



Sussex County Engineering Department
Sussex County, Delaware

PROJECT SPECIFICATION

CONTRACT S19-10

INLAND BAYS REGIONAL WASTEWATER
FACILITY: PHASE #2 EXPANSION

DECEMBER 2018

FINAL FOR BID

VOLUME I of II (DIVISION 0 – 11)


COUNTY ENGINEER

01/07/2019
DATE



WHITMAN, REQUARDT & ASSOCIATES, LLP



**Sussex County Engineering Department
Sussex County, Delaware**

**INLAND BAYS REGIONAL WASTEWATER FACILITY (IBRWF):
PHASE #2 EXPANSION
CONTRACT S19-10**

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**Sussex County Engineering Department
Sussex County, Delaware**

**INLAND BAYS REGIONAL WASTEWATER FACILITY (IBRWF):
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Sussex County, Delaware

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Sussex County, Delaware

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SECTION 00100

SUSSEX COUNTY ENGINEERING
SUSSEX COUNTY, DELAWARE
INLAND BAYS RWF – PHASE #2 EXPANSION

ADVERTISEMENT FOR BIDS

Sealed Bids, in duplicate, for the construction of the Inland Bays RWF – Phase #2 Expansion will be received by Sussex County, at the office of the Sussex County Council Chambers, 2 the Circle, Georgetown, Delaware 19477, until 11:00 AM local time on Friday XXXXX X, 2018 at which time the Bids received will be publicly opened and read.

The Project consists of the construction of a treatment plant capacity expansion including headworks, aeration, clarification, and effluent storage. Work includes furnishing all equipment, material and labor for the work described in the bid document drawings and specifications.

Bids will be received for a single prime Contract. Bids shall be on a lump sum and unit price basis as indicated in the Bid Form.

The Issuing Office for the Bidding Documents is: Whitman, Requardt & Associates, LLP, 801 South Caroline St., Baltimore, MD 21231, (443) 224-1676. Prospective Bidders may examine the Bidding Documents at the Issuing Office on Mondays through Fridays between the hours of 8:00 AM to 5:00 PM, and may obtain copies of the Bidding Documents from the Issuing Office as described below.

Bidding Documents also may be examined at Sussex County Engineering, Sussex County Administrative Office Building, 3rd Floor, 2 the Circle, Georgetown, Delaware 19477, (302) 855-7718, on Mondays through Fridays between the hours of 9:00 AM to 4:00 PM.

Bidding Documents may be obtained from the Issuing Office during the hours indicated above. Bidding Documents are available on compact disc (as portable document format (PDF) files) for a non-refundable charge of \$75.00, including shipping via overnight express service. Alternatively, printed Bidding Documents may be obtained from the Issuing Office either via in-person pick-up or via mail, upon Issuing Office's receipt of payment for the Bidding Documents. The non-refundable cost of printed Bidding Documents is \$150.00 per set, payable to Whitman, Requardt & Associates, LLP. Upon Issuing Office's receipt of payment, printed Bidding Documents will be sent via the prospective Bidder's delivery method of choice. The date that the Bidding Documents are transmitted by the Issuing Office will be considered the prospective Bidder's date of receipt of the Bidding Documents. Partial sets of Bidding Documents will not be available from the Issuing Office. Neither Owner nor Engineer will be responsible for full or partial sets of Bidding Documents, including Addenda if any, obtained from sources other than the Issuing Office.

A pre-bid conference will be held at 11:00 AM local time on Friday, XXXXX XX, 2018 at Sussex County Council Chambers, 2 the Circle, Georgetown, Delaware 19477. Attendance at the pre-bid conference is highly encouraged but is not mandatory.

Bid security shall be furnished in accordance with the Instructions to Bidders.

Owner: Sussex County Engineering
By: Hans Medlarz, P.E.
Title: County Engineer
Date: Xxxxxx XX, 2018

+ + END OF ADVERTISEMENT FOR BIDS + +

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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.

SUGGESTED INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS

Prepared by



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SUGGESTED INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. Issuing Office – The office from which the Bidding Documents are to be issued.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the advertisement or invitation to bid.

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid the following additional information:

A. Evidence of Bidder's authority to do business in the state where the Project is located.

B. Bidder's state or other contractor license number.

C. Subcontractor and Supplier information in accordance with Article 12; and

D. Meet the requirements of 29 Del Code, Section 6962.

3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

4.01 Site and Other Areas

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 Existing Site Conditions

A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
 2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
 3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 Site Visit and Testing by Bidders

- A. Bidder shall conduct the required Site visit during normal working hours, and shall not disturb any ongoing operations at the Site.
- B. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions. However, Bidder is responsible for making reasonable inspections of Site conditions in accordance with Article 5 hereof.
- C. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site.

- D. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- E. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 Owner's Safety Program

- A. Site visits and work at the Site may be governed by an Owner safety program. As the General Conditions indicate, if an Owner safety program exists, it will be noted in the Supplementary Conditions.

4.05 Other Work at the Site

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. visit the Site, conduct a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study 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. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding 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 Bidder; and (3) Bidder's safety precautions and programs;

- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

- 6.01 A pre-Bid conference will be held at the time and location stated in the invitation or advertisement to bid. The pre-bid conference is not mandatory, but Bidders are encouraged to attend and participate in the pre-bid conference. Representatives of Owner and Engineer will be present to discuss the Project. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents, but it shall be the Bidder's responsibility to make inquiry as to the addenda issued. Questions received less than seven days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.
- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents. All Bidders shall acknowledge receipt of all Addenda on the Bid Form. Failure to do so will result in Bid rejection.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 10 (ten) percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a certified check, bank money order, or a Bid bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of Paragraphs 6.01 and 6.02 of the General Conditions.

- 8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 20 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in which case the Bid security accompanying the proposal shall become the property of Owner. The next low Bidder in order of Bid price shall then be considered the lowest responsive Bidder and the Contract will be awarded to him. Should this Bidder default, the next low Bidder shall be considered and so on. In each case, a defaulting Bidder forfeits the Bid security.
- 8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be substantially completed and ready for final payment are set forth in the Agreement. Bidders must be prepared to complete the work within the Contract term as defined in these documents and as noted as the completion date on the Notice To Proceed.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract for the Work, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those “or-equal” or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an “or-equal” or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer at least 15 days prior to the date for receipt of Bids in the case of a proposed substitute and 5 days prior in the case of a proposed “or-equal”. Each such request shall comply with the requirements of Paragraphs 7.04 and 7.05 of the General Conditions. The burden of proof of the merit of the proposed item is upon Bidder. Engineer’s decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all prospective Bidders. Bidders shall not rely upon approvals made in any other manner. Substitutes and “or-equal” materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.04 and 7.05 of the General Conditions after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

- 11.03 If an award is made, Contractor shall be allowed to submit proposed substitutes and “or-equals” in accordance with the General Conditions. Bids for material or equipment that have not been preapproved to be consistent with the rest of the provisions that address both.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 Bidders must submit to Owner a list of the Subcontractors proposed for each type of work identified in the “Listing of Subcontractors”, as part of the Bid Form.

If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

- 12.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.06 of the General Conditions.
- 12.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.
- 12.04 The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.06.
- 12.05 Subcontractors shall be subject to 29 Del Code, Section 6962 (d)(10).

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form shall be completed in ink or typewritten and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein. Failure to comply may be cause for rejection. No allowances, segregated Bids or assignments will be considered. State all amounts in numerical figures. A Bidder shall make no additional stipulations on the Bid Form to qualify his Bid by attachments or any other matter. Stipulations or qualifications will be subject to Bid rejection.
- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature). The corporate address and state of incorporation shall be shown. The corporate seal shall be affixed and attested by the corporate secretary or an assistant corporate secretary.
- 13.03 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person. The state of formation of the firm and the official address of the firm shall be shown.

- 13.04 A Bid by an individual shall show the Bidder's name and official address.
- 13.05 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 13.06 All names shall be printed in ink below the signatures.
- 13.07 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.08 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form. Bidders will be required to comply with Title 30, Chapter 25 of the Delaware Code. Bidders shall have initiated the license application procedure with the Division of Revenue prior to, or in conjunction with, the submission of a bid on a contract, or in the case of a subcontractor, prior to the submission of a bid by the general contractor.
- 13.09 Each Bid must be accompanied by the completed Certification of Bidder, Listing of Subcontractors, and any other required bid submission forms.

ARTICLE 14 – BASIS OF BID

14.01 Lump Sum

- A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form.

14.02 Unit Price

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity" (which Owner or its representative has set forth in the Bid Form) for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

14.03 Allowances

- A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 Within each copy of the Bidding Documents, the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 7 of the Bid Form.
- 15.02 A Bid shall be received no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be sealed in a plainly marked package with the Project title, the Bid Opening date and time, and the Bidder's name, address and Delaware license number. Each bid shall be completed on the forms provided and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to Sussex County Engineer, Sussex County Administrative Office Building, 2 The Circle, P.O. Box 589, Georgetown, Delaware 19947.
- 15.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened. Oral, telegraphic, electronic, or telephonic Bids are invalid and will not receive consideration.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 Bids may not be withdrawn within sixty (60) days after the Bid Opening.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents,

or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

19.02 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.

19.03 Evaluation of Bids

A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

19.04 Owner shall determine that each Bidder is responsible before awarding the contract. In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder, as set forth below, and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents. Factors to be considered in determining the responsibility of a Bidder include the following:

- A. Bidder's financial, physical, personnel or other resources including subcontracts;
- B. Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of prevailing wage laws in Delaware or any other state;
- C. Bidder's written safety plan;
- D. Whether Bidder is qualified legally to contract with the State;
- E. Whether Bidder supplied all necessary information concerning its responsibility; and
- F. Any other specific criteria, which Owner sets forth herein or as may be hereinafter authorized in 29 Del. C. §6962(d)(13).

If Owner determines that a Bidder is nonresponsive and/or non-responsible, the determination shall be in writing and set forth the basis for the determination. A copy of the determination shall be sent to the affected Bidder within 5 working days of said determination. The final determination shall be made part of Owner's procurement file.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 20 – BONDS AND INSURANCE

20.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 21 – SIGNING OF AGREEMENT

21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 20 days thereafter, Successful Bidder shall execute and

deliver the required number of counterparts of the Agreement (and any bonds and insurance documentation required to be delivered by the Contract Documents) to Owner. Owner shall deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 22 – STATE TAXES

22.01 The Contractor shall be responsible for the payment of any state taxes, if any, assessed in relation to the Work, including but not limited to gross receipt taxes.

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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.

BID FORM FOR CONSTRUCTION CONTRACTS

Prepared by



Issued and Published Jointly by



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BID FORM

INLAND BAYS RWF – PHASE #2 EXPANSION
SUSSEX COUNTY CONTRACT NO. S19-10

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:

SUSSEX COUNTY ENGINEERING DEPARTMENT
ATTN: Hans M. Medlarz, P.E., SUSSEX COUNTY ENGINEER
2 THE CIRCLE
P.O. BOX 589
GEORGETOWN, DE 19947

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder 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. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding 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 Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder 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 Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid 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.
- E. There has been no violation of copyrights or patent rights in manufacturing, producing or selling the product or services shipped or ordered as a result of this Bid. The successful Bidder shall, at his own expense, defend any and all actions or suits charging such infringements, and will save Sussex County, and its appointed and elected officials, officers, partners, directors, employees, and agents harmless from any and all liability, loss, or expense occasioned by any such violation.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

**BID SCHEDULE
CONTRACT NO. S19-10**

PART A – PHASE #2 EXPANSION

NO.	ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
A-1	IBRWF Phase #2 Expansion	LS	1		

TOTAL FOR PART A \$ _____

PART B: STIPULATED CONTINGENT BID ITEMS

NO.	ITEM	UNIT	QUANTITY	UNIT PRICE	TOTAL PRICE
B-1	Contingent Unclassified Excavation	CY	400	11.00	4,400.00
B-2	Contingent Aggregate Material, Graded Aggregate Type "B" (Crusher Run)	Ton	500	21.00	10,500.00
B-3	Contingent Porous Fill Material, Coarse Aggregate No. 57 Stone	Ton	1000	23.00	23,000.00

B-4	Contractor Down Time	per hour	40	400.00	16,000.00
B-5	Contingent Hotmix	Ton	150	75.00	11,250.00
B-6	Furnish and Place 5,000 psi Concrete	CY	100	150.00	15,000.00
TOTAL FOR PART B				\$	80,150.00

BASE BID

(Total for Part A + Part B)

\$ _____

Bidder acknowledges that (1) each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and (2) estimated quantities are not guaranteed, and are solely for the purpose of comparison of Bids, and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are submitted with and made a condition of this Bid:
- A. Required Bid security;
 - B. List of Proposed Subcontractors;
 - C. List of Major Products of Equipment;
 - D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids. Bidders shall have initiated the license application procedure with the Division of Revenue prior to, or in conjunction with, the submission of a bid on a contract, or in the case of a subcontractor, prior to the submission of a bid by the general contractor in accordance with Title 30, Chapter 25 of the Delaware Code;
 - E. Contractor's License No.: _____ [or] Evidence of Bidder's ability to obtain a State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids;
 - F. Certification Regarding Compliance With Equal Opportunity Requirements/Non-Segregated Facilities Certification; and
 - G. Certification of Bidder.

ARTICLE 8 – DEFINED TERMS

- 8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER:

By:

Signature

Printed name

Attest:

Signature

Printed name

Title:

Submittal Date:

Address for giving notices:

Telephone Number:

Fax Number:

Contact Name and e-mail address:

Bidder's License No.:

Affix Corporate Seal
and Acknowledge
All Addenda

LISTING OF SUBCONTRACTORS

This document is an Attachment to the Bid Form and is a legally binding part thereof.

Each Bidder shall complete this “Listing of Subcontractors” in its entirety. Failure to do so may render the Bid Form non-responsive and may be grounds for its rejection by Owner.

The Subcontracted Amount is limited to 50% of the Total Contract.

Subcontractor Name & Address	Type of Work	Subcontract Amount

Total Subcontracted Amount: \$ _____

Percent of Total Contract: _____%

This page intentionally blank.

LIST OF MAJOR PRODUCTS OR EQUIPMENT

1. EQUIPMENT LISTING

This Bid Schedule is an attachment to the Bid Form and legally binding part thereof.

The Contractor shall list below the equipment manufacturer upon which he has based his Bid. The Contractor must circle one of the named manufacturers. The Bidder may submit a request for a substitute or "or approved equal" item as described in the Instructions to Bidders, Article 11.

