range: Range of the transmitter shall be the standard range of the manufacturer closest to the differential pressure range to be metered.
 - 2) Accuracy: 0.075 percent of span (linear output).
 - d. Physical:
 - 1) A clear plastic front cover shall be provided over a white face plate, with litho-printed black scale. Pointer stops shall be provided to prevent over-travel. Pointer shall be direct-connected to internal helix. Gauge body shall be die-cast aluminum, with impregnated hard coating, exterior finish to be baked gray hammerloid. Process connections shall be 1/4-inch female NPT. Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
10. Instruments installed within the classified envelope to be rated for use in Class I Division 2 environments, whether specifically mentioned in this Section or not.

2.5 SOURCE QUALITY CONTROL

- A. Section 014000, "Quality Requirements" for testing, inspection, and analysis requirements.

- B. Inspection: Visually inspect scrubber vessel according to ASME RTP-1 Visual Acceptance Level 2.
- C. Testing:
 - 1. Vessels: Acetone test interior of vessels according to ASTM C582.
 - 2. Scrubber and Hydrostatic Testing:
 - a. Fill vessel with water to 10 feet above overflow outlet of each scrubber sump.
 - b. Maintain for 24 hours with no leaks or repair leaks and retest.
 - c. Test control panel and controls.
- D. Certificate of Compliance: If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 - 1. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300, "Execution" for installation examination requirements.
- B. Verify that facility, piping, and electrical Work are ready to receive scrubber.
- C. Examine pads or supports to receive scrubber, fan, and pumps for proper anchor bolt locations and spacing.

3.2 INSTALLATION

- A. As indicated on Drawings and according to manufacturer's instructions.
- B. Initial Materials: Provide materials, grease, and oil as recommended by equipment manufacturers.
- C. Provide flanged flexible connections at air inlet and at discharge of scrubber exhaust fan.
- D. Provide test ports and air sampling tubes with cocks at each scrubber intake and exhaust stack or duct.
- E. The exhaust duct, power and control wiring, water supply, and drain line will be brought to the concrete pad by The Contractor. The Contractor is responsible for connecting the exhaust duct, power and control wiring, and piping. Contractor will furnish condensate, drainage and water piping as shown on the Drawings.

3.3 FIELD QUALITY CONTROL

- A. Inspection: Verify proper operation of equipment.
- B. Testing, Adjusting, and Balancing:
 - 1. Check control functions and adjust as required.
 - 2. Testing and Balancing by a certified NEBB company, provided by the Contractor.
- C. Startup: An acclimation period of up to 45 days after initial startup must be allowed for the growth of biological populations.
 - 1. Start-up of the systems is the responsibility of the manufacturer, who will furnish factory-trained personnel to complete this activity. Start-up will commence following a visual inspection and check out of the systems by the manufacturer's technical representative.
- D. Testing:
 - 1. Functional Testing: Prior to system startup, inspect components for proper alignment and connection and acceptable operation.
 - 2. Isolation Dampers: Per AMCA 500-D.
 - a. Maximum Leakage through Closed Damper: 0 scfm / sq ft of blade at pressure differential of 30 inch wg.
 - 3. Mechanical Commissioning:
 - a. Irrigation, and Nutrient Feed Systems:
 - 1) Confirm that all ductwork airflow is balanced.
 - 2) Verify proper water level in scrubber and system.
 - 3) Verify fans are energized and rotating in the proper direction.
 - 4) Verify recirculation pumps are operating properly as required for startup.
 - 5) Verify that pH probe is operable, calibrated, and providing a signal to the controller.
 - 6) Verify nutrient pump is operating properly.
 - 7) Verify operation of differential pressure indicator across scrubber.
 - 8) Verify operation of scrubber sump level indicator.
 - 9) Contractor shall be responsible for logging all operating parameters. Continue logging operating parameters for 30 days.
 - 4. Scrubber System Performance Testing:
 - a. Will not commence until the Testing and Balancing Report for the entire ductwork system is submitted and approved by the Engineer, and the approval of a Sampling and Analyses Plan submitted during the mechanical commissioning.
 - 1) Sample collection equipment and hydrogen sulfide monitoring instruments will be provided by the Manufacturer.
 - b. Owner will schedule acceptance testing within 60 days of system startup.

- c. Demonstrate hydrogen sulfide and odor levels in scrubber outlet are in accordance with the performance criteria specified in this section and that pressure drop through scrubber is less than specified in this Section.
- d. Procedure:
 - 1) Operate scrubber system in auto mode.
 - 2) Maintain design operating conditions for minimum six hours after an initial two-hour stabilization period.
 - 3) Monitor and record relevant operating parameters and operating conditions pursuant to the sampling plan.
 - 4) Collect minimum three samples per vessel for odor panel testing, every two hours
 - a) Send samples by overnight delivery for odor analyses at a qualified laboratory.
 - b) Inlet and Outlet samples shall be collected simultaneously.
 - c) Odor concentrations will be measured and analyzed per EN 13725.
 - 5) Continuously monitor hydrogen sulfide levels using a low range sampling system (LRSS from Detection Instruments) that measures H₂S at the inlet and out let of the scrubber concurrently and logs H₂S levels every minute throughout the test period.
 - 6) Continuously monitor pH levels using pH sensor/controller.
 - 7) If performance criteria are not attained, make adjustments or repairs and repeat test at no additional expense to the Owner.

E. Manufacturer Services:

- 1. Furnish services of manufacturer's representative experienced in installation of products furnished per this Section.
- 2. Services Provided by Manufacturer's Representative: Representative will be present at frequent enough intervals to ensure proper installation, testing and initial operation of equipment. Minimum time listed is for each odor control system.
 - a. Supervise Installation: Minimum Number of Trips: 1.
 - 1) Minimum Time on Site: 2 (8 hour working) days.
 - b. Inspect and Approve Installation: Minimum Number of Trips: 1.
 - 1) Minimum Time on Site: 2 (8 hour working) days.
 - 2) Provide to Engineer written certification the system is installed in accordance with manufacturer's recommendation.
 - 3) May be done directly following completion of supervising installation if acceptable to the Engineer.
 - c. Supervise Testing: Minimum Number of Trips: 1.
 - 1) Minimum Time on Site: 1 (8 hour working) day.
 - 2) May be done directly following completion of inspecting and approving installation if acceptable to the Engineer.

- d. Train Owner's and Engineer's Representatives: Minimum Number of Trips: 1.
 - 1) Minimum Time on Site: 1 (8 hour working) day.
 - 2) May be done following completion of testing supervision if test is successful and operation and maintenance manuals have been approved.

 - F. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 1. Make final adjustments to equipment under direction of manufacturer's representative.

 - G. The manufacturer's representative witnessing field tests will furnish the Owner, through the Contractor, a written report certifying that the odor control system:
 - 1. Has not been damaged by transportation or installation.
 - 2. Has been properly installed and accurately aligned.
 - 3. Has no mechanical defects.
 - 4. Is free from any undue stress imposed by connecting piping and/or anchor bolts.
 - 5. Is free of overheating of any parts.
 - 6. Is free of objectionable vibration and noise.
 - 7. The Contractor has accurately recorded the data obtained during the field test.
 - 8. Warranty.

 - H. Certificate of Acceptance to System Supplier: Issued by Owner upon successful demonstration of operation and head loss.
 - 1. Warranty period will commence on this date.
 - 2. System supplier will promptly repair and/or replace defective equipment at no additional cost to the Owner for a period of two years from Date of Certificate of Acceptance.

 - I. Warranty:
 - 1. Mechanical Components: Two years from Owner acceptance.
 - 2. Vessel, Media Supports, and Media: Ten years from Owner acceptance.
- 3.4 DEMONSTRATION
- A. Section 017900, "Demonstration and Training" for demonstration and training requirements.
 - B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 443133

This page intentionally left blank.