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>MANUFACTURER</u>
1.	Influent Screen	Headworks Inc
2.	Grit Removal Equipment	Westech, Smith and Loveless
3.	Aeration System	Parkson Biolac
4.	Clarifiers	Ovivo, Westech
5.	Sludge Pumps	Gorman Rupp
6.	Process Blowers	Kasser
7.	Split Case Pumps	Patterson, Fairbanks
8.	Filtration	Amiad
9.	Algae Control System	LG
10.	Slide Gates	Hydrogate, AquaVox

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SECTION 00303

CERTIFICATION OF BIDDER

This is to certify that the undersigned Bidder, _____ on the _____ day of _____, 20____, for Sussex County Project S19-10 entitled "**INLAND BAYS RWF – PHASE #2 EXPANSION**" the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization or corporation;
2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham bid;
3. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
4. Bidder has not engaged in corrupt, fraudulent, collusive or coercive practices in competing for the Contract. For the purposes of this Paragraph:
 - a. "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;
 - b. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - c. "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
 - d. "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.

CORPORATE SEAL

Signature of Bidder

BY: _____

Attest: _____

Secretary

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

My commission expires _____.

Notary Public

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**AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite, including subcontractors, that complies with this regulation:

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____, NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

EMPLOYEE DRUG TESTING REPORT FORM

Period Ending: _____

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds maintain testing data that includes but is not limited to the data elements below.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

Number of employees who worked on the jobsite during the report period: _____

Number of employees subject to random testing during the report period: _____

Number of Negative Results _____ Number of Positive Results _____

Action taken on employee(s) in response to a failed or positive random test:

Date: _____

This form is not required to be submitted to the Owner. Included as a reference to show information required to be maintained by the Contractor. The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor's or Subcontractor's offices (or by other means to make the data available for inspection by the Owner).

**EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS**

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

Name of employee with positive test result: _____

Last 4 digits of employee SSN: _____

Date test results received: _____

Action taken on employee in response to a positive test result:

Authorized Representative of Contractor/Subcontractor: _____
(typed or printed)

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

This form shall be sent by mail to the Owner within 24 hours of receipt of test results.

Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.

**CERTIFICATION REGARDING COMPLIANCE
WITH EQUAL OPPORTUNITY REQUIREMENTS**

The undersigned Bidder _____ (has, has not) previously performed work subject to the Presidents Executive Order Nos. 10925, 11114 or 11246.

**NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS
FOR CERTIFICATION OF NON-SEGREGATED FACILITIES**

A certification of Non-Segregated Facilities, as required by the May 9, 1967 order (32 F.R. 7439, May 19, 1967), on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding \$10,000, which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semi-annually, or annually).

NOTE: The penalty for making false statements in orders is prescribed in 18 U.S.C. 10001.

Date: _____

Signature of Bidder or Prospective Contractor

Address (Including Zip Code)

This page intentionally blank.

CERTIFICATION OF TITLE TO MATERIALS STORED OR TO BE STORED FOR INCORPORATION INTO
SUSSEX COUNTY CONTRACTS

This Certification is made by _____ hereinafter to be known as "Contractor" who is engaged in the performance of _____ Project, Project No. _____ ("Project") for Sussex County (hereinafter "County").

WHEREAS, the Contractor has purchased certain materials from _____ hereinafter referred to as "Vendor" for incorporation in the Project and has stockpiled or intends to stockpile or store certain materials or supplies at the contract site or at a place and manner approved by the County, namely the following materials and supplies:

DESCRIPTION AND QUANTITIES:

These described materials and supplies (hereinafter "Materials") shall be stored at the following location: _____ and in the following manner: _____.

WHEREAS, to comply with the provisions of the Contract Documents in connection with above noted Project requiring certification of the Contractor's absolute title to the Materials before the County can make payment to Contractor for such Materials, the Contractor has entered into the following agreement.

NOW THEREFORE, for and in consideration of the foregoing premises, the Contractor agrees, with the intention of being legally bound, as follows:

1. The Contractor certifies and represents that Contractor is the lawful holder of the absolute legal title to the Materials and has the full legal right, power and authority to sell and transfer title without restriction, Uniform Commercial Code or other filings, liens, or encumbrances of any kind on the part of the Vendor and/or any subcontractors.
2. The Contractor and their respective successors and assigns hereby warrant the title to the Materials to the County.
3. In the event that the Vendor has furnished or sold the Materials or transferred title to such Materials to a subcontractor of the Contractor rather than directly to the Contractor, this Certification of Title is hereby amended at all applicable points to reflect this fact. By execution of this Certification by any subcontractor, such subcontractor is executing this document for the purpose of acknowledging: that such subcontractor has made to the Contractor an outright sale and transfer of title which it may have to the Materials free of all restrictions, Uniform Commercial Code or other filings, liens or encumbrances; that such subcontractor does not have any interest of any kind in the Materials; that

such subcontractor has the right to make such transfer of title; that such subcontractor will not in the future make any claim whatsoever to the title of the Materials.

[signature page follows]

IN WITNESS WHEREOF, the parties hereto have caused this Certification of Title to be executed this ____ day of _____, 20__.

ATTEST:

BY:

TITLE:

CONTRACTOR

BY:

TITLE:

ATTEST:

BY:

TITLE:

SUBCONTRACTOR (if applicable)

BY:

TITLE:

This page intentionally blank.

RELEASE AND WAIVER FOR MATERIALS STORED ON PRIVATE PROPERTY

SUSSEX COUNTY PROJECT NO. _____

CONTRACT NAME:

STORAGE LOCATION ("Storage Site"):

STORAGE SITE OWNER(S) NAME: _____

MATERIALS STORED ("Materials"):

WHEREAS, the undersigned certifies to be the property owner, or authorized representative thereof, of the above described Storage Site; and

WHEREAS, the undersigned has contracted with the Contractor on the above-listed Sussex County Project in order to store and remove the above-referenced Materials from the Storage Site; and

WHEREAS, these Materials are the same as those for which the Contract is requesting payment, in whole or in part, from Sussex County in advance of removal of said Materials from the Storage Site.

NOW THEREFORE, in consideration of such payment being made to said Contractor, I/we do hereby release any and all claims which I/we have or can claim to have upon the Materials for any and all sums of money which may be due to me/us from said Contractor for permission to store the Materials on said Storage Site.

FURTHER, I/we do hereby consent and agree that in the event of the failure of the Contractor to fulfill and perform said Contract with Sussex County, or said Contract is canceled in whole or in part by Sussex County such that Contractor is prohibited from completing said Contract, then Sussex County or any substitute party or contractor may remove all such Materials from the Storage Site without further payments due to me/us for the use of the Storage Site.

FURTHER, I/we do hereby agree that for purposes of inspection, sampling, inventory, removal, or other reasons as determined necessary by Sussex County, the Sussex County employees, agents, officers, and contractors and the said agents, officers, employees thereof, shall have the right to enter the Storage Site at any or all times with equipment and vehicles to take therefrom any and all said stored Materials stored in connection with the above contract and that such right of ingress and egress to and from the Storage Site shall be without obstruction, objection or hindrance and without further payment due to me/us for such rights.

FURTHER, I/we do hereby waive any and all claims upon the Materials and upon the rights to remove same.

This instrument shall bind the property owner(s), their successors and assigns.

IN WITNESS WHEREOF, the parties hereto have caused this Release and Waiver to be executed this ____ day of _____, 20__.

STORAGE SITE PROPERTY OWNER

BY:

Print Name:

Title (if applicable):

SWORN AND SUBSCRIBED before me this ____ day of _____, 20__.

NOTARY PUBLIC

Name:

Date of Expiration: _____

SECTION 00340

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____
_____ of _____ in the County of _____
_____ and State of _____ as **Principal**,
and _____ of _____
in the County of _____ and State of _____ as **Surety**, legally authorized to
do business in the State of Delaware, and are held and firmly unto Sussex County (**Owner**) in the sum of _

_____) Dollars (\$ _____), for Sussex County Contract S19-10, "**IBRWF: Phase #2 Expansion**" to be
paid to the **Owner** for the use and benefit of **Owner** for which payment well and truly to be made, we do
bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally
for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bounden **Principal**
who has submitted to the **Owner** a certain proposal to enter into this contract for the furnishing of certain
material and/or services within the State, shall be awarded this Contract, and if said **Principal** shall well
and truly enter into and execute this Contract as may be required by the terms of this Contract and approved
by the **Owner** this Contract to be entered into within twenty days after the date of official notice of the
award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be
and remain in full force and virtue.

Sealed with _____ seal and dated this _____ day of _____ in the year of our Lord
two thousand and _____ (20____).

SEALED, AND DELIVERED IN THE
Presence of

Name of Bidder (Organization)

Corporate
Seal

By:

Authorized Signature

Attest _____

Title

Name of Surety

Witness: _____

By:

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

Prepared by



Issued and Published Jointly by



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

THIS AGREEMENT is by and between Sussex County, A political subdivision of the State of Delaware (“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:

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: IBRWF – Phase #2 Expansion.

ARTICLE 3 – ENGINEER

3.01 The Project has been designed by Whitman, Requardt and Associates, LLP.

3.02 The Owner has retained Whitman, Requardt and Associates, LLP (“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. In the event that Whitman, Requardt and Associates, LLP is no longer the Engineer for the project, Owner shall provide written notice to Contractor.

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 534 consecutive days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions.

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 \$ 1,200.00 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. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

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, 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 no more than once monthly during performance of the Work as provided in Paragraph 6.02.A.1 below, 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.
- B. The Contractor shall submit two (2) executed copies of the partial pay requisition to the Engineer for review and approval. Upon approval, the Engineer shall submit the approved payment requisition to Sussex County. Sussex County will have beginning on that date thirty (30) calendar days to process the monthly payment request for payment. In the event the 30th day is a weekend or County holiday, payment can be expected on the previous work day. Upon receipt of the check, Sussex County Engineering Department will notify the Contractor by telephone that the check is ready for pickup or delivery.
 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract
 - a. 95 percent of Work completed (with the balance being retainage); If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and

- b. 95 percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).
- C. Upon Substantial Completion of the entire construction to be provided under the Contract Documents, Owner may pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 100 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

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 – CONTRACTOR'S REPRESENTATIONS

- 7.01 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 or as is visible or apparent from a reasonably diligent inspection.
- 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 8 – CONTRACT DOCUMENTS

8.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement
 - 2. Performance bond
 - 3. Payment bond
 - 4. Other bonds
 - 5. General Conditions
 - 6. Supplementary Conditions
 - 7. Specifications as listed in the table of contents of the Project Manual.
 - 8. Drawings dated _____ [or] the Drawings listed on the attached sheet index.
 - 9. Addenda
 - 10. Contractor's Bid
 - 11. 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, if ratified by Owner.
 - e. Notice of Award.
- B. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 9 – MISCELLANEOUS

9.01 Terms

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

9.02 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.

9.03 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.

9.04 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.

9.05 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

9.06 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 in triplicate.

This Agreement will be effective on _____

OWNER:

CONTRACTOR:

By: Michael Vincent

By: _____

Title: President, Sussex County Council

Title: _____

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

Attest: _____

Attest: _____

Title: Clerk of the Sussex County Council

Title: _____

Address for giving notices:

Address for giving notices:

Sussex County Council-Engineering Dept.

2 The Circle, P.O. Box 589

Georgetown, DE 19947

PREVIOUSLY APPROVED FORM

License No.: _____
(where applicable)

NOTE TO USER: Use in those states or other jurisdictions where applicable or required.

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PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto **Sussex County** (“**Owner**”), in the amount of _____ (\$_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 2018.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Sussex County Project S19-10, **IBRWF – Phase #2 Expansion**, dated the _____ day of _____, 2018 (the “Contract”), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, hereby stipulates and agrees, if requested to do so by **Owner**, to fully perform and complete the work to be performed under the Contract pursuant to the terms, conditions and covenants thereof, if for any cause **Principal** fails or neglects to so fully perform and complete such work.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, assignments, subcontracts and transfers and hereby expressly stipulates and agrees that any and all things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omissions or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond.

Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Witness or Attest:

Name: _____

Address: _____

Name

By: _____(SEAL)

(Corporate Seal)

Name:

Title:

SURETY

Witness or Attest:

Name: _____

Address: _____

Name

By: _____(SEAL)

(Corporate Seal)

Name:

Title:

PAYMENT BOND

Bond Number:

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal ("**Principal**"), and _____ a _____ corporation, legally authorized to do business in the State of Delaware, as surety ("**Surety**"), are held and firmly bound unto **Sussex County** ("**Owner**") in the amount of _____ (\$ _____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

Sealed with our seals and dated this _____ day of _____, 2018.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Sussex County Project S19-10, **IBRWF PHASE #2 EXPANSION** dated the _____ day of _____, 2018 (the "Contract"), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

Surety, for value received, for itself and its successors and assigns, hereby stipulates and agrees that the obligation of **Surety** and its bond shall be in no way impaired or affected by any extension of time, modification, omission, addition or change in or to the Contract or the work to be performed thereunder, or by any payment thereunder before the time required therein, or by any waiver of any provisions thereof, or by any assignment, subletting or other transfer thereof or of any work to be performed or any monies due or to become due thereunder; and **Surety** hereby waives notice of any and all such extensions, modifications, omissions, additions, changes, payments, waivers, things done and omitted to be done by and in relation to assignees, subcontractors, and other transferees shall have the same effect as to **Surety** as though done or omitted to be done by or in relation to **Principal**.

Surety hereby stipulates and agrees that no modifications, omission or additions in or to the terms of the Contract shall in any way whatsoever affect the obligation of **Surety** and its bond. Any proceeding, legal or equitable, under this Bond may be brought in any court of competent jurisdiction in the State of Delaware. Notices to **Surety** or Contractor may be mailed or delivered to them at their respective addresses shown below.

IN WITNESS WHEREOF, **Principal** and **Surety** have hereunto set their hand and seals, and such of them as are corporations have caused their corporate seal to be hereto affixed and these presents to be signed by their duly authorized officers, the day and year first above written.

PRINCIPAL

Witness or Attest:

Name: _____

Address: _____

By: _____(SEAL)

Name

Name:

(Corporate Seal)

Title:

SURETY

Witness or Attest:

Name: _____

Address: _____

By: _____(SEAL)

Name

Name:

(Corporate Seal)

Title:

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



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).

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STANDARD GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT

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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. §§5501 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.H 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 consider 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 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 11.01.C.2.a and

11.01.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 special 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.

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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.

GUIDE TO THE PREPARATION OF SUPPLEMENTARY CONDITIONS

Prepared by



Issued and Published Jointly by



This Guide to the Preparation of Supplementary Conditions has been prepared for use with the Standard General Conditions of the Construction Contract (EJCDC® C-700, 2013 Edition). Their provisions are interrelated and a change in one may necessitate a change in the other. The suggested language contained in the Guide to the Preparation of Instructions to Bidders (EJCDC® C-200, 2013 Edition) is also carefully integrated with the suggested language of this document. The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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

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

ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

SC-1.01 Defined Terms

- A. If the Contract will include a Geotechnical Baseline Report (see Article 5 below), include the following definitions:

SC-1.01. Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:

“Conditional Acceptance” – A sixty (60) day period after substantial completion in which the Owner will have full use of the facilities but the Contractor shall maintain all portions of the Work included in the Contract.