SECTION 460753 - FORCED DRAFT STRIPPING TOWER (DEGASIFIER)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SYSTEM SUPPLIER SCOPE OF WORK

- A. The sulfide stripping system supplier shall provide all equipment, materials and incidentals as specified herein as a complete Sulfide stripping package. Note that stripping tower is also referred to as degasifier tower in the specifications. The system supplier shall provide all labor, materials required to completely install, test and make ready for operation the forced draft stripping towers as specified herein.
- B. The new degasifier system shall include, but not be limited to, one complete degasifier tower with all internal distribution headers, weir/troughs, mist eliminator, packing media; inlet filter with filter housing; forced draft blowers; all ductwork; necessary motors and controls; ladders; platforms; and grating as shown on the drawings and as specified herein. The entire system shall be supplied, installed and guaranteed by one supplier. The system supplier shall have a minimum of five years experience for design and supply of package packed tower systems to municipal water and wastewater systems in the State of Florida and a minimum of five installations of similar or larger size systems.
- C. All of the equipment shall be furnished and installed by a supplier/manufacturer who is fully experienced, reputable and qualified in the manufacture of the system components to be furnished. The equipment shall be designed, constructed and delivered in accordance with the best practices. Manufacturer of the new degasifier shall be KCH Engineered Systems, Duall, or approved equal. The supplier/manufacturer shall clarify as part of the shop drawings submittal all exceptions for his equipment. All exceptions shall be submitted to the Engineer for approval. Any equipment or part required or necessary to enhance the operation of the equipment not specified herein shall be submitted as part of the shop drawings submittal for the Engineer's approval.
- D. The new degasifier tower shall be approved by NSF for contact with potable water and have a minimum diameter of 9 ft and a minimum packed height of 12 ft. The treated water from each degasifier as mounted on clearwell structure shall flow through one chorine contact chamber as shown on the drawings. The top of the degasifier (duct included) shall not exceed 40 ft. above finish grade elevation. The system shall be furnished complete with top, distribution tray, ladder, inlet and outlet fittings.
- E. It shall be the responsibility of the equipment manufacturer to determine the number, size, and location of all anchor bolts to be set in concrete and all pipe and ladder supports. Anchor bolts and integral pipe and ladder supports shall be furnished by the manufacturer.

- F. The manufacturer shall be responsible for the design and structural integrity of the stripping tower and access ladders and platform.
- G. The stripping tower shall be certified by NSF 61 approved polyvinyl chloride/fiberglass overlay (PVC, FRP) with a UV coating. All materials that come in contact with the water being treated shall be NSF 61 approved. An NSF label shall be affixed to each vessel along with certificate by NSF.
- H. The design criteria for the construction of the stripping tower are as follows:

Degasifier Design Requirements

Item/Design Conditions

Number of air stripping towers required	1
Flow rate, water, and mgd each	3.0
pH, inlet water,	5.9
Average Temperature, degrees C	20
Average H ₂ S	3.3
Maximum Hydrogen Sulfide, inlet water, mg/l	4
Hydrogen Sulfide, minimum removal efficiency, %	92.5
Hydrogen Sulfide, maximum outlet water, mg/l	0.3
Type of Degasifier	Counter-current packed bed
Tower Diameter, ft	9
Packing Height, ft	12
Packing	Jaeger Tri-Pack #2 (3.5" diameter)
Mist Eliminator	>90% removal of 50 micron water
Air-Water Ratio, cfm/gpm	> 4.0
Maximum Water Loading, gpm/ft ²	33
Maximum Loading for Packing Supports, lb/sq. ft.	350
Number of Blowers	3 with spare parts
Air Flow (minimum), each blower, cfm	9,000
Pressure, each blower, inches w.g.	10
Horsepower, each blower, hp	30

1.3 RELATED WORK

- A. Fiberglass reinforced plastic (FRP) Pipe and Duct is included in Section 233116 “Fiberglass Ductwork and Accessories.”
- B. Electrical work, except as specified, is included in Division 26.
- C. Instrumentation work, except as specified, is included in Division 40.

1.4 SUBMITTALS

- A. Submit, to the Engineer for review in accordance with Section 013300, the following for approval prior to fabrication:
 - 1. Literature and complete shop drawings describing the equipment and showing all important details of construction and dimensions (dimensions of the vessel, thickness of

- the vessel walls, size and location of all fittings and nozzles, manways, and accessories being provided for the specific installation). In addition, provide complete manufacturer's drawings showing the dimensions of the packing supports, demister support, packing material, influent distribution system, and other accessories that are being provided for the specific installation. Include erection and base support details, pipe and ladder support details, ladder details, pipe and access connection details.
2. To the extent possible, include all structural and process design calculations and assumptions. The structural design calculations shall include, but are not limited to, consideration of the following:
 - a. Dead loads
 - b. Live loads
 - c. Wind loads
 - d. Anchor lug attachment to shelf
 - e. Anchor bolt size and embedment requirements
 - f. Consideration of effects of all cutouts and openings into the vessel walls
 - g. Attachment lugs for ladders, piping, structural members for walkways and other appurtenances
 - h. Lateral strength shall be based on certified test results
 - i. The process design calculations shall include calculated values for number of transfer units (NTU) and height of transfer units (HTU) and should provide an efficiency of 92% for sulfide removal at an influent pH of 5.90. Calculations shall include assumed values for mass transfer coefficients, hydraulic loading air to water ratio, ambient conditions, safety factors used, and other assumptions.
 3. The total weight of the equipment, including the weight and size of the largest components and operating weight.
 4. A complete bill of materials including anchor bolts and fastener, grates, packing supports and distribution tray.
 5. Certification that the equipment furnished conforms to the design criteria specified herein.
 6. In the event that it is impossible to conform with certain details of this section, describe completely all non-conforming aspects of the design.
 7. 10 sets of installation instructions.
- B. Fiberglass laminate samples shall be submitted with the shop drawings. These samples shall be from plant production area and shall be representative of the quality and hardness of the vessel to be furnished. If the vessel does not meet the standard of the samples, it may be rejected.
- C. Blower performance shall be based on tests made in accordance with AMCA Standard 210-74. The blower manufacturer shall submit certified blower performance curves for each blower at rated RPM. Performance curves shall show typical cfm versus Static Pressure and horsepower from "Shut-Off" to "Free Delivery."
- D. Submit certified sound data for the blowers, "Free Field" conditions five feet from the blower, at rated capacity, including inlet and outlet components and transmission loss through the casing. Data shall be presented as sound power levels, reference power 10 watts by Octave bands. Sound data shall be obtained from tests made in accordance with AMCA Standard 300.
- E. The vessel manufacturer shall submit written certification that the vessels furnished under this specification comply fully with the structural design requirements. Structural design calculations

shall be submitted for each different size and type of vessel, and shall be signed and stamped by a Professional Engineer registered in Florida.

- F. Complete drawings and component data sheets showing fabrication, assembly, installation and wiring schematics. Wiring drawings shall show all interface connections and control panel interior and exterior layouts.
- G. Submit a color sample in for Owner approval to match existing vessel color of existing vessel No. 1 and 2.

1.5 SPARES

- A. One set of gaskets.
- B. Ten Air Filters
- C. One bearing of each size.
- D. One year supply of proper lubrication.
- E. One blower motor, one wheel/shaft assembly, and associated belts and bearings

1.6 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM D4097 - Specification for Contract-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.
- B. American National Standards Institute (ANSI)
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.7 QUALITY ASSURANCE

- A. The tower manufacturer shall have quality control procedures adequate to ensure that all fabrication complies with this section. Quality control shall include a final inspection by the manufacturer and a written record of this final inspection.
- B. Inspection records shall be available to the Engineer. Upon request, manufacturer shall send a copy of his/her inspection records to the Engineer for review prior to inspection by the Engineer.
- C. The Vendor shall furnish at least one day of services of a trained, knowledgeable factory representative during the period of installation to supervise the final installation of equipment.
- D. Upon request, furnish the services of a knowledgeable, trained factory representative to inspect and approve of the equipment installation prior to start-up. Factory representative services may also be requested to make adjustments prior to acceptance. Allow a minimum of one day time.

- E. All of the equipment specified under this section shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the design, construction and operation of stripping tower systems. The manufacturer should provide evidence of successful operation in similar installation for a period of at least three years.
- F. Vendor shall guarantee in writing that the equipment furnished shall be free of manufacturing and fabrication defects in material and workmanship for a period of 12 months after the equipment is satisfactorily placed in service.

1.8 SYSTEM DESCRIPTION

- A. The air stripper shall treat and effectively remove hydrogen sulfide from the raw water. The system shall be capable of treating the raw water at the design flow rate (3.0 mgd per degasifier tower) and reducing the level of hydrogen sulfide by at least 92.5% of influent concentrations or 0.3 mg/L total sulfide at an influent raw water pH of 5.9.
- B. General
 - 1. The stripper unit shall be supplied as a “package”, i.e., all components of the system shall be assembled on a common mounting base. To facilitate locating the equipment in the existing treatment facility, the system shall permit easy dismantling and reassembly with no adverse effects on the system operation.
 - 2. The complete system shall be designed for corrosive outdoor service.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. All equipment shall be crated to protect against damage during shipment.
- B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- C. The finished surfaces of all exposed flanges shall be protected from damage during shipment. Furnish Stainless Steel bolts and gasket material for tower sections with equipment. Pre-drill all flange bolt holes to template.
- D. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- E. The tower shall be mounted on a skid or a protective framework so constructed as to provide easy handling for a crane and shall be provided with lifting rings to permit handling by crane. Nozzles, flanges, and other fittings shall not be used for lifting.