“Or-Equal” -Or approved equal, as that term is used in 29 Del. C. §6962.

SC 1.01.A.10 Delete the definition of “Claim” and replace with the following definition:

Claim – (a) A demand or assertion by Owner directly to Contractor in accordance with the provisions set forth herein; or (b) a demand or assertion by Contractor directly to Owner in accordance with the provisions set forth herein. A demand for money or services by a third party is not a Claim.

SC 1.01.A.21 Insert the following language after “Engineer” in Paragraph 1.01.A.21:

and approved or ratified by Owner

SC 1.01.A.48 Add the following 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 without a subsequent Change Order.

Delete the following language from the first sentence of Paragraph 1.01.A.48:

“and recommended by Engineer”

ARTICLE 2 – PRELIMINARY MATTERS

SC-2.01 Delivery of Bonds and Evidence of Insurance

SC-2.01 Delete Paragraph 2.01 B. and C. in their entirety and insert the following in their place:

B. Evidence of Contractor's Insurance: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies of insurance (including all endorsements, and identification of applicable self-insured retentions and deductibles) required to be provided by Contractor in Article 6. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

SC-2.04 Preconstruction Conference; Designation of Authorized Representatives

SC-2.04.B Add the following language to the end of Paragraph 2.04.B:

Owner shall designate a person, other than Engineer, for this responsibility.

ARTICLE 3 – DOCUMENTS, INTENT, REQUIREMENTS, REUSE

SC-3.01 Intent

SC 3.01.E Delete

SC-3.03 Reporting and Resolving Discrepancies

SC 3.03.A.2 Delete "by Engineer" in the last sentence and replacing it with "by Owner".

SC-3.04 Requirements of the Contract Documents

SC 3.04.A Remove the words "and Owner" from the first sentence of 3.04.A. Delete the last sentence and replace with:

Unless such matter is subject to the exceptions listed in subsection (c) below, Engineer shall review and submit to Owner a recommendation regarding any matters in question regarding the requirements of the Contract Documents. Within ten days of receipt of Engineer's recommendation, Owner shall issue a final decision regarding said matter, unless Owner gives notice of an extension of the deadline for said recommendation.

SC 3.04.C Replace the words "a decision or interpretation" with "recommendation" in the first sentence. Delete the last sentence and replace with:

If Contractor is dissatisfied with Owner's decision, Contractor may pursue resolution as provided in Article 12.

ARTICLE 4-COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01 Commencement of Contract Times; Notice to Proceed

SC 4.01.A Delete the first two sentences and replace with:

The Contract Times will commence to run on the day indicated in the Notice to Proceed.

SC-4.02 Starting the Work

SC 4.02-A At the end of the first sentence add:

“in accordance with the Notice to Proceed.”

SC-4.05 Delays in Contractor’s Progress

SC 4.05.A Delete “and Contract Price” at the end of the first sentence.

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

SC-5.01 Availability of Lands

SC 5.01.B Delete

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

- D. All permanent construction will be within lands of the Owner, public rights-of-way, or within easements through private property acquired by the Owner. The Contractor shall confine his operation strictly within the limits of the rights-of-way and construction areas. In the event the Contractor allows construction to occur outside the lands of the Owner, public rights-of-way, or within easements through private property, Contractor shall be responsible for correcting said error through relocating construction, obtaining corrective deeds or easements, or through other appropriate measures as may be agreed upon by the Owner. The Contractor shall replace in-kind and repair all damages within the prescribed areas equal to or superior than original conditions. Work will be permitted outside of the prescribed easement area if written permission to occupy additional ground is provided by the owner of the affected property. The Contractor shall be responsible for replacement of any property damaged outside of the prescribed area. Trees and other natural obstructions shall not be removed without written permission from the owner of the property. Such additional agreements shall be promptly sent to Engineer, in advance of construction, for filing.
- E. The Owner shall provide copies of easement drawings and related special conditions to the Contractor prior to the start of Work. The Contractor shall be responsible for compliance with the terms and conditions stated by each easement agreement. All Work defined therein shall be included in the appropriate unit prices bid for furnishing and installing the pipelines.
- F. The Contractor shall be responsible for acquiring his own construction staging area. Prior to occupation of the staging area, Contractor shall submit a copy of the letter of permission to occupy additional ground for a construction staging area signed by the owner of the property. The agreement shall include:
1. Tax Map and parcel number of the site.
 2. A description of the size and condition of the site.
 3. A description of the materials and equipment to be stored at the site.
 4. Period for which the site will be used.
 5. Provisions to limit dust and noise, and daily removal of trash.

6. Provisions for final restoration.

G. All property acquisition deeds and deeds of easement may be reviewed at Sussex County Engineering Department, Sussex County Administrative Offices, #2 the Circle, Georgetown, Delaware, Monday-Friday, 8:30 a.m. to 4:30 p.m. on working days.

SC-5.03 Subsurface and Physical Conditions

SC 5.03 Delete Paragraphs 5.03.A and 5.03.B in their entirety and insert the following:

- A. No reports of explorations or tests of subsurface conditions at or adjacent to the Site, or drawings of physical conditions relating to existing surface or subsurface structures at the Site, are known to Owner.

SC-5.05 Underground Facilities

SC 5.05.A Insert the following into paragraph A after the first sentence:

The Contractor shall make an exact determination of the location and extent of all overhead and underground utilities prior to performance of Work. If Contractor damages any utilities, he or she shall immediately take such measures as are required to prevent further damage and to protect life and property. The Contractor shall also immediately notify the affected utility company and make permanent repair of the damage. The Contractor shall pay for all damages incurred, as well as for the full repair and restoration thereto at the sole expense of Contractor with no expense being incurred by Sussex County.

SC-5.06 Hazardous Environmental Conditions

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.
- B. Not Used.

SC 5.06.I Delete paragraph in its entirety.

SC 5.06.J Delete the following sentence:

Nothing in this paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.01 Performance, Payment, and Other Bonds

SC-6.01.D Remove "20 days" in the first sentence, and replace with, "five business days".

SC-6.01-E Replace "Article 16" with "Section 16.02".

SC-6.02 Insurance—General Provisions

SC-6.02.A Remove "Owner and" from the sentence.

SC-6.02.C Replace the first sentence of 6.02.C with the following:

Prior to the start of Work under this Contract, Contractor shall deliver to Owner, with copies for each named insured and additional insured (as identified in the Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance and required endorsements establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract, that are satisfactory to and approved by Owner.

SC-6.02.D Delete.

SC-6.02-E Replace "Owner or Contractor" with "Owner" in both instances of this paragraph.
Replace "other party" with "Contractor".

SC-6.02.H Delete Paragraph 6.02.H in its entirety and replace with the following:

Without prejudice to any other right or remedy, if Contractor has failed to obtain required insurance, Owner may elect to obtain equivalent insurance, to protect Owner's interests at the expense of Contractor, and the Contract Price shall be adjusted accordingly.

SC 6.02.I Add the following sentence to the end of paragraph 6.02.I:

Nothing in this subsection shall be construed to allow insurance coverage, as required by the Contract Documents, to lapse during this Contract, unless and until specific, written authorization for alternative coverage is issued by Owner.

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

- K. Contractor shall require all Subcontractors to obtain and maintain workers' compensation, commercial general liability, contractors' pollution liability (optional), contractors' professional liability (optional) and automobile liability insurance to the same extent required of Contractor in this Article. Prior to the start of Work under this Contract, Contractor will furnish Subcontractors' certificates of insurance and required endorsements to Owner.
- L. No acceptance and/or approval of any insurance by Owner shall be construed as relieving or excusing Contractor, or its surety, or its bonds from any liability or obligation imposed upon them by the provisions of the Contract.
- M. Any deductibles or retentions of \$5,000 or greater (\$10,000 for umbrella excess liability) shall be disclosed by Contractor, and are subject to Owner's written approval. Any deductible or retention amounts elected by Contractor or its Subcontractors or imposed by Contractor's or Subcontractor's insurer(s) shall be the sole responsibility of Contractor or its Subcontractors and are not chargeable as expenses.
- N. If Owner is damaged by the failure or neglect of Contractor to obtain and maintain insurance as described and required herein, without so notifying Owner, then Contractor shall bear all reasonable costs properly attributable thereto.

6.03 Contractor's Liability Insurance

SC-6.03.B Delete 6.03.B.

SC-6.03.C Replace 6.03.C. 7. and 8 and add 9., 10. and 11. as follows:

7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 04 13 and CG 20 37 04 13 (together) or their equivalent.
8. For design professional additional insureds, ISO Endorsement CG 20 32 04 13, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
9. ISO Endorsement CG 20 01 04 13 "Primary and Noncontributory – Other Insurance Condition" or its equivalent;
10. Liability arising from the actions of Subcontractors.
11. Additional insured endorsements shall include coverage for Owner for Owner's general supervision of the Work.

SC-6.03.G Replace 6.03. G. with the as follows:

- 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 the respective elected and appointed officials, 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.

SC-6.03.H Change "two years" to "three years" in the second to last sentence.

SC-6.03.I.3 Amend the first sentence of 6.03. I.3 by replacing "10 days" with "30 days (10 days for non-payment of premium)".

SC 6.03-I Amend Paragraph 6.03.J as follows:

- J. The coverage requirements for specific policies of insurance, other than Contractor's employer's liability insurance, must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies. Employer's liability limits may be satisfied by a combination of employer's liability and excess or umbrella insurance limits.

SC 6.03 Add the following after Paragraph 6.03.J:

- K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:
 1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions shall provide statutory benefits as required by any state or Federal law, including standard "other states" coverage and employers liability insurance with limits of:
 - a. \$500,000 each accident for bodily injury by accident;
 - b. \$500,000 each employee for bodily injury by disease; and
 - c. \$500,000 policy limit for bodily injury by disease.
 2. Commercial General Liability under Paragraph 6.03.C of the General Conditions:

- a. \$1,000,000 combined single limit - each occurrence;
- b. \$1,000,000 personal and advertising injury;
- c. \$2,000,000 combined single limit - general aggregate; and
- d. \$2,000,000 combined single limit - products/completed operations aggregate.

If box is checked, Contractor is required to provide a general aggregate limit that applies per project.

3. Automobile Liability under Paragraph 6.03.D. of the General Conditions:
\$1,000,000 combined single limit - each accident.

4. Excess or Umbrella Liability under Paragraph 6.03.E. of the General Conditions:

- a. \$5,000,000 combined single limit - each occurrence;
- b. \$5,000,000 combined single limit - aggregate other than products/completed operations and auto liability; and
- c. \$5,000,000 combined single limit - products/completed operations aggregate

5. Contractor's Pollution Liability under Paragraph 6.03.F. of the General Conditions:

- a. \$_____ each occurrence; and
- b. \$_____ general aggregate.

If box is checked, Contractor is required to provide Contractor's Pollution Liability insurance under this Contract

6. Contractor's Professional Liability under Paragraph 6.03.H of the General Conditions:

- a. \$_____ each claim; and
- b. \$_____ annual aggregate.

If box is checked, Contractor is required to provide Contractor's Professional Liability insurance under this Contract

L. Waivers of Rights of Recovery

- 1. Contractor and all Subcontractors shall waive any and all rights against Owner and Engineer, and the respective elected and appointed officials, officers, directors, members, partners, employees, agents, consultants, and subcontractors of each for bodily injury and property damage claims arising from the Contract.
- 2. As respects Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions, include DCRB form WC 00 03 03 "Waiver of Our Right of Recovery from Others Endorsement", or its equivalent.
- 3. As respects Commercial General Liability under Paragraph 6.03.C. of the General Conditions, include ISO Endorsement CG 24 04 "Waiver of Transfer of Rights of Recovery", or its equivalent.

4. As respects Automobile Liability under Paragraph 6.03.D. of the General Conditions, include ISO Endorsement CA 04 44 "Waiver of Transfer of Rights of Recovery Against Others to Us (Waiver of Subrogation)" or its equivalent.
5. Waiver of right of recovery endorsements required herein shall designate Owner and Engineer, and the respective elected and appointed officials, officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and be submitted in conjunction with certificates of insurance.

6.04 Owner's Liability Insurance

SC-6.04 Delete Paragraphs 6.04.A and 6.04.B in its entirety.

SC-6.05 Property Insurance

SC-6.05.A As respects 6.05. A., Builder's Risk, Owner shall purchase and maintain property insurance on the Work on a replacement cost basis with a limit equal to or exceeding the Contract Price. This insurance shall be maintained until Substantial Completion. This property insurance shall insure the interests of the Owner, Contractor, Subcontractors and Engineer in the Work and shall name them as insured.

This insurance shall:

SC-6.05A.2 As respects 6.05. replace A. 2. with as follows:

2. be written on a builder's risk "all risk" policy form that shall insure against "all risk" perils (ISO Form CP 10 30 Special Form - Causes of Loss or its equivalent) and the following perils or causes of loss:
 - a. ISO Form CP 11 21 "Builders Risk—Theft of Building Materials, Fixtures, Machinery, Equipment" or its equivalent;
 - b. Equipment breakdown perils (ISO Form CP 10 46 "Equipment Breakdown Cause of Loss" or its equivalent");
 - c. Collapse (ISO Form CP 11 20 "Builders Risk – Collapse During Construction" or its equivalent);
 - d. Debris removal;
 - e. Earthquake, volcanic activity, and other earth movement;
 - f. Flood;
 - g. Water damage (other than that caused by flood);
 - h. Ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions;
 - i. Demolition occasioned by enforcement of Laws and Regulations; and
 - j. Terrorism.

If insurance against the perils of equipment breakdown, flood or earthquake; volcanic activity, and other earth movement, flood or terrorism, 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.

SC-6.05 As respects 6.05. replace A. 5. And A.6. with as follows:

5. Include coverage for 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), with a limit exceeding or equal to the greater of ten percent of the Contract Price or \$100,000;
6. extend to cover damage or loss to insured property while in transit, with a limit exceeding or equal to the greater of ten percent of the Contract Price or \$100,000;

SC-6.05. Amend the first sentence of 6.05. B. by replacing "10 days" with "30 days (10 days for non-payment of premium)".

SC-6.05 As respects 6.05. replace F. with:

- F. Contractor shall be responsible for any and all loss of or damage to property, equipment and/or materials owned by Contractor or any subcontractors or their respective officers, directors, partners, members or employees, not forming a part of the Work as described in 6.05 A.3., and any consequential loss of income or extra expense that results from such loss or damage to such property. Contractor or any subcontractors may purchase insurance to protect their interests for such property (including any consequential loss of income or extra expenses).