PART 2 – PRODUCTS

2.1 GENERAL

- A. The degasifier system manufacturer shall be KCH Engineered Systems.
- B. The degasifier shall be located above the clearwell as shown on the drawings. The degasifier shall be capable of operation without freezing during the winter assuming ambient temperature of 20 degrees F.
- C. The vessel shall be PVC overlaid with FRP. The PVC shall be Type II, Grade II conforming to ASTM 1784-89 with a minimum ¼-inch thickness. The FRP overlay shall have a minimum thickness of 3/16 inch. The bottom shall be 1/2-inch thick minimum. The resin shall be reinforced with with the chopped fiber method for the exterior. The final UV coat is required such that no glass fiber is exposed. The final UV coat shall be pigmented with the color selected by the Engineer. The fiberglass overlay shall contain an ultraviolet absorber to protect the resin from ultraviolet degradation.
- D. PVC sheet fabrication design shall utilize butt fusion welded longitudinal seams whenever possible. PVC sheets shall be precision beveled at a 45-degree angle at each weldable joint. Butt fusion weld quality shall be verified by microprocessor measurement and documentation through the weld cycle for time, pressure and force for each cycle (melting, heating and welding).
- E. PVC sheets shall be hot gas welded per ANSI/AWS G.1.10 hot gas thermoplastic welding standards at all seams and joints. The sump section of the vessel shall be tested by hydrostatic test to the air inlet or non-destructive spark test be demonstrated before application of the FRP overlay. All thermoplastic welds shall be applied by fabricators that have been certified through a formal testing program based upon ASTM C1147 and ANSA/AWS standards.
- F. The degasifier tower and attachments shall be designed in accordance with the 2017 Florida Building Code and with all additional supplements for ultimate design wind speed (V_{ult}) of 138 mph, unless local codes and regulations require a higher wind load.
- G. The degasifier shall be of the forced draft type with random dumped internal packing.
- H. The water and forced air will circulate counter-currently, the forced air being introduced below the packing. A six-inch minimum distance shall be provided between the packing support and the top of the air inlet duct to facilitate distribution of air across the packing.
- I. The degasifier shall be provided with access ports to allow for gravity loading and unloading of the packing and for maintenance of the weir through distributors and packing support system.
- J. Maximum tower water loading shall not exceed 33 gpm/ft².
- K. The air-flow rate shall be determined by the degasifier manufacturer to achieve the required removal rate; however, the air-to-water ratio shall not be less than 4.3 cfm/gpm.
- L. Water distribution weirs shall be fabricated in such a manner that they can be disassembled and removed through a 30-inch manway.

- M. Weir through distributor shall be arranged to ensure even water distribution on the packing. Inlet piping shall be 16 -inch diameter and inlet trough must be sized accordingly and baffled to prevent jetting and sloshing in the trough.
- N. The degasifier shall be provided with lifting lugs to provide access for maintenance.
- O. The degasifier shall be installed directly on top of clearwell. The product water pipe which passes into the clearwell shall extend from the side of the tower, and have a flanged connection as shown on the Drawings.
- P. All connections and nozzles shall be PVC interior with reinforced thermosetting resin overlay.
- Q. Distribution header and laterals shall be Schedule 80 PVC.
- R. All connections two (2) inches and larger shall be flanged and shall have ANSI standard dimensions and bolting patterns.
- S. Packing for the degasifiers shall be polypropylene and have minimum nominal diameter of 3.5 inches as manufactured by Jaeger Products Tri-Pack #2 or approved equal.
- T. Mist eliminator shall be polypropylene Jaeger Tri-Pack #1 or approved equal.
- U. All bolts, fasteners, supports, hinges, lifting lugs, etc., shall be Type 316 Stainless Steel.
- W. Platforms, ladders, gratings, and railings shall be aluminum. The platform shall be as shown on the drawings. Platforms, ladders, gratings, and railings shall be designed and provided by manufacturer. Each platform shall allow access and manually operated dampers. The platform shall be designed in accordance with the requirements of OSHA latest edition and Southern Building Code, for live loads of minimum 200 lbs/sq. ft.
- X. Gaskets shall be neoprene.
- Y. The stripping tower system shall include the following accessories at a minimum: Location and orientation of ports shall be reviewed and approved by the Engineer during shop drawing review.
 - (1) 30" manway (weir trough)
 - (1) 30" manway (mist eliminator)
 - (1) 30" manway (packed bed)
 - (1) 30" manway (sump)
 - (1) flange connection for influent pipe – 16"
 - (1) connection for outlet pipe – 16"
 - (1) 24" x 24" flanged air inlet
 - (1) 24" flanged air outlet
 - (1) flanged sample port at bottom of sidewall located below static level
 - (2) NPT connections for pressure drop indicator
 - (2) 6" nozzles for recirculating cleaning solution with butterfly valve camlock fittings
 - (1) 3" nozzles for a side isolation well with site gauge for level indication in the sump
 - (1) 1" injection port for hypochlorite addition
 - (1) 1" injection port for other chemical addition
 - (1) 4" sump drain
 - (1) 4" threaded overflow

- Z. FRP gel coating color shall match existing and be coordinated with the Owner during shop drawing review.

2.2 DEGASIFIER (STRIPPING) TOWER

- A. The design criteria, described in Part 1.01, have been established for the air stripping tower to meet the required removal efficiency of the contaminants of concern.
- B. The packing material shall be 3.5-in diameter polypropylene tripacks as manufactured by Jaeger Products Inc., Spring TX, or approved equal. Furnish the new tower complete with packing.
- C. The stripping tower shall be suitably designed to withstand structural load encountered during handling, installation and operation.
- D. The tower shall be designed to be self-supporting with no external guy wires or structural framework. The bottom of the towers shall be fabricated with a flange or base ring with outstanding leg capable of withstanding all stresses to be imposed in the support of the towers. The flange or ring shall be anchored to a concrete foundation to be constructed by Contractor. Furnish all required anchor bolts and fasteners required for erection of the individual sections of the towers. All anchor bolts, fasteners of every kind shall of Type 316 Stainless Steel. Also furnish any padding to be installed between the bottom of the towers and the supporting concrete slab.
- E. The base of the tower shall have a minimum thickness of 1/2-in and shall taper in steps to a minimum thickness of 1/4-in at the top. The wall thickness shall be designed to withstand:
 - 1. Design wind speed as listed on the structural drawings.
 - 2. Loadings imposed by filling the full height of the tower with liquids of a specific gravity equal to 1.1.
 - 3. In addition, the deflection of the tower from the vertical under any condition of loading shall not exceed 1-in.
- F. Provide a site gauge external to the sump to monitor the water level in the stripper sump.
- G. All designs shall take into account the influence of the attached caged ladder and piping to be supported by the towers.
- H. Differential pressure indicators (DPI) shall be provided for each stripper tower. Refer to Paragraph 2.05 for differential pressure gauge requirements.
- I. The stripping tower towers shall be connected via a FRP duct system to one centrifugal blower.

2.3 VESSELS

- A. The vessel shall be PVC overlaid with FRP and UV coating. The PVC shall be Type II, Grade II conforming to ASTM 1784-89 with a minimum 1/4-inch thickness. The FRP overlay shall have a minimum thickness of 3/16. The bottom shall be 1/2-inch thickness. The resin shall be reinforced with the chopped fiber method for the exterior.

- B. The degasifier shall be of the forced draft type with random dumped internal packing.
- C. The water and forced air will circulate countercurrently; the air being introduced below the packing. A 6-inch minimum distance shall be provided between the packing support and the top of the air inlet duct to facilitate distribution of air across the packing.
- D. The degasifier shall be provided with access ports, manway, ladders, and catwalks, as shown, to allow for gravity loading and unloading of the packing, and for maintenance of the distribution laterals and nozzles and packing support systems. The ladders and platforms shall be designed by the supplier and shall be manufactured of aluminum. The supplier shall submit signed and sealed drawings by a registered professional Engineer in Florida for the ladders and platforms. The minimum live load shall be 200 psf and the maximum deflection is ¼ inch. Fiberglass unit shall be thickened at ladder and platform support locations. Manway covers shall be of clear lexan, designed for the internal pressures of the system. A PVC or FRP coverplate shall be supplied with 316SS hardware. Winged nuts shall be used to attach the manway cover to the manway opening.
- E. A weir-trough liquid distribution system manufactured of NSF 61 approved material shall be used in the degasifier towers to ensure that even liquid distribution is achieved throughout the entire specified operating flow range.
- F. All FRP duct, fittings, and flanges shall have a design internal pressure rating of 20-inch w.c. vacuum and pressure as specified in ASTM D2310. Material of construction shall be similar to vessel.
- G. The degasifier shall have an exhaust air outlet on the top of the towers suitable for connections to ducts leading to the odor control scrubber. The air outlet area shall be designed to ensure that the air maximum outlet velocity does not exceed 3,600 ft/min.
- H. All connections and nozzles shall be reinforced thermosetting resin over PVC.
- I. Distribution system shall be PVC.
- J. All connections 2-inches and larger shall be flanged and shall have ANSI standard dimensions and bolting patterns.
- K. All hardware including nuts, bolts, fasteners, supports, hinges, lifting lugs, etc., shall be Type 316 Stainless Steel.
- L. Gaskets shall be neoprene.
- M. Vessel shall be designed in accordance with all applicable codes and regulations. Signed and sealed drawings shall be submitted by an Engineer registered in the State of Florida. Drawings and calculations shall illustrate the vessel and anchor bolts ability to withstand the required wind loads.
- N. Packing: The dumped packing shall be Jaeger Tri-Packs packing or approved equal, size as specified. Packing shall meet or exceed the following parameters:

Three and One Half inch Tri-Pack
Surface Area: 38 ft²/ft³

Packing Factor: 12
Void Space: 95%

- O. **Back of Flanges:** The area on the back of all flanges around each bolt hole shall be the diameter of a standard washer and shall be flat and parallel to the flange face.
- P. **Nozzles - Support:** All nozzles shall be gusseted.
- Q. **Nozzles - Angle to Vessel:** Unless otherwise specified, nozzles on top or bottom shall have flanged faces perpendicular to the centerline of the vessel, and nozzles on side walls shall have flanged faces perpendicular to radial centerlines. Tolerance on angle flange face with respect to vessel centerline shall be 2 degree.
- R. **Nozzles - Attachment to Wall:** Unless otherwise specified, nozzles on top and sides of all type of vessels shall be attached to the vessel wall according to Figure 3, ASTM D 3299. Nozzles on bottom of vessel shall be attached according to Figure 4, ASTM D 3299. Flanges for pipe connections shall be flat faced with drillings conforming to ANSI B16.5.
- S. **Lifting Lugs:** Suitable 316SS lifting lugs shall be provided for use in transporting and placing PVC/FRP vessels.
- T. **Equipment Identification Plates:** Plastic identification plate shall be provided for each vertical section of vessel. Locate plate on outside vertical wall, 4 feet above the bottom for the lower section, 2 feet above the body flange for the other sections of the vessel. The following information shall be included:
 - 1. Name and address of manufacturer.
 - 2. Date of manufacture.
 - 3. Equipment number as shown on the drawings.

2.4 CORROSION RESISTANT FORCED DRAFT BLOWERS

- A. One centrifugal blower of PVC/FRP construction shall be located upstream from the new stripping tower. Two additional centrifugal blowers shall be provided to replace the existing blowers as shown on the Drawings. Each blower shall have a capacity of 9,000 scfm at a design static pressure of 10-in of water. The three blowers shall be manufactured by KCH Engineered Systems.
- B. The blower motors shall be furnished by the system manufacturer with the following performance requirements and shall meet the requirements for motors in Division 26:
 - 1. The motor(s) shall be rated at 30 hp maximum and shall be 460 Volts, 3 Phase, 60 Hz.
 - 2. The motor(s) shall be premium efficiency severe duty with minimum 1.15 service factor.
 - 3. The motor(s) shall have TEFC enclosures for service in high humidity/high hydrogen sulfide atmospheres.
 - 4. The motor(s) shall have a Class B insulation system. Class F insulation may be used but shall be limited to Class B temperature rise.
 - 5. The motor's average B-10 bearing life shall be greater than 100,000 hours.

- C. Submit, in accordance with section 013300, all data and the blower schedules. The submittal shall include blower data sheets with a description of the proposed blower, blower size, type, arrangement, materials of construction, weight, motor horsepower, motor type, power supply, and frame size. Each submittal shall include pertinent equipment dimensional data, blower performance (operating data) information, and a performance curve showing the blower operating point and range. A list of accessories to be furnished shall be included on each submittal. Significant dimensional differences between the specified equipment and the proposed equipment shall be noted on the equipment submittal. Provide conformation of material suitability for corrosion resistance.
- D. The blower wheel shall be backward inclined design of 316 stainless steel with a 316 stainless steel hub and 316 stainless steel shaft. The blower shall be fabricated of same material as the Degasifier shell. The blower rotor shall be designed for a minimum tip speed of 265 ft/sec.
- E. The blowers will be furnished with a sleeved inlet and flanged outlet and a PVC pipe coupling type drain. Flanged drain optional.
- F. Bearings shall be grease lubricated ball or roller bearings in housings that allow easy bearing replacement.
- G. Shaft seal shall be neoprene gasketed FRP plate.
- H. The blowers shall be placed on 316 stainless steel base plates. No metal parts shall be exposed to the corrosive air stream.
- I. Auxiliary contacts for remote monitoring, indication of alarm conditions and automatic start of supply blowers shall be provided. Auxiliary contacts shall be SPDT, dry type. See electrical drawings for emergency lock-out relays.
- J. Each blower shall have an independent air inlet filter housing with the following specifications:
 - 1. Filter elements shall be designed for 9,000 cfm and shall be 95% efficient of 10 micron Arizona road test. The filter velocity shall not exceed 600 fpm.
 - 2. Filters shall be held in place with hinged retaining screens, front and back, for easy removal.
 - 3. All connections shall be flanged and isolated from vibrations.
 - 4. The housing shall have its own support structure and frame and be fabricated of type T5051 checkered plate aluminum.
 - 5. Housing shall be 12-gauge aluminum.
 - 6. The filter system shall be as manufactured by TSC-Jacobs North or approved equal.
 - 7. Filters shall be disposable.
- K. The inlet filter weather hood shall prevent water from entering the blower.
- L. Provide backdraft dampers on the blower outlet.
- M. Contractor shall coordinate the outlet blower connection sizes with the stripping tower inlet connection sizes and provide appropriately sized ductwork, dampers and reducers as required.

2.5 PACKING FOULING INDICATOR

- A. The packing fouling indicator shall be a pressure drop indicator, magnehelic type, 4" dial, calibrated from 0-5 inches water column (or as recommended by stripping tower manufacturer), as manufactured by Dwyer Instruments, or approved equal.
- B. The indicator shall be mounted on the vessel.
- C. Connections shall be made with PVC Schedule 80 piping.
- D. Parts shall be 3/4 inch NPT full couplings.
- E. Drip legs shall be placed next to the indicator for both connections with valve

2.6 LADDER PLATFORM ASSEMBLY

- A. The ladder platform assembly shall be manufactured of aluminum using 316 Stainless Steel fasteners and hardware. The unit shall have a cage as required by OSHA, handrails and kick plates to match existing unit.
- B. The platform assembly shall be designed to access the manways and provide safe operation and maintenance for the degasifier.
- C. The ladder and platform assembly shall be designed and provided by the manufacturer.
- D. The ladder and platform assembly shall be designed to accommodate for a future stripping tower to be installed in the future.

2.7 INSTRUMENTATION AND CONTROLS

- A. Automatic control of the degasifier, including the degasifier blowers, shall be provided from the plant SCADA system. The degasifier manufacturer shall provide a detailed sequence of operation to be implemented by the SCADA system supplier. The sequence of operation shall include a complete description of the control strategy, basis of design settings, protective interlocking scheme, P&ID, etc.
- B. All monitoring and control components required for operation of the degasifiers shall be furnished by the degasifier manufacturer, including but not limited to the following:
 - 1. Degasifier water flow switches
 - 2. Degasifier high water level switches
 - 3. Degasifier differential pressure indicators
- C. Power distribution to the degasifier blowers shall be provided from the plant motor control center. Monitoring and control of the degasifier blowers shall be provided from the plant SCADA system.
- D. For monitoring high water level alarm, one liquid level switch (LSH) shall be mounted on the side of each degasifier. Level switches shall be compatible with degasifier conditions, as

manufactured by Harwil Corporation, or approved equal. High level switches shall be interlocked to shutdown the blowers and stop the water flow into the degasifiers.

- E. For monitoring water flow, one flow switch (FSL) shall be provided for each degasifier. Flow switches shall be compatible with the installed conditions, as manufactured by Harwil Corporation, or approved equal.

PART 3 – EXECUTION

3.1 SHIPPING AND HANDLING

- A. All vessel shipped horizontally shall be supported by cradles supporting at least 120 degrees (bottom one-third) of the vessel circumference.

3.2 INSTALLATION

- A. Vessel shall be installed in accordance with the manufacturer's technical data and printed instructions, and in the locations shown on the drawings.

3.3 SURFACE PREPARATIONS AND SHOP PAINTING

- A. PVC overlaid with FRP vessel will be coated with a UV coating on all exterior surfaces at the factory. Other equipment to be supplied under this section requiring surface preparation and shop priming shall be performed as part of the work of this section.
- B. Provide touch-up painting in the field for any scratches or nicks caused through installation.
- C. FRP gel coating color shall match existing and be coordinated with Owner during shop drawing review.