SC-6.05.B. Amend the first sentence of 6.05.B. by replacing "10 days" with "30 days (10 days for non-payment of premium)".

SC-6.06 Amend

- 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 to the extent commercially available, against Engineer or its consultants, or their officers, directors, members, partners, members, 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, depending on the builders' risk insurers agreement to permit a waiver, 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 (dependent on the conditions in 6.06. A.) Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - a. 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
 - b. 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 (dependent on the conditions in 6.06. A.) Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

ARTICLE 7 – CONTRACTOR’S RESPONSIBILITIES

SC-7.02 Labor; Working Hours

SC-7.02.B. is deleted and replaced by the following:

- B. Except as otherwise required for the safety and 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 working hours as defined below:

Work Hours:

Work will not be permitted on Saturday, Sunday, or holidays observed by Owner unless approval is given in response to a written request a minimum of 48 hours in advance of commencing work. Emergency repairs or actions are an obvious exception. Normal working hours shall consist of a nine hour work day performed between the hours of 7:00 a.m. and 5:00 p.m. Any requests by Owner to limit the Work on certain areas of the Site to certain hours of the day will be accommodated by Contractor. Extensions to the Contract Time will not be permitted, as these limited work hours have been accommodated in the Contract Time as set forth herein.

Overtime:

Engineer & Sussex County Engineering Department’s overtime hours will be tracked for any work beyond the first 45 hours of the week. Subcontractors must work the same work hours as the Contractor. Owner will be responsible for payment of all inspection personnel for the first 40 hours of overtime. All overtime work beyond the first 40 hours of overtime for the entire projects duration must be paid by the Contractor.

Observed Holidays:

New Years Day	Martin Luther King Jr.’s Birthday
Good Friday	Memorial Day
Independence Day	Labor Day
Elections Day	Return Day
Veterans Day	Thanksgiving Day
Day after Thanksgiving	Christmas Eve
Christmas Day	

SC-7.04 “Or Equals”

SC 7.04.A Amend the third sentence of Paragraph 7.04.A by striking out the following words:

Unless the specification or description contains or is followed by words reading that no like, equivalent, or ‘or-equal’ item is permitted

SC-7.05 Substitutes

SC 7.05.C Substitute the third sentence of 7.05.C with the following:

Engineer will make a recommendation to Owner regarding acceptability of "or equal" item.

In sentence four of 7.05.C, insert "subject to Owner's approval" after ...and Engineer determines.

SC 7.05.D Replace "Engineer's" with "Owner's" in the second paragraph of 7.05.D.

SC-7.06 Concerning Subcontractors, Suppliers, and Others

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

The Contractor shall not award work valued at more than fifty percent of the Contract Price to Subcontractor(s), without prior written approval of the Owner.

SC 7.06.D Delete paragraph in its entirety.

SC 7.06.E Delete paragraph in its entirety and replace with the following:

E. The Contractor shall submit to the Engineer a list of the names of proposed subcontractors and such other persons and organizations who are to furnish principal items of materials or equipment for the project. The Engineer may notify the Contractor in writing if either the Owner or the Engineer, after due investigation, has reasonable objection to any subcontractor, person, or organization on such list. The failure of the Owner or the Engineer to make objection to any subcontractor, person or organization on the list shall not constitute an acceptance of such Contractor, person, or organization. Acceptance of any such subcontractor, person, or organization shall not constitute a waiver of any right of the Owner to the Engineer to reject defective work, material, or equipment or work, material, or equipment not in conformance with the requirements of the Contract Documents.

SC 7.06.F Delete paragraph in its entirety and replace with the following:

F. If the Owner or the Engineer refuses to accept any subcontractor, person, or organization or such list, the Contractor will submit an acceptable substitute, and the Contract price shall remain unchanged or shall be increased or decreased by the difference in cost occasioned by such substitution, and an appropriate change order, if necessary, shall be issued.

SC 7.06.G Delete paragraph in its entirety.

SC 7.06.M. is deleted and replaced with the following:

M. All work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Document for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 6.05, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor and all other individuals or entities identified in the

Supplementary Conditions to be listed as insured or additional insured (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

SC 7.06 The following paragraphs are added to modify SC 7.06 as follows:

P. The provisions of this Section 7.06 shall be subject to 29 Del. C. §6962 which shall be incorporated by reference herein in the event that this Contract involves a “public building” as defined therein. To the extent of the provisions of Section 7.06 conflict with the State Code, the State Code shall govern.

SC-7.07 Patent Fees and Royalties

SC 7.07.A is deleted and replaced with the following:

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. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner, Engineer, Engineer’s Consultants, and the officers, directors, appointed and elected officials, partners, employees or agents, and other consultants 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.

SC 7.07.B Delete in its entirety.

SC-7.11 Record Documents

SC 7.11.A Insert “and Owner” to the end of the last sentence of the paragraph.

The following paragraphs are added to modify paragraph 7.11 as follows:

B. All work shall be measured, by the Contractor, during installation and before covering and backfilling. All measurements shall be referenced to project vertical datum and stationing shown on the drawings. All measurements will be recorded and kept current until completion of the Work. Such measurement records shall be transmitted to the Engineer to check Applications for Payment. The Contractor shall field survey inverts for installed gravity sewer pipelines and submit the results along with the Application for Payment for that particular section of sewer. All field measurements for all forcemain record documents shall be updated each month and

shall also be submitted with the Application for Payment for that particular section of forcemain. The surveys shall indicate the pipeline in question has been installed in accordance with the Contract Documents.

C. Contractor shall be responsible for recording, keeping and monitoring Record Drawings of work constructed in the field. Record Drawings will be kept on hand in the Contractor's field office for inspection by the Engineer. Two sets of initial draft Record Drawings shall be issued to the Engineer no later than 14-days from the date of substantial completion.

D. See Section 01050 Field Services for Record Document requirements.

SC-7.12 Safety and Protection

Insert the following after the first sentence of paragraph 7.12A:

"Contractor shall review the tenets of his safety program with Owner and Engineer at the Pre-Construction Meeting, and review the program status at each progress meeting."

The following paragraphs are added to modify paragraph 7.12 as follows:

H. Access during construction:

1. The Contractor shall schedule Work to minimize the time period during which vehicular access to each building or dwelling along the work route is prevented. The Contractor shall provide, at all times, safe pedestrian access to all building or dwellings, whether residential, commercial, or other.
2. Construction shall be scheduled to interfere as little as possible with traffic. Necessary barricades, suitable and sufficient danger signals and signs in accordance with the Delaware Traffic Control Manual shall be provided for the protection of existing property and safety of the Public.

I. Protection of Property and Utilities:

1. The location of utilities, facilities, or structures that may be shown on the plans or encountered in the work are not guaranteed. Any inaccuracy or omission in such information shall not relieve the Contractor of his responsibility to protect such existing features from damage or unscheduled interruption of service.
2. The Contractor shall contact "Miss Utility" at (800)282-8555 at least 48 hours prior to digging in the vicinity of existing underground utilities to have them located and marked.
3. The Contractor shall pay all charges levied by utility companies for work to locate, inspect, protect, relocate, replace or repair overhead or underground utilities necessary for the construction of the project. The Owner assumes no responsibility for damages or downtime for the Contractor or their subcontractors resulting from the inadequate or negligent performance by utility locators.
4. The Contractor shall, at his own expense, locate, protect and repair damages to all overhead and underground utilities whether shown by the drawings or not. The Contractor shall cooperate with the utility service, or governing

agency to prevent the unscheduled interruption of utility services and facilities during repair or replacement.

5. The Contractor shall comply with the Utility Damage Prevention and Safety Act for the State of Delaware, Title 26, Delaware Code, Chapter 8.

J. Safety Plan:

1. The CONTRACTOR shall follow all nationally recognized Safety, Health and Environmental standards in fulfillment of this Contract, including but not limited to Sussex County's Safety Policy #10 Trenching and Excavation, which is included within the Appendix of these specifications.
2. The CONTRACTOR shall erect and maintain, as required by the existing conditions and performance of this Contract reasonable safeguards for safety and protection of the worksite, during all hours for the durations of the project. Reasonable safeguards, include but are not limited to posting danger signs, erecting fences, adding spill containment, or constructing other physical barriers that will protect workers, bystanders and the general public from hazards.
3. Contractor shall submit to the County for review a project specific safety plan addressing his intended program for maintaining safety in accordance with the above referenced requirements.

SC-7.15 Emergencies

SC 7.15.A Replace "Engineer" with "Owner" in the last sentence.

SC-7.16 Shop Drawings and Samples

The following paragraphs are hereby added to paragraph 7.16 as follows:

F. Survey and Stake-out Submittals

1. All surveying and stake-out and rim elevation work shall be done by persons licensed by the State of Delaware to perform such work.
2. Work done by the Contractor without having first established proper lines and grade, or work done by him to incorrect line and grade, may be ordered removed and replaced at no increase in contract price.
3. Any bench marks destroyed through or as a direct result of the Contractor's construction operations shall be replaced and/or restored at his expense with no additional cost to the Owner.
4. See Section 01050 FIELD SERVICES for additional surveying requirements.

SC-7.17 Contractor's General Warranty and Guarantee

Modify paragraph 7.17A as follows:

- 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

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entitled to rely on Contractor's warranty and guarantee. The guarantee shall be as follows:

1. Against all faulty or imperfect materials and against all imperfect, careless and/or unskilled workmanship, as evidenced by excessive pipe settlement, cracked pavement, failure of structures, and/or equipment, etc.
2. That the entire equipment and each and every part thereof, shall operate with proper care and attention in a satisfactory manner, and in accordance with the requirements of these Contract Documents.
3. That the entire structure in the vicinity of work done shall be watertight and leak-proof, at every point and in every particular.
4. The Contractor agrees to replace with proper workmanship and materials, and to execute, correct or repair, without cost to the Owner, any Work which may be found to be improper or imperfect.
5. The guarantee obligations assumed by the Contractor under these Contract Documents shall not be held or taken to be in any way impaired because of the specification, indication or approval by or on behalf of the Owner of any articles, materials, means, combinations or things used or to be used in the construction, performance and completion of the Work, or any part thereof.
6. No use or acceptance by the Owner of the Work or any part thereof, nor any failure to use the same, nor any repairs, adjustments, replacements or corrections made by the Owner due to the Contractor's failure to comply with any of the obligations under the Contract Documents, shall impair in any way the guarantee obligations assumed by the Contractor under these Contract Documents.

SC-7.18 Indemnification

Replace the first sentence of 7.18.A with:

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, defend and hold harmless Owner and Engineer, and the elected and appointed officials, 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 in whole or in part 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. Contractor shall be liable, regardless of whether or not such claims, damages, losses, injuries, or expenses are caused in part by a party indemnified hereunder.

Owner shall cooperate and assist the indemnifying party in the defense of the claim. The indemnifying party shall bear the cost of and have the right to control the defense and shall have the right to select counsel after consulting with the indemnified party. Contractor shall not settle or compromise any claim without the written consent of Owner.

7.18.B is deleted and replaced with the following:

B. In any and all claims against Owner, Engineer, Engineer's Consultants, and the elected and appointed officials, officers, directors, partners, employees, agents and other consultants and subcontractors of each by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, and 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, Contractor agrees to expressly waive its immunity, if any, as a complying employer under the Workers' Compensation law or statute, but only to the extent that such immunity would bar or affect recovery under or enforcement of any indemnification obligation contained herein. This waiver applies to the Delaware Workers' Compensation Act 19 Del. C. Chapter 23 including amendments, or any other applicable state Workers' Compensation law or statute.

SC-7.19 Delegation of Professional Design Services

Delete this Section in its entirety.

SC-7.20 No Limitation of Liability

Paragraph 7.20 is added to the Standard General Conditions as follows:

It is understood and agreed that any and all of the duties, liabilities, and/or obligations imposed upon or assumed by the Contractor and the Surety, or either of them, by or under the Contract Documents, shall be taken and construed to be cumulative, and that the mention of any specific duty, liability, or obligation imposed upon or assumed by the Contractor and/or the Surety under the Contract Documents shall not be taken or construed as a limitation or restriction upon any or all of the other duties, liabilities, and/or obligations imposed upon or assumed by the Contractor and/or the Surety by or under the Contract Documents.

SC-7.21 Progress Photographs

Paragraph 7.21 is added to the Standard General Conditions as follows:

See section 01380 CONSTRUCTION PHOTOGRAPHS for construction photograph requirements.

ARTICLE 8 – OTHER WORK AT THE SITE

SC-8.01 Other Work

SC 8.01.B Delete paragraph in its entirety.

SC-8.02 Coordination

SC-8.02 Delete Paragraph 8.02.A in its entirety and replace with the following:

A. Owner will make reasonable efforts to provide advance notice of any other work being performed or to be performed at or adjacent to the Site. Owner's failure to

provide such notice will not be construed as a default of the Contract Documents. In such notice, Owner shall include the following:

SC-8.03 Legal Relationships

SC 8.03.A Delete paragraph 8.03.A and replace with the following:

If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, or any other contractor working for Owner, causes damage to the Work of 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 Times. Contractor must submit any Change Proposal seeking an equitable adjustment in 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. 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.

SC 8.03.B Delete this paragraph in its entirety.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

SC-9.01 Communications to Contractor

SC 9.01.A Delete Paragraph in its entirety.

SC-9.02 Replacement of Engineer

9.02.A Delete Paragraph and insert the following language in lieu thereof:

Owner may at its discretion appoint an engineer to replace Engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

SC-9.06 Insurance

SC 9.06.A Delete Paragraph in its entirety.

SC-9.11 Evidence of Financial Arrangements

SC 9.11.A Delete Paragraph in its entirety.

SC-9.12 Safety Programs

SC 9.12.A Insert "in writing" to the end of the Paragraph.

SC-9.13 Permits

SC 9.13 is added to the Standard General Conditions as follows:

The Owner shall be responsible for obtaining the following permits: Sussex Soil Conservation District Sediment and Erosion Control approval. Local, State and Federal permits secured by the

Owner are included in these specifications or will be provided to the low bidder at the preconstruction conference. The Contractor shall comply with the provisions of all such permits, and the cost of all work dictated by such permits shall be included in the prices bid. The Contractor is responsible for applying for and obtaining all other permits including, but not limited to: DNREC AIR Quality Permits and Building Permits.

ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION

SC-10.03 Project Representative

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

- B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.
1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
 2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
 3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.
 4. Liaison:
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
 5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
 6. Shop Drawings and Samples:
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.

- c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
8. Review of Work and Rejection of Defective Work:
 - a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
9. Inspections, Tests, and System Start-ups:
 - a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 - b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.
10. Records:
 - a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
 - b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
 - c. Maintain records for use in preparing Project documentation.

11. Reports:
 - a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
 - b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
 - c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.
 12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.
 13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.
 14. Completion:
 - a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
 - b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
 - c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.
- C. The RPR shall not:
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.
5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

SC-10.07 Decisions on Requirements of Contract Documents and Acceptability of Work

SC 10.07 Rename Section "Engineer Recommendations".

SC 10.07.A Delete Paragraph in its entirety and replace with:

Engineer will render recommendations as noted throughout the Contract Documents.

SC-10.08 Limitations on Engineer's Authority and Responsibilities

SC 10.08.A Add the following sentence to the end of paragraph:

This provision shall apply to Engineer's authority or responsibility to Contractor, and such authority, responsibilities and decisions impacting Owner shall not be affected by this Paragraph 10.08.

SC 10.08.B Add the following sentence to the end of paragraph:

Engineer shall be responsible for reporting to Owner any failures of Contractor with respect to the Contract Documents of which Engineer becomes or should have become aware through reasonably diligent observation or inspection.

SC 10.08.D Remove the words "only" and "generally" from the first sentence.

SC 10.08.D Add the following sentence to the end of the paragraph:

To the extent that Engineer is able to or should be able to discern any error or omission in the exercise of its professional standard of care, Engineer will be responsible for any failure to fulfill this obligation to Owner.

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

SC-11.01 Amending and Supplementing Contract Documents

SC 11.01.A Restate the sentence to read:

The Contract Documents may be amended or supplemented by a Change Order.

SC 11.01.A.1.b Delete paragraph in its entirety.

SC 11.01.A.2 Delete paragraph in its entirety.

SC 11.01.A.3 Delete paragraph in its entirety.

SC 11.02.A Replace "shall" with "may" in the second sentence of this paragraph.

SC-11.04 Change of Contract Price

SC 11.04.A Delete Paragraph in its entirety and insert the following language in lieu thereof:

A. The Contract Price may only be changed by Change Order. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party and to Engineer promptly (but in no event later than twenty (20) days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. If such claim is made in connection with an extension of the Contract Time, such notice shall be in addition to the notice required under Paragraph 12.01. On or before the fifth day of the month succeeding that in which he has provided such notice, Contractor shall provide Owner and Engineer with an itemized statement of the details and amount of such claim and a written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by Engineer in accordance with Article 10, if Owner and Contractor cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this Paragraph 12.01.A.

SC 11.04.B.1 Delete paragraph in its entirety and replace with:

1. The value of the work covered by a change order or any Claim for an adjustment in the Contract Price will be determined as follows:
2. Where the Work is not covered by unit prices contained in the Contract Bid, the cost of the Work shall be determined on a time and material basis, plus a Contractor's fee for overhead and profit. Said Contractor's fee shall be determined as follows:
 - a. For Work performed by the General Contractor, the Contractor's overhead and profit fee shall be 10%.
 - b. For Work performed by a subcontractor, the subcontractor's overhead and profit fee shall be 10% and the General Contractor's fee shall be 5%.

SC 11.04.B.2 Delete paragraph in its entirety.

SC 11.04.B.3 Delete paragraph in its entirety.

SC 11.04.C Delete section in its entirety.

SC-11.05 Change of Contract Times

11.05.A Delete Paragraph and insert the following language in lieu thereof:

A. The Contract Time may only be changed by Change Order. Any Claim for an extension or shortening of the Contract Time shall be based on written notice delivered by the party making the claim to the other party to Engineer promptly (but no event later than twenty (20) days) after the occurrence of the event giving rise to the claim and state the general nature of the claim. On or before such notice, the party making the Claim shall provide the other party and Engineer with notice of the extent of the claim with supporting data and a written statement that the adjustment claimed is the entire adjustment to which the claimant is entitled as a result of the occurrence of said event. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with this Paragraph 12.01A.

SC-11.06 Change Proposals

SC 11.06 Amend the first sentence of the paragraph to state:

Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Owner 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.

SC 11.06.A.2 Amend the first sentence of the paragraph to state:

Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, make a recommendation to Owner to deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part.

SC 11.06.A.2 Delete the second sentence and replace it with:

Such recommendations may be transmitted verbally or in writing.

SC 11.06.A.3 Replace this section and replace with:

Owner will consider Engineer's recommendation in its decision, but Owner shall make the final decision with respect to any Change Proposal. Owner's decision will be final and binding unless the Contractor appeals the decision by filing a Claim under Article 12.

SC-11.07 Execution of Change Orders

SC 11.07.A.3.c Amend the sentence to state "agreed to by the parties."

SC 11.07.B Delete "Owner or" in the first sentence.

SC-11.08 Notification to Surety

SC 11.08.A Add the following to the end of the paragraph:

If Contractor does not give this notice, Contractor will be solely responsible for any damages or losses to Owner resulting from said failure to give notice. Owner may apply a set-off against any funds owed to Contractor to collect such damages or losses and shall be permitted to bring suit if Contractor fails to reimburse Owner for any amounts owed.

ARTICLE 12 – CLAIMS

SC-12.01 Claims

SC 12.01.A.1 Delete the sentence and replace with:

Appeals by Contractor of Owner's decisions regarding Change Proposals;

SC 12.01.A.3 Delete sentence in its entirety.

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

SC-13.01 Cost of the Work

SC 13.01.B.1 Insert "in writing" to the end of the last sentence in the paragraph.

SC 13.01.B.5 Add to the end of the sentence "and previously authorized to be retained by Owner in writing".

SC-13.02 Allowances

SC 13.02.C Delete Paragraph 13.02.C in its entirety and insert the following in its place:
[Deleted]

SC-13.03 Unit Price Work

SC 13.03.D Replace the second sentence with the following:

Engineer will review with Contractor the Engineer's preliminary determinations on such matters before making a recommendation to Owner who shall render a written decision thereon (by recommendation of an Application for Payment or otherwise).

Replace the last sentence with the following:

Owner's written decision thereon will be final and binding (except as modified by Owner to reflect changed factual conditions or more accurate data) upon Contractor, subject to the provisions of the following paragraph.

SC 13.03.E Delete Paragraph 13.03.E in its entirety and insert the following in its place:

- E. The unit price of an item of Unit Price Work, with the exception of contingent items, shall be subject to reevaluation and adjustment under the following conditions:
1. if the extended price of a particular item of Unit Price Work amounts to 20 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and
 2. if there is no corresponding adjustment with respect to any other item of Work; and
 3. if Contractor believes that Contractor has incurred additional expense as a result thereof, Contractor may submit a Change Proposal, or if Owner believes that the quantity variation entitles Owner to an adjustment in the unit price, Owner may make a Claim, seeking an adjustment in the Contract Price.

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

SC-14.03 Defective Work

SC 14.03 B Delete the existing sentence with the following:

Engineer has the authority to make recommendations to Owner whether Work is defective, and Owner may then reject defective Work.

SC-14.04 Acceptance of Defective Work

SC 14.04.A Add the following sentence to the end of the paragraph:

In addition, Owner may require Contractor to provide a bond or other security in a form acceptable to Owner prior to acceptance of any defective Work.

SC-14.05 Uncovering Work

SC 14.05.A In the first sentence, remove "has the authority" and replace with "may recommend to Owner".

SC 14.05.C Insert "and Owner concurs with Engineer's recommendation," after "or tested by others" in the first sentence.

SC 14.08 Add the following new section to the Standard General Conditions:

SC-14.08 Punch List Work

SC 14.08.A Add the following paragraph to Section 14.08:

In addition to Corrective Work or repair of Defective Work, the Owner shall exercise the rights and remedies described in Paragraphs 14.07 for Punch-List Work items that are not completed within the time period stipulated in the Punch-List.

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

SC-15.01 Progress Payments

SC 15.01.B Delete the first sentence of Paragraph 15.01.B.1 and replace with the following:

Fourteen (14) calendar days prior to the monthly progress meeting, the Contractor shall provide a draft copy of the monthly payment request to the resident project representative for initial review. Seven (7) calendar days prior to the monthly progress meeting, Contractor shall submit to the Resident Project Representative seven (7) executed copies of the Application for Payment for final review and approval. All Applications for Payment must be signed and notarized by the Contractor. All Applications for Payment must be accompanied by an updated construction schedule. Owner, at its sole and absolute discretion, may allow or disallow a request from Contractor to make application for materials and equipment not incorporated into the Work. 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 the executed form entitled "Certification of Title to Materials Stored or to be Stored for Incorporation into Sussex County Contracts" 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. Failure to submit proof of payment to the material supplier prior to processing the next Application for Payment will in the deduction of the applicable Material payment in its entirety from progress payments, until such time as the proof of payment is received by the Engineer. If materials or equipment will not be stored on the Site, Contractor must provide the executed form entitled "Release and Waiver for Materials Stored on Private Property".

- SC 15.01.B Amend the second sentence of Paragraph 15.01.B.1 by striking out the following text: "a bill of sale, invoice, or other."
- SC 15.01.B.3 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.C.2 Delete the phrase "to the best of Engineer's knowledge, information, and belief" from the first sentence.
- SC 15.01.C.3.b After the phrase "between the parties", insert "unrelated to the portion of the Work under review".
- SC 15.01.C.4 Delete the first sentence and replace with the following:
Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of or Owner's payment of any payment, including final payment, will impose responsibility on Engineer or Owner.
- SC 15.01.D.1 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:
The Application for Payment with Engineer's recommendations will be presented to the Owner 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 thirty (30) days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor. In the event the 30th day is a weekend or County holiday, payment can be expected on the previous work day. Upon receipt of the check, Owner will notify the Contractor by telephone that the check is ready for pickup or delivery.
- SC 15.01.E.2 Delete the word "immediate" from the first sentence.

SC-15.02 Contractor's Warranty of Title

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

SC-15.03 Substantial Completion

- SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

- SC 15.03.C Delete all language after sentence two and replace with the following:

Owner shall have 14 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provision of the certificate or attached punch list.

Engineer will have 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, 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 Owner requested.

SC 15.03.F Add the following new paragraph after 15.03-E:

F. Conditional Acceptance

1. Upon Substantial Completion a sixty (60) day Conditional Acceptance period begins. During this period the Owner will have full use of the facilities. The Contractor, at his entire cost and expense, shall maintain all portions of the Work included in this Contract including seeding and pavement restoration to meet the requirements of these specifications for and during the period sixty (60) days from and after the date of Substantial Completion of the entire Work by the Owner and, in addition, shall at his entire cost and expense, make all repairs and replacements of the Work and appurtenances which may become necessary in the judgement of the Engineer at any time or times during said sixty (60) day period on account of any failures or defects in said Work and appurtenances due to improper Work done or materials furnished by the Contractor within twenty-four (24) hours of having received notice from the Owner to do so. Final Inspection and Final Application for Payment, as outlined in the General Conditions, shall not take place until the expiration of the Conditional Acceptance period.
2. The Owner shall have the right to enter the premises at any time for the purpose of doing work not covered by the Contract Documents. This provision shall not be construed as relieving the Contractor of the sole responsibility for the care and protection of the Work, or the restoration of any damaged Work except as such may be caused by agents or employees of the Owner.

SC-15.05 - Final Inspection

SC 15.05.A is modified as follows:

At the beginning of the first sentence ADD At the end of the Conditional Acceptance period or, upon written notice from CONTRACTOR that the entire work or agreed upon portion thereof is complete, whichever occurs later Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection by Owner and Engineer reveals that the Work, or agreed portion thereof, is incomplete or defective.

SC-15.06 Final Payment

SC 15.06.A In the first sentence, after "operating instruction" insert "all reports required under the Contract Documents".

SC 15.06.A.2 Add new subsection f.:

- f. Satisfactory evidence that all subcontractors have been paid, except for any payment subject to dispute, in which case Owner may withhold 150% of amount withheld by Contractor in its dispute with subcontractor.

SC 15.06.B.1 Add "If Owner is in agreement," at the beginning of the 3rd sentence.

SC 15.06.C.1 Insert "and Owner's agreement to final payment" after "Engineer's written recommendation".

SC 15.06.D.1 Insert "to the extent Owner is in agreement with said amount" after "the amount recommended by Engineer,".

SC-16.02 Owner May Terminate for Cause

SC 16.02.A Delete the term indicated for the following subsections of SC 16.02:

1. "persistent"
2. "material"
4. "repeated"

SC 16.02.D Add to the end of the last sentence:

within a timeframe designated by Owner in writing. In the event that such defect is not cured within the timeframe designated by Owner, Owner may immediately and without further notice, terminate for cause.

SC-16.04 Contractor May Stop Work or Terminate

SC 16.04.A Delete item 2 within the paragraph.

SC 16.04A Change "30 days" to "60 days" in item A.3.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.01 Methods and Procedures

SC 17.01 Please add the following new section after 17.01.B:

C. If the parties cannot reach an agreement in response to a dispute, the parties may pursue any remedy available under law or equity. No additional action or notice shall be required by this Contract.

ARTICLE 18-MISCELLANEOUS

SC-18.01 Giving Notice

SC 18.01.A Add new subsection A.3:

Delivered by US Mail.

SC 19 Add Article 19 titled "Mandatory Drug Testing Requirements":

19.01 Purpose

A. The Office of Management and Budget ("Office"), has developed these regulations that require Contractors and Subcontractors to implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds pursuant to 29 Del.C. §6908(a)(6). The regulations establish the mechanism, standards and requirements of a Mandatory Drug Testing Program that will be incorporated by reference into all Large Public Works Contracts awarded pursuant to 29 Del.C. §6962.

19.02 Definitions

"Consortium"/"Third Party Administrator" or "(C/TPA)" means a service agent that provides or coordinates the provision of a variety of drug and alcohol testing services to employers. C/TPAs

typically perform administrative tasks concerning the operation of the employers' drug and alcohol testing programs. This term includes, but is not limited to, groups of employers who join together to administer, as a single entity, the drug and alcohol testing programs of its members.

"Contractor" means an entity such as, but not limited to, an individual, firm, partnership or corporation that has a contractual obligation to perform work for contracts awarded pursuant to 29 Del.C. §6962.

"Division of Facilities Management" and "DFM" means the Division of Facilities Management within the Office of Management and Budget.

"Drug Testing Firm" is an entity engaged in the business of providing drug testing services for businesses, individuals, governments or any entity that requires drug testing of Employees, applicants, licensees, etc., in compliance with these requirements.

"Employee" means an individual employed by a Contractor or Subcontractor who works on the Jobsite of a Large Public Works Contract but does not fulfill a clerical or administrative function. For the purpose of this definition, clerical or administrative functions shall refer to job responsibilities that do not generally require an employee to work outside of the Contractor's Jobsite office, home office or other employer-provided office. For the purposes of this regulation, the term "Employee" shall also include supervisors and foremen working on the Jobsite. The term "Employee" shall also include employees of a Contractor or Subcontractor working on or delivering materials and equipment to and from a Jobsite.