3.4 FIELD TESTING

- A. The degasifier system supplier shall furnish the service of a factory representative for a minimum of three days who has complete knowledge of proper operation and maintenance of the equipment to inspect the final installation and to supervise the test runs.
- B. The degasifier shall be tested under approximate design conditions utilizing the existing water at the utility. The system supplier shall furnish utilities, labor, and a flowmeter for air flow measuring. The test shall be supervised by the degasifier system supplier and witnessed by representatives of the contractor, Engineer and Owner. The system shall provide the specified percentage removal of hydrogen sulfide from the influent water stream at design conditions. A minimum of one day shall be required for testing the degasifiers.
- C. If the systems or any component thereof fails to operate properly, the necessary changes shall be made or components shall be replaced until the system operates to the satisfaction of the

contractor, Engineer and Owner. Any units that remain unable to meet the operating requirements shall be removed and replaced with satisfactory units at no cost to the Owner.

- D. A minimum of one full day shall be required solely for training the Owner's personnel by the degasifier system factory representative. Two hours of this training shall occur in a classroom setting discussing the concepts and theory of operation.

END OF SECTION 460753

SECTION 463143 - CARBON DIOXIDE GAS FEED EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Carbon Dioxide System as shown on the Drawings and as specified herein, and including the following:
 - 1. Installation of a new 91-ton carbon dioxide horizontal, cylindrical storage tank and all appurtenances.
 - 2. Modification of the existing pressure solution feed (PSF) panel and all associated piping to provide a maximum carbon dioxide feed rate of 1,622 pounds per hour (lb/hr).
- B. Related Requirements:
 - 1. Section 099100 - Painting: Product and execution requirements for finishes specified by this Section.
 - 2. Section 400563 - Ball Valves: Execution requirements for ball valves as specified by this Section.
- C. Carbon Dioxide Storage and Feed System Supplier:
 - 1. The Carbon Dioxide Storage and Feed System supplier shall provide a complete system complete with new 91-ton carbon dioxide tank and any required modifications to the existing carbon dioxide feed system to provide a maximum feed rate of 1,622 lb/hr. The carrier water supply pumps will not be upgraded as a part of this project and will only be required to inject a maximum of 1,200 lb/hr.
 - 2. The Carbon Dioxide Storage and Feed System shall be provided by a single supplier.

1.3 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications.
 - 2. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- B. Mining Safety and Health Administration: Requirements for self-contained breathing apparatus.
- C. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. National Institute for Occupational Safety and Health: Requirements for self-contained breathing apparatus.

1.4 PREINSTALLATION MEETINGS

A. Section 013100 “Project Management and Coordination” Requirements for preinstallation meeting.

B. Convene minimum two weeks prior to commencing Work of this Section.

1.5 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer information describing materials of construction, fabrication, and protective coatings.

C. Shop Drawings:

1. Indicate materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details.
2. Submit schematic diagram of each system, including tag marks for each item of equipment cross-referenced to carbon dioxide feed system equipment list.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions:

1. Submit detailed instructions on installation requirements, including storage and handling procedures, anchoring, and layout.
2. Submit installation, selection, and hookup configuration, with pipe and accessory elevations.
3. Submit hanging and support requirements and recommendations.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.

H. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.

- B. Project Record Documents: Record actual locations and final orientation of equipment and accessories.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish one set of manufacturer's recommended spare parts, including following:
 - a. Two pressure gauges.
- C. Tools: Furnish special wrenches and other devices required for Owner to maintain and calibrate equipment and instrumentation.

1.8 QUALITY ASSURANCE

- A. Perform Work according to St. Johns County Utility standards.
- B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Section 017700 "Closeout Procedures" Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for carbon dioxide gas feed equipment.

1.13 INTENT

- A. This specification does not purport to cover every detail inherent in the design and modifications of the carbon dioxide storage and feed system, but rather to set forth the basic criteria required of the system. It shall be incumbent upon the carbon dioxide system supplier to supply a complete system including and required modifications to the existing equipment, ready for placement into service as intended, except those items specifically excluded in their scope of supply. The limits of supply for the carbon dioxide system manufacturer shall be as specified in this Section and shown on the drawings. Contractor shall supply and install all necessary equipment for a complete and operational carbon dioxide storage and feed system whether specified and shown, or not; as well as piping, fittings, appurtenances, instrumentation, controls, safety devices, and other necessary equipment except as specifically excluded in this specification and the drawings.

PART 2 - PRODUCTS

2.1 CARBON DIOXIDE GAS FEED EQUIPMENT

A. Manufacturers:

1. TOMCO₂ Systems®
2. Substitutions: Not permitted.

B. Description:

1. Storage: Carbon dioxide shall be stored as a liquid in a horizontal cylindrical storage tank which is equipped to receive delivery from tank trucks equipped with unloading pumps. Carbon dioxide in storage shall be maintained at approximately 300 psig and at a temperature of approximately 0°F within the storage tank. An electric vaporizer shall be provided to vaporize liquid carbon dioxide from the tank and return it as a gas into the top of the tank. The liquid carbon dioxide shall be cooled by a built-in refrigeration system within tank.
2. Feed System: Carbon dioxide gas shall be drawn from the top of the new and existing tanks, heated by a vapor heater in each tank to about 60°F and piped as shown on the Drawings. The carbon dioxide gas pressure shall be reduced in the modified pressure

solution feed panel, injected into pressurized carrier water, and then the solution diffused into the 24" raw water line.

C. Performance and Design Criteria:

1. Carbon Dioxide Maximum Gas Flow Rate: 1,622 lb./day.
2. Operating Temperature:
 - a. Minimum: CO2: -20 degrees F; Water 40 degrees F.
 - b. Maximum: CO2: 100 degrees F; Water 80 degrees F.
3. Accuracy: Plus or minus 4 percent of full scale.
4. Repeatability: Plus or minus 1 percent of full scale.
5. Linearity: Plus or minus 0.5 percent of full scale.
6. Automatically switch gas supply from empty cylinder to full cylinder.
7. Vacuum Checking: Entire system capable of being checked in place.
8. Carbon dioxide feed pressure to carrier water: 75 psig
9. Available Carrier Water Supply: 690 gpm at 55 psig.

D. High-Pressure Storage Tanks:

1. Capacity: 91-ton.
2. Maximum Allowable Working Pressure: 350 psig.

E. Pressurized Solution Feed System:

1. Description:
 - a. The existing pressure solution feed system is capable of providing a maximum of 690 lb/hr at a minimum carrier water supply of 690 gpm at 55 psig. Manufacturer shall provide all required modifications to the existing pressure solution feed panel to increase the maximum carbon dioxide feed rate to 1,622 lb/hr. At a minimum, these modifications shall be as shown on the Drawing and as specified herein. The carrier water supply pumps will not be upgraded as a part of this project and will only be required to inject a maximum of 1,200 lb/hr.

F. Operation:

1. Electrical Characteristics:
 - a. As specified in Section 260503 - Equipment Wiring Connections.
 - b. Voltage: 480 V, three phase, 60 Hz.
 - c. Maximum Fuse Size: 150 A.
 - d. Minimum Circuit Ampacity: 20 A.
2. Control Panel:
 - a. Factory mounted.
 - b. NEMA 250 Type 4X.
 - c. Single-point power connection and grounding lug.

3. Controller:
 - a. Turn-Down: 20:1.
 - b. Accuracy: Plus or minus 2 percent of full scale.
 - c. Mounting: Manifold.
 - d. Display: 20-character digital display.
 - e. Inputs:
 - 1) Three analog channels.
 - 2) Four 12- to 24-V dc inputs.
 - f. Outputs:
 - 1) Two 4- to 20-mA dc output signals.
 - 2) Two alarm contacts.
 - 3) Communication Protocol: Modbus RS-485.
4. Disconnect Switch: Factory mounted in control panel.
5. Operation Sequences: Manual, Remote, Flow pacing, Trim.

2.2 MATERIALS

- A. All materials and products furnished, and the complete installation shall comply with the applicable ASME Code and the suggested practices of the Compressed Gas Association.
- B. Liquid Carbon Dioxide Storage Tank
 1. Liquid carbon dioxide storage tank shall be a new horizontal shop-fabricated welded steel pressure vessel, designed and constructed in accordance with Section 8, Division I of the ASME Code for unfired pressure vessels. The tank shall be complete with dual saddle support assembly for mounting as shown on the Drawings. Anchor bolts shall be used to attach the saddle supports to the concrete slab. The tank shall be equipped with a ground lug.
 2. The tank shall be capable of holding 91 tons of liquid carbon dioxide at a working pressure of 300 psi and at a temperature of 0°F, and shall be a Model No. WT-91C as manufactured by TOMCO₂ Systems®, no substitutions.
 3. The tank shall be complete with all necessary accessories as shown on the Drawings and as required for proper operation of the system; including but not limited to the following items: a differential pressure liquid level gage and transmitter calibrated to read in pounds, a 0 to 600 psig pressure gauge and pressure transmitter, and all necessary pipe connections for filling and withdrawal of carbon dioxide to and from the storage tank.
 4. The pressure vessel shall be insulated with 4-inch foamed in place urethane insulation having a thermal conductivity not greater than 0.04 BTU per hour per square foot of surface area per degree Fahrenheit temperature difference, assuming a wind speed 5 mph. The outer shell shall be 0.063-inch (minimum) prepainted aluminum straight shell with preformed flanged and dished heads. Provide all necessary schedule 80 pipe connections for filling and withdrawal of carbon dioxide from the storage tank. No separate fill station will be required.
 5. The tank shall be equipped with complete environmentally safe refrigeration system utilizing refrigerant R-404A. The refrigeration system shall be attached to the storage

vessel as shown on the Drawings and housed in an aluminum control house. The system shall automatically maintain the carbon dioxide in the storage tank at a temperature of -1°F to +1°F and at a pressure of 300 psig. The refrigeration unit shall be equipped with a condensing unit driven by a 6.0 hp, 480 volt, 60Hz, 3 phase compressor and provided with a NEMA 4X, stainless steel, disconnect switch, a motor starter and a 120 volt control voltage transformer. The condensing unit shall include a sight glass, refrigerant line, solenoid valve, expansion valve, and a refrigeration coil mounted internally in the storage tank. Automatic controls shall be provided to automatically start and stop the compressor, thereby controlling the temperature of the carbon dioxide and maintaining the proper operating temperature and pressure.

6. The pressure vessel shall be protected from being subjected to pressure greater than the maximum allowable working pressure (350 psig) by means of two ASME bleeder type pressure relief valves operating in conjunction with a three-way switching valve and two spring operated ASME safety relief valves operating in conjunction with a three-way switching valve. The safety relief valves shall be set at a pressure as determined by the tank manufacturer. The tank shall be provided with a pressure switch to sound an alarm automatically in the event of excessive high or low pressure in the tank. The alarm horn and indicating lights shall be mounted on the refrigeration control panel located on the storage tank. The panel shall be complete with an alarm silence circuit to shut off the audible alarm. Contacts shall be provided for remote indication of high and low tank pressure alarm, as well as 4-20 mA analog outputs for tank level and pressure.
7. All nozzles which penetrate the outer shell of the tank shall be Schedule 80 stainless steel. All piping and fittings furnished as a part of the storage vessel shall be Schedule 80 type 304 stainless steel. Fittings shall be screwed type 2000 psi rated screwed fittings.
8. The storage tank shall be provided with an enclosure at one end to provide weather protection for the pressure-building vaporizer, vapor heater, electrical control equipment, piping and valves. Enclosure shall consist of a structural frame with aluminum sheet cover (0.04 inches thick, minimum). The cabinet and storage tank shall be rated for FL wind requirements of up to 120 mph. Storage tank enclosure, frame, and other exposed metal surfaces shall be painted per manufacturer's recommendations and standards. Adequate vent area shall be provided to allow cooling air circulation for the refrigeration system. Four lockable, hinged doors to provide access to the enclosure and inside accessories shall be provided. The hinges shall be placed such that the door opens to the most accessible proposed sidewalk.

C. Carbon Dioxide Vaporizer

1. Carbon dioxide vaporizer shall be installed integral to the aluminum control housing and shall be of the electric pressure build type.
2. Carbon dioxide vaporizer provided shall be capable of vaporizing the carbon dioxide feed rate of 870 lb/hr and maintain a minimum pressure of 300 psig in the storage tanks. The vaporizer model shall be M-632 by TOMCO Systems. Automatic controls shall be provided to control the vaporizer to maintain the tank pressure above 245 psig. An adjustable differential pressure switch shall activate the vaporizer at 245 psig and shall deactivate the unit at 255 psig.
3. The carbon dioxide vaporizer shall be designed to NEMA 3R standards and shall include integral fused main power disconnect switch; 120V AC control power transformer with primary and secondary fusing; heating element contactor with local pilot light indicator and auxiliary control contact to facilitate remote indication of heater operational status; high temperature cut-out switch with manual reset and auxiliary control contact to facilitate remote indication of high temperature; purging valve to facilitate easy removal

of accumulated impurities; and a safety relief valve. Electrical power supply to the unit shall be 480V AC/3Ø/60 Hz. Electrical power consumption for each vaporizer shall not exceed 60 kW.

4. The electrical controls will be housed in a NEMA 4X type-304 stainless steel enclosure with a fused disconnect switch. The vaporizer shall be supplied as an integral part of the storage tank; pre-piped, pre-wired and pre-insulated and located in the storage tank equipment enclosure.
5. The carbon dioxide vaporizer shall be Model M-1260C1 (maximum capacity of 1,622 lb/hr) as manufactured by TOMCO₂ Systems®.

D. Carbon Dioxide Vapor Heater

1. Carbon dioxide vapor heater shall be of the direct-to-process electric type.
2. The vapor heater shall be capable of heating a minimum of 1,500 pounds per hour of carbon dioxide gas from a temperature of 0°F to room temperature (approximately 60-70°F). The vapor heater model shall be CVH-8 by TOMCO Systems. The vapor heater shall be supplied complete with electronic temperature control. The operating control range of the vapor heater shall be adjustable from 0°F to 70°F.
3. The vapor heater shall be pre-piped and prewired inside the aluminum control cabinet.
4. The carbon dioxide vapor heater shall be designed to NEMA 12 standards and shall include integral NEMA 12 fused main power disconnect switch; 120V AC control power transformer with primary and secondary fusing; heating element contactor with local pilot light indicator and high temperature cut-out switch if temperature exceeds 200° F with manual reset button. Electrical power supply to the unit shall be 480V AC, single phase, 60 Hz. Electrical power consumption for each vapor heater shall not exceed 8 kW.
5. Solid high conductivity aluminum pressure castings containing the electrical resistance heaters and aluminum castings containing the stainless steel tubing for the CO₂ vapor shall be provided. The electrical components will be housed in a stainless steel enclosure with a thru-the-door disconnect switch. The vapor heater shall be pre-installed in the tank cabinet.
6. The vapor heater shall be Model CVH-8SS as manufactured by TOMCO₂ Systems®.

E. First Stage Pressure Regulator Station

1. One carbon dioxide pressure reducing regulator will be modified, which is to be mounted in the CO₂ pipeline after the carbon dioxide vapor heater. The regulator shall be used to reduce the pressure from approximately 300 psig to 120 psig. The regulator shall have a malleable iron body, aluminum spring case and lower case, nitrile and aluminum valve disc and holder, nylon fabric coated with nitrile diaphragm, chrome plated brass valve stem and brass valve stem guide. The outlet pressure of the regulator shall be easily adjusted through the use of an adjustment screw.
2. One pressure gauge, 2-1/2" dial, 0 to 400 psig range, complete with isolation valve, shall be provided for indication of the CO₂ pressure downstream of the regulator.
3. One (1) pressure relief valve shall be provided to protect the components from over pressurization due to thermal expansion. Relief valves shall be constructed of brass with stainless steel spring and rated for CO₂ service. Relief pressure shall be pre-set at 450 psig.

F. Pressurized Solution Feed System

1. All carbon dioxide piping and fittings (size to be determined by Manufacturer) shall be Type 304 stainless steel. All water piping and fittings (6-inch) shall be Schedule 10 Type 304 stainless steel.
2. Wye strainer on the inlet side of the carbon dioxide feed panel shall be bronze
3. One second stage pressure reducing valve, will be supplied. The regulator will reduce the carbon dioxide pressure from the first stage regulator to the desired operating pressure. The regulator will have a malleable iron body, aluminum spring case and lower case, nitrile and aluminum valve disc and holder, nylon fabric coated with nitrile diaphragm, stainless steel valve stem and valve stem guide. The outlet pressure of the regulator will be easily adjusted through the use of an adjustment screw.
4. Pressure gauges, with stainless steel bodies, shall be provided for indication of the CO2 pressure upstream and downstream of the second stage regulator. The pressure gauge shall have local indication of CO2 pressure in PSIG, 2-1/2" inch dial, and 0-200 psig range.
5. Manually operated by-pass CO2 flow control valve shall be supplied. The valve will be stainless steel construction and designed for positive control of CO2 flow.
6. CO2 isolation ball valves will be supplied; one for the panel, two for the control valve by-pass and three for the flow meter and by-pass and one for the solenoid valve by-pass. The valve bodies will be of Type-316 stainless steel construction with stainless steel trim. The ball valves will be designed specifically for CO2 service.
7. 316 stainless steel ball check valve will be provided in the CO2 injection line.
8. Pressure relief valves shall be provided for protection of the PSF Panel components. The valves shall have a brass body and stainless steel spring. Safety relief valves shall be set to relieve at 150 psig and 50 psig. The valves will require venting outside (by others).
9. All necessary modification to the pressure solution feed panel valves, safeties, gauges, pipe, pipe fittings, and control signal isolators, etc. shall be included as part of the modifications to the system. The CO2 gas piping shall be schedule 80 type 304 stainless steel.

G. Pressure Solution Feed Control Panel

1. Modify pressure solution feed control panel as required for all modification to the existing system and addition of the new 91-ton carbon dioxide storage tank and all associated appurtenances.