"Impairment" or "Impaired" means symptoms that an Employee while working may be under the influence of drugs or alcohol that may decrease or lessen the Employee's performance of the duties or tasks of the Employee's job position, including symptoms of the Employee's speech, walking, standing, physical dexterity, agility, coordination, actions, movement, demeanor, appearance, clothing, odor, irrational or unusual behavior, negligence or carelessness in operating equipment, machinery or production or manufacturing processes, disregard for the safety of the Employee or others, or other symptoms causing a reasonable suspicion of the use of drugs or alcohol.

"Jobsite" means the site or area directly or indirectly owned, operated or controlled by the Owner in which the Contractor or Subcontractor performs work or delivers services to the Owner. For the purpose of this definition, "Jobsite" does not mean a remote work site not under the direct or indirect control of the Owner in which work is performed to fulfill the Contractor's or Subcontractor's obligations.

"Large Public Works Contract" means a contract for a public works construction awarded pursuant to 29 Del.C. §6962.

"Mandatory Drug Testing Program" and "Program" means a defined set of basic procedures, requirements and rules that must be used by a Contractor or Subcontractor to test employees for drugs in compliance with these requirements.

"Owner" is the state agency, school district or entity that awards a Large Public Works Contract to a Contractor pursuant to 29 Del.C. §6962.

"Positive Test Result" and "Fail a Drug Test" means the result reported by a Health and Human Services certified laboratory when a specimen contains a drug or drug metabolite equal to or greater than the cutoff concentration. For purposes of these regulations, an Employee shall not be considered to have a Positive Test Result nor shall an Employee be considered to "Fail a Drug Test", unless the employee was impaired by marijuana at the Jobsite if:

- The Employee is a Registered Qualifying Patient and;

- The drug detected was marijuana, a component of marijuana, or marijuana metabolites.

“Random Drug Testing” means that an Employee is chosen at random for testing without advance notice, from a pool of Employees or as a member of a Consortium. Specific requirements for random drug testing conducted under these regulations are described in Section 19.05.

“Registered Qualifying Patient” means a person (1) validly issued and in possession of an unexpired Registry Identification Card as defined by 16 Del.C. §4902A (14), and (2) subject to confirmation through a "verification system" as set forth at 16 Del.C. §4902A(17).

“Subcontractor” means an entity such as, but not limited to, an individual, firm, partnership or corporation that has a contractual obligation to perform work for, or supply services to a Contractor as defined in Section 19.02.

19.03 Employee drug testing documentation requirements

A. The following documentation requirements apply:

1. At bid submission - A solicitation for a Large Public Works Contract must require each Contractor that submits a bid for the work to submit with the bid a signed affidavit certifying that the Contractor and Subcontractor(s) has in place or will implement during the entire term of the contract a Mandatory Drug Testing Program that complies with this regulation.
2. At least two business days prior to contract execution – The awarded Contractor shall provide to the Owner copies of the Employee Drug Testing Program for the Contractor and for all listed Subcontractors.
3. During contract execution – Contractors that employ additional Subcontractors on the jobsite may do so only after submitting a copy of the Subcontractor’s Employee Drug Testing Program. A Contractor or Subcontractor shall not commence work until the Owner has concluded the Employee Drug Testing Program complies with this Regulation as per subsection 19.03 B.
4. In the event of an emergency a Contractor may employ additional Subcontractors on the jobsite prior to submitting the Subcontractor’s Employee Drug Testing Program provided that said Program is submitted to the Owner as soon as practicable.

B. A Contractor or Subcontractor shall be treated as having a Mandatory Drug Testing Program that complies with this regulation if the Program includes the following:

1. The Program meets the minimum standards in Section 19.04 of this regulation.
2. The Program provides for the frequency of testing of Employees as per Section 19.05 of this regulation.
3. The Program imposes disciplinary measures on an Employee who fails a drug test as per Section 19.06 of this regulation.

C. Prequalified Contractors and Subcontractors – A Contractor or Subcontractor may meet the provisions of subsection 19.03A if they are Prequalified through the DFM Prequalification and if the DFM Prequalification includes provisions requiring an Employee Mandatory Drug Testing Program that meet the requirements of Sections 19.04, 19.05 and 19.06 of this Regulation

D. The State shall not be obligated to pay, and the Contractor or Subcontractor shall expressly agree that, any portion of work performed by a Contractor or Subcontractor commenced before that Contractor or Subcontractor has complied with subsections 19.03 A and 19.03 B, provided however that emergency work as referenced in subsection 19.03 A.4 may not be subject to this provision.

19.04 Minimum Standards for a Mandatory Drug Testing Program

A. Testing for the presence of drugs in an Employee's system and the handling of test specimens shall be conducted in accordance with guidelines for the collection, chain-of-custody procedures, laboratory testing, and Medical Officer Review procedures contained within the Mandatory Guidelines for Federal Workplace Drug Testing Programs published by the Substance Abuse and Mental Health Services Administration (SAMHSA) (49 CFR Part 40). All tests must be processed by a federal Health and Human Services certified laboratory. Contractors must provide documentation detailing the procedures used in the collection, testing and reporting of drug tests sufficient to show conformance with SAMHSA guidelines.

B. Contractors and Subcontractors subject to these regulations may procure the services of an appropriate Drug Testing Firm to administer their program. A Contractor or Subcontractor may also participate in a Consortium. A Contractor or Subcontractor may also implement a Mandatory Drug Testing Program using in-house personnel and resources.

C. Employees subject to drug testing shall be tested using at a minimum a seven-panel protocol testing plus alcohol screening for the following:

D. The frequency of Random Drug Testing and the methodology for selecting Employees to be screened are defined in Section 19.05 and shall be incorporated into Contractor and Subcontractor mandatory testing procedures. A Contractor or Subcontractor may incorporate rules or requirements that exceed the requirements defined herein.

19.05 Drug Testing Requirements – Frequency for the Testing of Employees

A. Initial Drug Testing - Employees commencing work on a Jobsite must be tested with the exception that an Employee who has passed a random or scheduled drug test within the past 180 days from the date of commencing work or an Employee who passed a pre-employment drug test administered pursuant to an Contractor's or Subcontractor's Program and is subject to testing as part of a Contractor's or Subcontractor's ongoing Program or as part of a Consortium shall be permitted to work at the Jobsite without further testing; however, the Employee is still subject to random testing.

B. Random Drug Testing - During the course of a project, each Contractor and Subcontractor with Employees on the Jobsite shall maintain a Program that meets or exceeds the following requirements.

1. All Employees will be subject to random, unannounced testing.
2. The selection of Employees shall be made by a scientifically valid method of randomly generating an employee identifier from a Contractor or Sub-contractor's entire pool of employees, through those Employees working on a Public Works Jobsite or through the Contractor or Subcontractor's participation in a Consortium.
3. A Contractor or Subcontractor's Program shall provide that no less than 5% of a Contractor's or Subcontractor's employees shall be randomly selected each month for drug testing and no less than 2.5% of a Contractor or Subcontractor's employees be randomly selected for alcohol testing. Contractors or Subcontractors may participate in a Consortium

provided that no less than 5% of the Consortium's pool shall be subject to drug testing each month and no less than 2.5% of the Consortium's pool shall be subject to alcohol testing each month. Contractors or Subcontractors with less than 10 employees that do not participate in a Consortium shall test at least one of their employees, selected randomly per month. Each employee shall have an equal chance of selection each time the selection is made. Because the selection process is random, some Employees may not be tested within a year, while others may be tested more than once. Nothing in this regulation shall require an Employee of a Contractor or Subcontractor not working or assigned to a Public Works Jobsite to be subject to random alcohol testing.

4. Employees notified that they have been selected must report within four hours for testing to a site specified. Employees so notified must have been given such notification at least four hours before the scheduled closing time of the testing facility. Any failure to report for random testing, or to cooperate with the testing procedure shall be considered a positive result.

5. Purposely impeding or delaying an Employee's fulfillment of the testing requirements herein by a Contractor or Subcontractor may subject the Contractor or Subcontractor to sanctions listed in Section 19.08.

C. Reasonable Suspicion Testing – An Employee will be required to take a drug and/or alcohol test at any time his or her employing Contractor, Subcontractor or the Owner reasonably believes that he or she has an Impairment caused by drugs and/or alcohol. Further, an Employee may be required to take a drug and/or alcohol test at any time his or her employing Contractor, Subcontractor or the Owner finds drug paraphernalia and/or open alcohol containers on the Jobsite.

D. Return to Duty Testing – As required in Section 19.06.

E. Accident Triggered Testing – An Employee will be required to take a drug test and may be subject to an alcohol breathalyzer test at any time there is a Jobsite accident involving loss or significant property damage, injury or death to an Employee of the Contractor, Subcontractor, or Owner or member of the public.

1. As soon as practicable following an accident, the Contractor will notify the Employee(s) whose performance could have contributed to the accident of the need for the test.

2. The appropriate Contractor shall ensure that an Employee, required to be tested under this section, report to a testing center as soon as practicable, but no longer than 4 hours after the accident. Employees so notified must have been given such notification at least four hours before the scheduled closing time of the testing facility. If the drug test is not conducted within 4 hours, attempts to conduct the test must cease and the reasons for the failure to test documented.

3. An Employee who is subject to post-accident testing who fails to remain readily available for such testing, including notifying a supervisor of his or her location if he or she leaves the scene of the accident prior to submission to such test, may be deemed to have refused to submit to testing.

4. If an Employee fails or refuses to be tested, he/she must be removed from the Jobsite and shall be subject to consequences in Section 19.06.

5. Nothing in this section shall be construed to require the delay of necessary medical attention for the injured following an accident, or to prohibit an Employee from leaving the scene of an accident for the period necessary to obtain assistance in responding to the accident, or to obtain necessary emergency medical care.

F. All testing required by this section shall be administered according to the standards outlined in Section 19.04.

19.06 Consequences of a Positive Test Result

A. The disciplinary measures contained within a Contractor's or Subcontractor's Program for an employee who tests positive to a mandatory drug test must include at a minimum, all of the following:

1. The Employee is subject to an immediate suspension from any public works Jobsite.
2. The Employee is not eligible for reinstatement by the Contractor or Subcontractor to any public works Jobsite until 30 days after the Employee tests negative on a seven drug panel plus alcohol test certified by a medical review officer.
3. The Employee is subject to unscheduled monthly random testing as per subsection 19.05 B.
4. An Employee who has tested positive for more than one drug test within a three year period shall be permanently banned from working at public works Jobsites.
5. An Employee who has tested positive for marijuana, a component of marijuana, or marijuana metabolites and is a Registered Qualifying Patient shall be exempted from the disciplinary actions contained in this section unless:
 - a. The Employee was Impaired by marijuana at the Jobsite.
 - b. Employment of the Registered Qualifying Patient would cause the Owner to lose monetary or licensing-related benefits under Federal law.

B. A Contractor or Subcontractor shall report the Positive Test Result to the Employee's professional licensing board, if applicable.

19.07 Contractor and Subcontractor Certification of Compliance with Regulations

A. During the term of the contract:

1. During the term of the contract, Contractors and Subcontractors on the Jobsite for more than 30 days shall maintain testing data that includes but is not limited to the data elements contained in subsection 19.07 A.2:
 - a. A Contractor or Subcontractor that is employed on the Jobsite for less than 30 days shall not be subject to the reporting requirements contained in subsection 19.07 A.2 of this regulation, unless the Owner specifies that such reporting is required in the Invitation to Bid or Specifications relating to the work to be performed.
2. The data shall at a minimum contain the following elements:
 - a. The number of Employees who worked on the Jobsite during the previous month.
 - b. The number of Employees subjected to random testing during the previous month.
 - c. The number of negative results and the number of positive results.

- d. Action taken by the Contractor or Subcontractor on an Employee who failed or tested positive to a random test.
3. Test results must be kept by a Contractor or Subcontractor for a minimum of 1 year subsequent to the date of close out of the Public Works project.
4. Any Positive Test Result of an Employee working on a Public Works Jobsite including the Employee name and action taken in response by a Contractor or Subcontractor must be reported by the Contractor or Subcontractor to the Owner within 24 hours of the Contractor or Subcontractor receiving the test results.
5. The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor or Subcontractor's offices or by other means to make the data available for inspection by the Owner.
6. The failure to comply with these reporting requirements may be considered a material breach of any agreement relating to the performance of work by the Contractor or Subcontractor.

19.08 Penalties

A. Contractor or Subcontractor on a Large Public Works contract that fails to implement a Mandatory Drug Testing Program in accordance with this regulation or falsifies testing results shall be subject to the following sanctions:

1. Written warning (1st offense).
2. Prohibition from bidding on new public works jobs for a period not to exceed three months (2nd offense) and one year (3rd offense).
3. For subsequent offenses, debarment or bond revocation.

B. Notwithstanding any other provision of this regulation, if any failure to comply with the requirements of this regulation are particularly flagrant or egregious, the Owner may seek a termination for cause, a temporary suspension, a determination that the Contractor or Subcontractor is not responsible, debarment or bond revocation, and any other statutory, common law, or equitable remedy.

SECTION 01050

FIELD SERVICES

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01050

FIELD SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide and pay for field services for Project.
 - 1. Survey work required in execution of Project.
 - 2. The method of field staking for the construction of the work shall be at the option of the Contractor.
 - 3. The accuracy of any method of staking shall be the responsibility of the Contractor. All engineering for vertical and horizontal control shall be the responsibility of the Contractor.
 - 4. The Contractor shall be held responsible for the preservation of all stakes and marks. If any stakes or marks are carelessly or willfully disturbed by the Contractor, the Contractor shall not proceed with any work until he has established such points, marks, lines and elevations as may be necessary for the prosecution of the work.
 - 5. Civil, structural or other professional engineering services specified or required to execute Contractor's construction methods.
- B. The Contractor shall retain the services of a registered land surveyor licensed in the State of Delaware to identify existing control points and maintain a survey during construction.

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. Qualified engineer or registered land surveyor registered in the State of Delaware, acceptable to the Owner and the Engineer.
- B. Registered professional engineer of the discipline required for the specific service on the Project, currently licensed in the State of Delaware.

1.03 SURVEY REFERENCE POINTS

Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.

- A. Make no changes or relocations without prior written notice to the Engineer.
- B. Report to the Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- C. Require surveyor to replace Project control points which may be lost or destroyed at no additional cost to the Owner.

1.04 PROJECT SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent bench marks on site, referenced to data established by survey control points.
- B. Record locations, with horizontal and vertical data, on Project Record Documents.
- C. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:
 - 1. Site improvements:
 - a. Stakes for grading, fill and topsoil replacement.
 - b. Utility slopes and invert elevations.
 - 2. Batter boards for structure.
 - 3. Building foundation, column locations and floor levels.
 - 4. Controlling lines and levels required for mechanical and electrical trades.
 - 5. Controlling lines and grades for all utility installations.
- C. From time to time, verify layouts by same methods.