H. Flow Control Valve

1. The PSF equipment shall include one gas actuated carbon dioxide flow control valve assembly. The flow control valve shall be pneumatically operated, spring opposed, with a diaphragm actuator controlled via an electronic signal from an electro-pneumatic I/P transducer. The transducer shall convert a 4-20mA analog control signal from the SCADA system into a directly proportional pneumatic output. The valve actuator shall be supplied complete with a carbon dioxide gas regulator for utilizing the carbon dioxide gas as the pneumatic source.

I. Flow Meter

1. The PSF equipment shall include one indicating electronic Coriolis carbon dioxide flow meter/transmitter. The body and wetted parts shall be type 316 stainless steel. The meter will be designed for mass flow and will transmit a 4-20mA analog signal to the SCADA system. Accuracy of the meter will be one percent of full scale. The flow meter shall be sized to correspond with the design rate of carbon dioxide per hour. A local LCD display

shall provide readout of local flow rate or total flow. The sensor housing shall be type 304L stainless steel. The meter housing shall be rated NEMA 4X. The flow meter shall be Micro Motion Elite-Series, or approved equal.

J. Labels

1. Labels for the Carbon Dioxide Storage tank.

- a. The following label shall be placed on the storage tank. Two labels shall be placed in different conspicuous locations tank.

"CARBON DIOXIDE"

- b. The label as shown above shall be in bold print and the letters shall have a minimum height of 4 inches. The lettering shall be placed on a background having the same color as that used for the carbon dioxide piping. The labels shall be placed on the tanks in such a manner that they shall not be readily removable.

2. Hazardous material signal arrangement

- a. The tank shall be provided with hazardous material signal arrangements painted on both ends and both sides. Each signal arrangement shall be a 5-inch by 5-inch diamond shaped background. The health signal shall be painted blue, and flammability signal shall be painted red, and the reactivity signal shall be painted yellow. All signals shall be 2-inches high. In the diamond shaped signal arrangement, the health signal shall be identified at the left, the flammability signal shall be identified at the top, the reactivity signal shall be identified at the right, and the bottom shall be used to identify special hazards. The following numerical gradings shall be given to the signal: health - "3", flammability - "0", and reactivity - "0".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017700 - Closeout Procedures” Requirements for installation examination.
B. Verify layout and orientation of equipment, accessories, and piping connections.

3.2 INSTALLATION

- A. According to manufacturer recommendations and as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
B. Leak Testing: As recommended by feed equipment manufacturer.

- C. **Manufacturer Services:** Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 5 days on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- D. **Equipment Acceptance:**
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.4 CLEANING

- A. Section 017700 "Closeout Procedures" Requirements for cleaning.
- B. Before use, dismantle and clean new valves or other equipment received in oily condition.
- C. Test valves with clean, dry air at 150 psig for seat tightness before installation.

3.5 DEMONSTRATION

- A. Section 017700 "Closeout Procedures" Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 463143

This page intentionally left blank.

SECTION 463342 – DIAPHRAGM-TYPE METERING PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Provide chemical metering pumps as shown on the drawings and as specified herein.
- B. All chemical metering pumps shall be pre-engineered and as specified herein as manufactured by ProMinent to match existing NaOCl pumps for Clearwell No. 1. The chemical metering pumps are required to be fully functional at temperatures up to 104 degrees F.
 - 1. Two chemical metering pumps for sodium hypochlorite for disinfection in clearwell, ground storage tanks, and high service pump suction header.
- C. The work includes, but is not limited to, the purchase and installation of new equipment as shown on the drawings and specified herein.

1.3 RELATED REQUIREMENTS

- A. Section 013300 “Submittals”.
- B. Section 017823 “Operation and Maintenance Data”.
- C. Section 407000 “Instrumentation for Process Systems”
- D. Section 330531.16 “Polyvinyl Chloride Pressure Pipe for Water Service”.
- E. Electrical work not herein specified is included in Division 26. A 120 volt/1 phase power supply will be provided under Division 26 to each dual metering pump control panel, as shown on the drawings.
- F. Electric motors shall be furnished as part of the work of this section and shall be in accordance with Division 26.

1.4 SUBMITTALS

- A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of Section 013300. Submittals shall include at least the following:

1. Data on the characteristics and performance of all pumps, including Manufacturer's certified rating data.
2. Certified shop drawings showing all important details of construction, dimensions, and anchor bolt locations.
3. Descriptive literature, bulletins, and/or catalogs of the equipment.
4. The total weight of the equipment.
5. A complete total bill of materials.
6. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, packing, etc. on the list.
7. All information required by Section 013300.
8. Complete data on motors in accordance with Division 26.
9. Complete wiring diagrams and schematics of each control panel, controllers, control device and operator's station furnished under this section.
10. Complete wiring diagrams and schematics of all power and control systems showing wiring requirements between all system components, motors, sensors, control panels, etc., including connections to work of other sections.
11. Data on noise.
12. The recommended grades of lubricants, along with references to alternative equal products by other manufacturers.
13. Certification by the supplier that the equipment and materials to be provided are suitable for the service intended.
14. A complete description of chemical resistance of the component materials that will come in contact with chemicals, as specified herein.
15. A letter of certification from the supplier that the chemical metering skid system design and installation are sufficient for satisfactory operation of the metering system.
16. In the event that it is impossible to conform with certain details of the Specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

B. Operating and Maintenance Data and Training:

1. Operating and maintenance instructions shall be furnished to the Engineer as provided in Section 017823. The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.
2. A factory representative who has a complete knowledge of the proper operation and maintenance shall be provided for a minimum of 1 full day solely to instruct representatives of the Owner and Engineer on proper operation and maintenance of the equipment. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner.
3. The technical representative shall have at least four years of experience in chemical system training and instruction. Training sessions shall be scheduled not less than two weeks in advance. Written training materials consisting of the final O&M manuals shall be provided to each of the Owner's personnel in attendance and shall remain with the trainees.

1.5 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

- B. American Society for Testing and Materials (ASTM)
- C. American National Standards Institute (ANSI)
- D. Anti-Friction Bearing Manufacturers Association (AFBMA)
- E. American Welding Society (AWS)
- F. Occupational Safety and Health Administration (OSHA)
- G. Underwriters Laboratories (UL)
- H. Where reference is made to one of the above standards, the revision in effect at the time of contract award shall apply.

1.6 QUALITY ASSURANCE

- A. The pumps covered by these Specifications are intended to be standard pumping equipment, as modified by these Specifications, of proven ability, as manufactured by a single manufacturer, having long experience in the production of such pumps. The pumps furnished shall be designed, constructed, and installed in accordance with the best practices and methods, and shall operate satisfactorily when installed as specified herein and shown on the drawings.
- B. Should equipment which differs from these Specifications be offered and approved by Engineer and Owner as equal to that specified, such equipment shall be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution shall be made at no additional cost to the Owner and be as approved by the Owner, and Engineer.

1.7 SYSTEM DESCRIPTION

- A. Sodium Hypochlorite – Disinfection
 - 1. The 12.5-15% commercial sodium hypochlorite solution from one of the two 8,700-gallon double wall high density crosslinked polyethylene tanks shall be fed without dilution to one primary application point in the chamber of the new Clearwell Complex No. 2. The sodium hypochlorite will also be intermittently fed to two emergency application points on the HSP suction header and to a maintenance and emergency application point at each GST.
 - 2. For the primary disinfection application points in the clearwell, the variable speed pumps will be controlled by the plant SCADA system based on the raw water flow rate and on the finished water chlorine analyzer.
 - 3. For the emergency application points on the HSP suction header, an alarm from the distribution water chlorine analyzer will signal the operators that the line must be opened. The pumps will then be controlled by the plant SCADA system based on the distribution water chlorine analyzer.
 - 4. For the maintenance and emergency application points in each GST, plant operators will manually open the lines to each application point and will override the controls to allow chlorine to be freely injected into each GST.

- B. Refer to the Process and Instrumentation Diagrams in the Drawings for specific control requirements of the chemical pump systems.

1.8 TOOLS AND SPARE PARTS

- A. All special tools required for normal operation and maintenance shall be furnished with the equipment.
- B. Manufacturer's Preventive maintenance kit shall include the following spare parts at a minimum:
 - 1. One diaphragm assembly.
 - 2. Two sets of valve gaskets, one set of seals, and O-rings.
- C. All tools and spare parts shall be packed and identified in accordance with manufacturer's recommendations.
- D. With the O&M manual submittal, provide a list of all spare and replacement parts with individual prices and location where they are available. Prices shall remain in effect for a period of not less than one year after final acceptance.

1.9 POWER SUPPLY

- A. All motors and items of equipment shall be designed for operation on a power supply as shown on Electrical drawings.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. All pumps, controllers, motors, and appurtenances shall be shipped from the Manufacturer in protective cartons or containers.
- B. All flanges, pipe connections, and electrical connections shall be suitably protected to prevent damage during delivery, storage, and installation.
- C. The Manufacturer shall provide written instructions on storage and handling of the equipment to the Contractor.