1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Surveys for Record Drawings. A copy of all survey information shall be submitted in an electronic format AutoCAD 2012™ (.DWG).

1.06 SUBMITTALS

- A. Submit name and address of Surveyor and professional engineer to the Engineer.
- B. On request of the Engineer, submit documentation to verify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer or surveyor, licensed in the State of Delaware, certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.
- D. Submit drawings showing locations of all structures constructed. This drawing shall be included with the project record documents.
- E. Submit cut sheets for all utility work to Project Engineer for review. Cut sheets shall include all required invert and rim information, indicate the applicable vertical datum and benchmark used, and be signed and sealed by Qualified engineer or registered land surveyor registered in the State of Delaware. All invert information shall be provided at a minimum 50' interval. For gravity sewers, one cutsheet shall be provided per manhole run.

1.07 RECORD DOCUMENTS

- A. All work shall be measured, by the CONTRACTOR, during installation and before covering and backfilling. All measurements shall be referenced to project vertical datum and stationing shown on the drawings. All measurements will be recorded and kept current until completion of the Work. Such measurement records shall be transmitted to the ENGINEER to check requests for payment. The Contractor shall field survey inverts for installed gravity sewer pipelines and submit the results along with the payment request for that particular section of sewer. All field measurements for all forcemain record documents shall be updated each month and shall also be submitted with the payment request for that

particular section of forcemain. The surveys shall indicate the pipeline in question has been installed in accordance with the Contract Documents.

- B. CONTRACTOR shall be responsible for recording, keeping and monitoring Record Drawings of work constructed in the field. Record Drawings will be kept on hand in the CONTRACTOR's field office for inspection by the ENGINEER. Two sets of initial draft Record Drawings shall be issued to the ENGINEER no later than 14-days from the date of substantial completion.
- C. After restoration and substantial completion, the CONTRACTOR shall field survey, and record on the drawings the following information:
1. Forcemains
All forcemain inverts at valves, fittings, and every 100' stations. Field measurements off of existing utility poles, edge of pavement or other permanent structures shall be provided. There shall be at least two measurements shown on the Record Drawings to locate each valve and bend. All valve locations shall be surveyed by a Registered Surveyor licensed in the State of Delaware and witnessed by the ENGINEER and CONTRACTOR.
 2. Plant Facilities
Dimensions for all finished concrete pads with locations of equipment shall also be provided along with record drawings of control and electrical equipment. Permanent monuments will be set by the OWNER after construction is complete. All piping inverts into and out of structures shall be surveyed by a Registered Surveyor licensed in the State of Delaware and witnessed by the ENGINEER and CONTRACTOR.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01106

CONSTRUCTION SCHEDULING, COORDINATION AND SEQUENCING

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SECTION 01106

CONSTRUCTION SCHEDULING, COORDINATION AND SEQUENCING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Construction work under this contract shall be performed in such manner as to minimize interferences with the operations of the existing facilities. The treatment facilities must be maintained in continuous operation during the course of the work under this Contract.
- B. All operations of valves and gates required to perform the work shall be done by the Owner. The Owner or his designated agent shall be informed in writing at least 24 hours, or longer where specified, in advance of the need to operate valves or gates or other actions which could affect facility operations.
- C. To achieve reliable, continuous facilities operation, new and upgraded equipment and facilities shall be tested and in operating condition before final tie-ins are made which connect new and upgraded equipment and facilities to existing equipment and facilities.
- D. The Contractor shall submit to the Engineer, drawings showing details of all temporary connections or facilities as required.
- E. When removing a process unit from service, the Contractor shall allow the process unit to drain naturally or be pumped to its lowest level. All remaining fluids shall be removed by the Contractor at his expense. Solids shall be disposed of off-site by the Contractor at his expense. Disposal of these solids must be in accordance with federal, state and local codes.
- F. There may be other Contractors working at these facilities at the same time. The Contractor shall schedule and perform his work in a manner that shall not interfere or delay the performance of other Contractors or consultants engaged in other projects. If the Contractor becomes aware of any circumstances whereby the Project shall adversely affect any other project on site or vice versa, he shall immediately notify the Engineer and indicate what actions, if any, are needed to coordinate the work of the various projects.
- G. At all times the Contractor shall maintain access for operation and maintenance personnel to existing facilities. All existing pumping station facilities shall be maintained secured and weather tight by the contractor prior to final demolition.

- H. No extra payment shall be made for any labor, materials, tools, equipment or temporary facilities required during the construction and/or upgrade of facilities. All costs therefore shall be considered to have been included in the bid price.

1.02 FACILITY SHUTDOWNS AND ASSOCIATED REQUIREMENTS

A. General Description

- 1. The existing facilities are operated 24 hours per day. Continuous operation of the plant shall be maintained at all times. The Contractor shall provide the necessary conveyance or transfer equipment (pumps, piping, hoses etc.) at no additional cost to the Owner. No uncontrolled spillage of wastewater from a pipe or conduit shall be permitted.

1.03 SEQUENCE OF CONSTRUCTION

- A. The Contractor shall, prior to beginning any work, prepare and submit for review a sequence of construction that includes all of the work included in the Contract. All work under this contract shall be completed within the construction time stated in this contract.
- B. The sequence of construction shall show items of work on the critical path and other major items that have the potential to impact the critical path. All items shall be tested and be complete for operation before beginning on the next item of work unless otherwise noted.
- C. Specific to this project, the Contractor shall recognize the minimum requirements related to construction activities and sequencing. The Contractor shall be responsible for the successful completion of work while maintaining operations at the existing treatment plant.
 - 1. All existing Clarifiers, Lagoons, Headworks, interconnecting channels and piping shall remain operational unless stated otherwise in the sequencing.
 - 2. Construct Clarifiers No. 3 & No. 4, Pump and Blower Building No. 2, the Aeration Lagoons No. 3 & No. 4, Aeration Distribution Box, Grit Facility, Filtered Irrigation Pump Station, North Headworks and Flow Meter Vault. Perform modifications to the existing Clarifier Distribution Box and Chemical Building.
 - 3. Isolate the area in front of the 36" bulkhead located in the Chlorine Contact Tank. Install the 36" tie-in from the flow meter vault into the existing 36" bulkhead.
 - 4. Install 24" North Headworks influent line to the existing isolated influent wye. Install the 24" tie-in from the Grit Facility to the existing Headworks.

Install 30" tie-in from the existing Clarifier Distribution Structure to Aeration Lagoons No. 3 and No. 4. Install 12" RAS tie-in from Ex. Pump and Blower Building to Aeration Lagoon Distribution Box.

5. Isolate Aerated Lagoons No. 1 and No. 2 from the Aeration Lagoon Distribution Box.
6. Redirect flows in the existing Clarifier Distribution Structure to Clarifiers No.3 and No.4.
7. Isolate and temporarily shut down the existing Headworks from the plant. Perform modifications to the existing 24" force main from Headworks to the Aeration Lagoon Distribution Box for Lagoons 1 & 2. Demolish and cap existing 12" RAS piping 10' from the existing Aeration distribution structure.
8. At this point, all lines shall be fully operational. Lower the weir gates at the existing Headworks to allow flow to flow through both Headworks Structures. Remove the Aeration Lagoon No. 1 and No. 2 isolation at the Aeration Lagoon Distribution Box. Remove the Clarifier No. 1 and No. 2 isolation at the Clarifier Distribution Box.

1.04 COORDINATION

A. Contractor, Subcontractors and Owner Personnel

1. The Contractor is responsible for the proper coordination of his work and his subcontractor's work, to prevent interference with the operation of the various facilities and to assure that the Owner is made aware in advance of proposed construction activities.
2. There will be no basis for claim for extra compensation or contract time extension due to delay caused by the Contractor's failure to give proper notice for requested shutdowns or to advise the Owner of proposed construction activities that in the judgment of the Owner will interfere with operation of the various facilities.
3. Should an emergency condition arise at the various facilities, the Owner has the authority to require the Contractor and his subcontractors to suspend their operations temporarily until conditions return to normal, without claim for extra cost or contract time extension by the Contractor and his subcontractors.

B. Subcontractors

1. Where the work of any subcontractor will be installed in close proximity to work of other subcontractors, or where there is evidence that the work of any subcontractor will interfere with the work of other subcontractors, the

Contractor shall work out space allocations to make a satisfactory adjustment. If so ordered by the Engineer, the Contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1/4 inch equals 1 foot, clearly showing how work is to be installed in relation to the work of others. If the Contractor permits any work to be installed before coordinating with the various subcontractors; or so as to cause interference with work of other subcontractors, he shall make necessary changes in the work to correct the condition without extra cost to the Owner.

2. The Contractor shall arrange that each subcontractor determines the location, size and arrangement of all chases and openings and shall establish clearances in concealed spaces required for the proper installation of its work and shall see that such are provided.

C. Utility Companies

1. The County is obtaining an electrical service from Delaware Electric Coop as part of this project. All applications for service and associated fees will be paid for by the County. However, the Contractor is responsible to install all facilities associated with these services as noted on the contract drawings and coordinate with each utility company for the service extensions. Contractor shall schedule and coordinate accordingly.
2. The County is obtaining a natural gas service from Chesapeake Utilities as part of this project. All applications for service and associated fees will be paid for by the County. However, the Contractor is responsible to install all facilities associated with these services as noted on the contract drawings and coordinate with each utility company for the service extensions. Contractor shall schedule and coordinate accordingly.

PART 2 - PRODUCTS **Not used**

PART 3 - EXECUTION **Not used**

END OF SECTION 01106

SECTION 01130

MEASUREMENT AND PAYMENT

PARAGRAPH INDEX

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01130

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall receive and accept the compensation provided in the Proposal and the Contract as full payment for furnishing all labor, materials, tools, equipment and services for performing all operations necessary to complete the Work under the Contract, and also in full payment for all loss or damages arising from the nature of the Work, or from any discrepancy between the actual quantities of work and the quantities herein estimated by the Engineer, or from action of the elements or from any unforeseen difficulties which may be encountered during the prosecution of the Work until the final acceptance by the Owner.
- B. The prices stated in the Proposal include all costs and expenses for taxes, labor, equipment, materials, commissions, transportation, patent fees and royalties, labor for handling materials during inspection, together with any and all other costs and expenses for performing and completing the Work as shown on the Contract Drawings and specified herein. The basis of payment for an item at the lump sum price in the Proposal shall be in accordance with the description of that item in this section.
- C. The Contractor's attention is called to the fact that the quotations for the various items of the Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of work has not been defined by a Bid Form Pay Item, he shall include the cost for that work in some other applicable bid item, so that his proposal for the Work reflects his total price for completing the Work in its entirety.
- D. Quantities listed on the proposal form are estimated quantities, to be used for bid evaluation and award of the contract. These quantities are not limiting. The Owner reserves the right to increase or decrease the quantities as necessary during the progress of the work.
- E. Items listed as STIPULATED CONTINGENT UNIT PRICE ITEMS in the proposal are to be used and will be paid for only at the written direction and authorization of the Engineer, if agreed to by the Owner. Payment under this section will be made for materials furnished and placed in addition to those shown or beyond the limits indicated or reasonably inferred by the Contract Documents. Measurement and payment will be in accordance with the Proposal and will include, but not necessarily be limited to, furnishing, hauling, placing and

installing of materials and the furnishing of such manpower and equipment as required to accomplish the work as directed in writing by the Engineer.

F. Alterations

1. The Owner reserves the right to change the alignment, grade, form, length, dimensions or materials of the Work under the Contract, whenever conditions or obstructions are met that render the changes desirable or necessary. All such alterations shall be paid for under the total lump sum bid or at a unit price bid for these items of work, except as follows:
 - a. In the case that such alterations make the Work less expensive to the Contractor, a proper deduction shall be made from the contract prices and the Contractor shall have no claim on this account for damages or for anticipated profits on the work that may be dispensed with.
 - b. In the case such alterations make the Work more expensive to the Contractor, a proper addition shall be made to the contract prices.
 - c. Any additions or subtractions to the contract prices shall be proposed by the Contractor and then reviewed by the Engineer and approved by the Owner.
 - d. In case the quantity of work in individual non-contingent unit price items of work increases or decreases greater than twenty five (25) percent of the bid quantity, unit prices may be renegotiated if the total cost of the given unit price item exceeds five (5) percent of the total contract amount.
2. Engineer May Increase or Decrease Quantities
 - a. The Engineer reserves the right to increase or decrease the quantity of material to be furnished or work to be done under the Contract whenever he deems it advisable or necessary. Such increase or decrease shall in no way violate or invalidate the Contract.
 - b. For the unit price items included in the bid, the Contractor will be paid for the actual amount of the authorized work done or material furnished under each item of the Proposal, at the unit price bid for that item. In case the quantity of any item is increased, the Contractor shall not be entitled to compensation over and above the unit price bid for each item. In case the quantity is decreased, the Contractor shall have no claim for damages on account of loss of anticipated profits because of such decrease.

- c. For the contingency items, the Contractor shall be paid for actual quantities installed, on written order of the Engineer.

1.02 MEASUREMENT

- A. The quantities for payment under this Contract shall be determined by actual measurement of the completed items, in place and accepted by the Owner, in accordance with the Contract Documents. A representative of the Contractor shall witness all field measurements.

1.03 PAYMENT

- A. Payments during the course of the Work for lump sum items will be made on the basis of percentage of completion of the work items listed in the Schedule of Values for each lump sum item. The Schedule of Values shall be prepared by the Contractor and submitted to the Engineer within 15 days of the execution of the Contract and shall serve as a breakdown of the lump sum bid for the purpose of arriving at a basis for the monthly estimate. The Schedule of Values shall be broken down into categories and each category further broken down into each applicable specification section. The schedule shall add up to 100% of the Lump Sum Bid.
- B. Payments during the course of the Work for unit price items will be made on the basis of actual amount of the work item installed at the end of the pay period. Determination of the amount of the work item installed shall be made by the Contractor and reviewed and approved by the Engineer.
- C. With the Schedule of Values, the Contractor shall submit to the Engineer an estimate of monthly pay application values over the course of the project. The estimates are for the Owner's information in administering the project.

1.04 LUMP SUM ITEMS

Item A-1: IBRWF Phase #2 Expansion

Measurement and Payment: The lump sum price bid for this item shall be for full compensation for the construction of the IBRWF Phase #2 Expansion as described in the contract documents, plans and specifications, all complete and in place with the exception of work included in Part B of the bid schedule.