1.11 WARRANTY

- A. The equipment shall be warranted by the Manufacturer for a period of one (1) year from date of beneficial use, to be free from defects in workmanship, design or material. If the equipment should fail during the warranty period due to a defective part(s), it shall be replaced in the machine and the unit(s) restored to service at no additional cost to the Owner.
- B. The Manufacturer's warranty period shall start concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Specifications are intended to give a general description of what is required, but do not cover all details which may vary in accordance with the exact requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, installation and field testing of all materials, equipment and apparatus as required. Any additional auxiliary equipment necessary for the proper operation of the proposed installation not mentioned in these Specifications or shown on the drawings shall be furnished and installed.
- B. The pumps shall be rigidly and accurately anchored into position by Contractor in accordance with manufacturer's installation recommendations. All necessary foundation bolts, plates, nuts and washers shall be furnished and installed by Contractor in accordance with manufacturer's recommendations. Anchor bolts shall be Titanium for the sodium hypochlorite metering pumps. Each pump shall be rigidly mounted to an existing polypropylene channel base. Skids shall be constructed the pumps are a minimum of 6-inches above the floor slab in the event of a chemical leak.
- C. The pumps shall be installed in an existing skid as shown on the Drawings. Contractor shall be responsible for coordinating all modifications requirements to connect the new chemical metering pumps to the existing chemical metering skid including modifications to existing skid piping and replacement of reducers.
- D. Stainless steel nameplates giving the name of the manufacturer, model number and serial number, capacity, and other pertinent data shall be attached to each pump and motor.
 - 1. Pump nameplates shall include capacity, head, speed, and any other pertinent information.
 - 2. Motor nameplates shall include horsepower, speed, voltage, amperes, service factor and any other pertinent data.
- E. The chemical feed pumps shall be mechanical diaphragm metering pumps as manufactured by Prominent, no substitutions will be accepted. All pumps shall be the products of a single manufacturer.

2.2 METERING PUMPS – GENERAL

- A. Pumps shall be variable speed chemical feed microprocessor-controlled, mechanically actuated diaphragm metering pumps, motor driven, as manufactured by Prominent and shall be of suitable materials for pumping the respective chemical solutions. Each pump shall be capable of receiving a 4-20 mA external signal for flow pacing and allow manual control at the pump. Single ball type check valves shall be provided on the suction and discharge, including a replaceable ball guide. The pumps shall be dry-lift self-priming and capable of indefinite operation without process fluid.
 - 1. All pumps shall be designed to deliver the capacity tabulated below at the minimum discharge pressure specified.

2. All pumps shall be provided with a manual micrometer type stroke adjustment mechanism, to permit 0 to 100 percent capacity control while in motion, on each head. The mechanism shall provide positive repeatable settings within plus or minus 1 percent over the entire range. Pump delivery shall be repeatable within plus or minus 1 percent accuracy over a 10:1 range.
3. All pumps shall be provided with pressure relief valves with a set pressure of 50 psig maximum. Set pressure shall be field adjustable.

Sodium Hypochlorite Metering Pumps (Clearwell Complex No. 2 Disinfection – 12.5% solution strength)

Number of Units	2 (1 duty/1 standby)
Capacity (maximum)	20 gal/hr
Capacity (minimum)	2.9 gal/hr
Horsepower	1/8 Hp
Maximum Back Pressure (as created by backpressure valve)	25 psig
Model Used for Design:	ProMinent Sigma/1

- B. The metering pumps shall all be driven by variable speed motors, mechanically actuated, disc diaphragm, and meet the following design and performance criteria. Each metering pump shall have an electronic variable speed control. The pumps shall be ProMinent Sigma/1.
- C. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE-faced fluid contact surface. The diaphragm shall be of a convex design fitting into a concave liquid end to minimize dead volume and promote flow of solids in suspension.
- D. Drives and Capacity Control (Motorized Pumps)
 1. Stroke frequency control for motorized pumps shall be done with an integral dual function VFD and stepper motor pump controller. The first 1/3 of the frequency in strokes per minutes will operate with the stepper motor and pump frequency greater than 1/3 will operate with the internal VFD. Control shall be switchable between manual or external control via 4-20 mA signal. In manual mode, stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the pump's LCD. In external mode, the pump shall be capable of receiving a 4-20 mA input via optional external control cable. The metering pump shall be capable of remote ON-OFF operation using the PAUSE function via a voltage-free contact relay through an optional control cable. Pump shall include TEFC, four-pole AC motor.
 2. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. The stroke length shall be displayed on the pump LCD in 1% increments.
- E. Drives and Capacity Control
 1. Stroke length control shall be adjustable manually by means of a stroke length knob, in increments of 1%, from 0% to 100% of stroke length. The stroke length shall be displayed on the pump LCD in 1% increments.
 2. Programming shall allow pump to be calibrated so as to display pump output in gallons/hour or liters/hour, and stroke frequency in strokes per minute. The flow calibration feature shall be maintained when stroke length is changed up to plus or minus 10% on the stroke length knob. If stroke length is changed by more than 10%, a yellow

- warning light will light and a flashing message “calib” will appear indicating re-calibration is required.
3. The pump shall be equipped with the programmable function of pressure levels to allow pump to operate at reduced pressures from the maximum rated pressure of the pump.
 4. The pump shall be equipped with the programmable function of electronic interlocking of the keypad by access code to prevent unauthorized adjustments to the pump.
 5. Keypad shall allow for scrolling and display on LCD such parameters as stroke frequency, stroke length, stroke counter, pump output in gals/hr or l/hr, dosing quantity, mA current input being received by pump, and indication of external mode.
 6. Stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the LCD.
 7. The metering pump shall be capable of receiving a pulse input via optional external control cable such that 1 pulse gives 1 pump stroke rate. The pump shall be capable of remote ON-OFF operation using the pause function via a voltage free contact relay through an optional control cable.
 8. The pump shall accept an analog signal such that stroke frequency is proportional to 4-20mA or 20-4mA, the choice of which is programmable at the pump. Analog to digital converters external to the pump shall not be allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The chemical metering pumps shall be installed in accordance with manufacturer's instructions and recommendations in locations shown on the drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the recommendations of the manufacturer. Anchor bolts shall be set in accordance with the shop drawings.

3.2 INSPECTION AND TESTING

- A. Contractor is responsible for assuring services, labor, and equipment of the manufacturer as specified herein. The equipment manufacturer shall furnish the services of a competent and experienced representative who has complete knowledge of proper operation and maintenance of the equipment to inspect the installed equipment, supervise the initial test run, and to provide instructions to the plant personnel. Three visits shall be provided by chemical metering skid manufacturer. The first visit shall be to conduct inspection of installation and shall be a minimum of one day. The second visit shall be a minimum of three days and shall complete start-up and operate and supervise the preliminary test (no chemicals) and the full functional test. The third visit shall be to instruct plant personnel in the operation and maintenance of the equipment and shall be a minimum of one day. The final copies of operation and maintenance manuals specified in Section 017823 must have been delivered to the Owner prior to scheduling the third visit for the instruction period.
- B. The second visit to complete start-up shall consist of the preliminary test without chemicals on the first day, flushing on the second day, and then full functional testing on the third day.
 1. Preliminary Test without Chemicals

- a. Upon completion of installation, the manufacturer, shall perform a preliminary test (no chemicals) over the full range of each system to ensure the functioning of all component parts. The test shall be over the full range of capacity. The manufacturer shall furnish all labor and equipment. Air and power shall be supplied by the Contractor. Approval of the preliminary test by the Engineer and Owner shall not constitute final acceptance of the equipment furnished.

2. Full Functional Test

- a. Full functional testing shall be performed in the presence of the Owner and a qualified manufacturer's representative on the system. The manufacturer shall furnish all labor materials and equipment required for such tests and shall correct any deficiencies noted by repairing or replacing the defective component and retesting as required until the equipment meets the Specifications. A performance check shall be made on each metering pump with the chemical it is intended to pump. Pumps shall be tested at 10%, 20%, 50%, 75%, and 100% of scale, as required. The total error based on the field determined instrument errors, shall not exceed plus or minus two percent of the actual flow for the pumps. If, during running of the tests, one or more points appear to be out by more than the specified amount, the manufacturer shall make such adjustments or alterations as are necessary to bring equipment up to specification performance. Following such adjustment, the tests shall be repeated for all specified points to ensure compliance. Thirty days will be allowed for any changes necessary to meet the specifications. Otherwise the Owner reserves the right to have the rejected equipment removed from the site and replaced by satisfactory equipment that operates in accordance with the Specifications. Chemicals for the full operating test will be furnished by the Owner.

END OF SECTION 463342

This page intentionally left blank.