The lump sum price for this item shall be full compensation for providing and installing all items necessary for a complete operating system including, but not limited to all labor, equipment, tools and materials, to provide, install and construct all sediment/erosion controls, all mechanical systems (pumps, pipe, plumbing, sanitary system, building drains, specialty and standard valves, flow meters), all H.V.A.C. systems, ventilation systems, painting/coating/labeling

systems, electrical, controls, power distribution systems, lighting systems, all instrumentation/ telemetry systems, stairs, platforms, grating, miscellaneous metals; building complete; start-up and training on all installed equipment, equipment pads, all cast-in-place concrete complete, all structural reinforcement, structural steel, all wall/floor/roof penetrations, foundations, concrete pipe encasements, all building pipe connections to the installed yard pipe; site electrical work, rough site and final site grading, plant water modifications, full site restoration, excavation, rock excavation, backfilling, off-site disposal of excess construction materials/spoils and unusable soils and materials; certifications, permit fees; and laboratory testing fees and all other work necessary to complete the work as shown or specified.

The lump sum price for this item shall be full compensation for installing all items necessary for a complete operating system including manufacturers testing and startup services.

1.05 STIPULATED CONTINGENT BID ITEMS

Item B-1: CONTINGENT UNCLASSIFIED EXCAVATION

1. This item of work shall consist of unclassified excavation, as described in Section 02200 of this Specification, of all unsuitable material below subgrade, or of all material in addition to that shown on the Drawings, specified, or included in other Bid Items, and in accordance with the written direction of the Engineer.
2. Measurement under this item will be made on the basis of the volume of material excavated in compliance with the Contract Documents, in cubic yards measured in place, as directed and approved by the Engineer.
3. Payment for work completed under this item will be made at the unit price bid per cubic yard for Contingent Unclassified Excavation which price shall include and cover furnishing all labor, materials, equipment, tools and incidentals required to perform the unclassified excavation, and includes excavation support, loading, hauling, disposal and all related work required to satisfactorily complete the work as shown, specified or directed.

Item B-2: CONTINGENT AGGREGATE MATERIAL, GRADED AGGREGATE TYPE "B" (Crusher Run)

1. This item of work shall consist of furnishing and placing complete, approved aggregate material, Graded Aggregate Type "B" (Crusher Run), as described in Section 02200 of this Specification, in addition to that shown on the Drawings, specified, or included in other Bid Items, and in

accordance with the written direction of the Engineer.

Measurement under this item will be made on the basis of the actual in-place tons of approved material satisfactorily furnished and placed in compliance with the Contract Documents, as directed by the Engineer in accordance with the requirements established in Section 02200 of this specification.

Payment under this item will be made at the unit price bid per ton, which shall include and cover furnishing all labor, materials, and equipment necessary to complete the work as shown, as specified, or as directed by the Engineer.

Item B-3: CONTINGENT POROUS FILL MATERIAL, COARSE AGGREGATE NO. 57 STONE

1. This item of work shall consist of furnishing and placing complete, porous fill material, Coarse Aggregate No. 57 Stone, as described in Section 02200 of this Specification, in addition to that shown on the Drawings, specified, or as included in other Bid Items, and in accordance with the written direction of the Engineer.
2. Measurement under this item will be made on the basis of the actual in-place tons of approved material satisfactorily furnished and placed in compliance with the Contract Documents, as directed by the Engineer in accordance with the requirements established in Section 02200 of this specification.
3. Payment under this item will be made at the unit price bid per ton, as referenced in paragraph (2) above, which shall include and cover furnishing all labor, materials, and equipment necessary to complete the work as shown, as specified, or as directed by the Engineer.

Item B-4: CONTRACTOR DOWN TIME

1. This item of work shall consist of time that the Contractor is unable to proceed with the work as authorized by the Engineer. This item shall only be authorized for legitimate items which would otherwise result in potential change order request, and shall not be used for minor miscellaneous stoppages, nor for downtime resulting from the Contractor's own actions or from the inadequate or negligent performance by utility locators.

2. Measurement under this item will be based on the actual number of hours that the Contractor is unable to work based on the discretion of the Engineer.

Item B-5: FURNISH AND PLACE 5,000 PSI CONCRETE

1. Payment for furnishing and placing concrete as specified, shown or directed (except where payment is otherwise provided for or is included in other items) will be made by the cubic yard for the amount of 5,000 psi concrete actually placed as directed and approved by the Engineer in writing.

The unit price bid for furnishing and placing 5,000 psi concrete shall include and cover the furnishing of all material for, and all labor and equipment necessary to complete the work to the satisfaction of the Engineer. The unit price bid shall include, but is not limited to; excavation, backfill, erecting and removing forms, and all other incidental items required for the proper installation of the work.

1.06 PAYMENT FOR MATERIALS NOT INCORPORATED INTO THE WORK

A. Storage of Materials

1. Payment for equipment and materials stored on the site, or elsewhere as specified in the GENERAL CONDITIONS and Supplementary Conditions, and not actually incorporated in the work will be made on the basis of 95% of the amount of paid invoices submitted to the Engineer for incorporation in the monthly estimate.
2. Storage shall be in accordance with manufacturer's recommendations.

B. Authorization for Payment

1. Payment will be authorized after the delivery to the construction site or other approved location and after being certified by the Engineer as being stored in conformation with the manufacturer's recommendations and satisfactory evidence is provided that the items are as specified.
2. Title to all items of equipment and materials upon which payment has been made shall rest with the Owner and documents transferring title shall be executed by the Contractor. Transfer of ownership shall not relieve the Contractor of continuing insurance coverage and of protecting stored items against damage, deterioration, theft or loss of any kind.

3. Should materials or equipment become damaged or be stored improperly or contrary to the manufacturer's recommendations, being therefore subject to later damage, then the Engineer will reduce the next following monthly payment by an amount sufficient to repair or replace such units.
4. To initiate a request for partial payment the Contractor shall submit his request in writing to the Engineer with all necessary evidence.
5. Examples of material or equipment to which partial payment applies includes the following:
 - a. Piping
 - b. Valves
 - c. Structural Steel
 - d. Pumps
 - e. Process Equipment
 - f. Electrical Panels

PART II - PRODUCTS (Not Used)

PART III - EXECUTION (Not Used)

END OF SECTION 01130

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SECTION 01200

PROJECT MEETINGS

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1.03	Progress Meetings	01200-4

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

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SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Engineer will schedule and administer a preconstruction meeting, periodic progress meetings, and specially called meetings throughout the progress of the work.
 - 1. Prepare agenda for meetings
 - 2. Make physical arrangements for meetings
 - 3. Preside at meetings
- B. Representatives of Contractor, subcontractors and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. The Contractor shall attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.02 PRECONSTRUCTION MEETING

- A. A preconstruction meeting will be scheduled before the Contractor starts work at the site.
- B. Location: A site designated by the Engineer.
- C. Attendance:
 - 1. Owner's representative
 - 2. Engineer and his professional consultants
 - 3. Contractor's project manager and superintendent
 - 4. Major subcontractors
 - 5. Major suppliers

6. Utilities representative(s)
 7. Others as appropriate
- D. Suggested Agenda:
1. Distribution and discussion of:
 - a. List of major subcontractors and suppliers
 - b. Projected construction schedules
 2. Critical work sequencing.
 3. Major equipment deliveries and priorities.
 4. Detouring of traffic and street access.
 5. Project coordination:
Designation and responsible personnel.
 6. Procedures and processing of:
 - a. Field decisions
 - b. Proposal requests
 - c. Submittals
 - d. Change Orders
 - e. Applications for payment
 7. Adequacy of distribution of Contract Documents.
 8. Procedures for maintaining Record Documents.
 9. Use of premises:
 - a. Office, work and storage areas.

- b. Owners' requirements.
 - 10. Construction facilities, controls and construction aids.
 - 11. Temporary utilities.
 - 12. Housekeeping procedures.
 - 13. Check of required Bond and Insurance certifications.
 - 14. Liquidated damages.
 - 15. Check of required Permits.
 - 16. Laboratory testing of material requirements.
 - 17. Inventory of material stored on site.
 - 18. Wage determination compliance and records, work hours.
 - 19. MBE/WBE fair share objective, affirmative action, nondiscrimination policies, if applicable.
 - 20. Communication lines and contact persons, including address and telephone number.
 - 21. Manufacturers' operation and maintenance manuals, and operation and maintenance training.
 - 22. Regulatory agency inspections.
 - 23. Progress agency inspections.
 - 24. Jobsite safety.

1.03 PROGRESS MEETINGS

- A. Regular periodic meetings will be held every 30 days or less. The first meeting will be scheduled 30 days after the preconstruction meeting or 30 days or less after the date of Notice to Proceed.
- B. Meetings will be scheduled as required by progress of the work.

- C. Location of the meetings: Contractor or Engineer Field Office.
- D. Attendance:
 - 1. Engineer and his professional consultants as needed.
 - 2. Contractor
 - 3. Owner's representative
 - 4. Subcontractors as appropriate to the agenda.
 - 5. Suppliers as appropriate to the agenda.
 - 6. Others as appropriate.
- E. Suggested Agenda:
 - 1. Review and approval of minutes of previous meeting.
 - 2. Review of work progress since previous meeting.
 - 3. Field observations, problems, conflicts.
 - 4. Problems which impede Construction Schedule.
 - 5. Review of off-site fabrication, delivery schedules.
 - 6. Corrective measures and procedures to regain projected schedule.
 - 7. Revisions to Construction Schedule.
 - 8. Progress schedule during succeeding work period.
 - 9. Coordination of schedules.
 - 10. Review submittal schedules; expedite as required.
 - 11. Maintenance of quality standards.
 - 12. Pending changes and substitutions.

- 13. Review proposed changes for:
 - a. Effect on Construction Schedule and on completion date.
 - b. Effect on other contracts of the Project.
- F. The Contractor is to attend progress meetings and is to study previous meeting minutes and current agenda items, in order to be prepared to discuss pertinent topics such as deliveries of materials and equipment, progress of the work, etc.
- G. The Contractor is to provide a current shop drawing submittal log at each progress meeting in accordance with Section 01300.
- H. The Contractor is to provide a current schedule at each progress meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01200

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SECTION 01300

SUBMITTALS

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SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall submit to the Engineer for review and approval such shop drawings, test reports and product data on materials and equipment (hereinafter in this article called data), and material samples (hereinafter in this article called samples) as are required for the proper control of work, including but not limited to those shop drawings product data and samples for materials and equipment specified elsewhere in the Specifications and in the Contract Drawings.

- B. Within thirty (30) days after the effective date of the Agreement, the Contractor shall submit to the Engineer a complete list of preliminary data on items for which Shop Drawings are to be submitted. Included in this list shall be the names of all proposed manufacturers furnishing specified items. Review of this list by the Engineer shall in no way be expressed or implied to relieve the Contractor from submitting complete Shop Drawings and providing materials, equipment, etc., fully in accordance with the Specifications. The procedure is required in order to expedite final review of Shop Drawings.

- C. The Contractor is to maintain an accurate updated submittal log and will bring this log to each scheduled progress meeting with the Owner and the Engineer. This log should include the following items:
 - 1. Submittal-Description and Number assigned.
 - 2. Date to Engineer.
 - 3. Date returned to Contractor (from Engineer).
 - 4. Status of Submittal (Approved, Approved as Noted, Revise and Return, Rejected).
 - 5. Date of Resubmittal and Return (as applicable).
 - 6. Date material release (for fabrication).
 - 7. Projected date of fabrication.
 - 8. Projected date of delivery to site.
 - 9. Status of O&M manuals submittal.
 - 10. Specification Section.
 - 11. Drawings Sheet Number.

1.02 TYPES OF SUBMITTALS

- A. Shop drawings for manufactured or fabricated items, schedules, diagrams and like material prepared specially for this project.
- B. Product Data which include pre-printed material, manufacturer's descriptive literature, illustrations, catalog data, performance charts and the like intended to identify a part of the work but not necessarily prepared exclusively for this Contract.
- C. Samples which include physical examples of products, materials, assemblies or workmanship which are identical to a portion of the work and which establish standards for materials, workmanship, or appearance of the finished work.
- D. Administrative data to include information required to support the administrative requirements of the contract as called for in the specifications.

1.03 PROCEDURE FOR SUBMITTALS

- A. General
 - 1. Except where specifically stated otherwise all submittals shall be made to the Engineer for his approval. Submittals of all but administrative data shall be submitted electronically. Submittals shall be complete for each component of work or system and shall include all inter-related portions of a system. At the completion of the project, the Contractor shall furnish the Engineer one revised record copy as described in Paragraph 1.06.
 - 2. Administrative data shall be submitted in triplicate (3 copies).

1.04 CONTRACTOR'S RESPONSIBILITY

- A. It is the duty of the Contractor to check all drawings, data and samples prepared by or for him before submitting them to the Engineer for review. Each and every copy of the Drawings and data shall bear Contractor's stamp showing that they have been checked. Shop drawings submitted to the Engineer without the Contractor's stamp will be returned to the Contractor for conformance with this requirement. Shop drawings shall indicate any deviations in the submittal from requirements of the Contract Documents.
- B. Engineer's Contract Drawings shall not be reproduced for the purpose of making shop drawings.

-
- C. Determine and verify:
1. Field measurements.
 2. Field construction criteria.
 3. Catalog numbers and similar data.
 4. Conformance with Specifications.
- D. The Contractor shall furnish the Engineer a schedule of Shop Drawings submittals fixing the respective dates for the submission of shop drawings, the beginning of manufacture, testing and installation of materials, supplies and equipment. This schedule shall indicate those submittals that are critical to the progress schedule.
- E. The Contractor shall ensure that no work is begun on any item of work requiring an approved submittal until such approval is obtained.
- F. The Contractor shall not begin any of the work covered by a drawing, data, or a sample returned marked "REVISE AND RETURN / AMEND AND RESUBMIT" OR "REJECTED" until a revision or correction thereof has been reviewed and returned to him, by the Engineer, with approval.
- G. One approved copy of all submittals shall be held by the Contractor at the construction site.
- H. Each submittal shall be assigned a sequential number by the Contractor, for purposes of easy identification, and shall retain its assigned number with appropriate subscript, on required resubmissions. The assigned number shall consist of the Contract Number, followed by the specification section number where the item is specified, followed by a sequential number indicating the number of submittals in that Section (e.g., 03300-11 is the 11th separate submittal for items specified in Section 03300). Resubmittals shall be identified with the same number as the original submittal (03300-11-R1), followed by the subscript R1, R2, etc. All products and materials submitted shall be clearly identified with the appropriate equipment name and number as it appears in the Contract Document.
- I. The Contractor shall submit to the Engineer all drawings and schedules sufficiently in advance of construction requirements to provide no less than 30 calendar days for reviewing and appropriate action from the time the Engineer receives them.

-
- J. All submittals shall be accompanied with a transmittal letter prepared in triplicate containing the following information:
1. Date.
 2. Project Title and Number.
 3. Contractor's name and address.
 4. The Number of each Shop Drawing, Project Data, and Sample submitted.
 5. Notification of Deviations from Contract Documents.
 6. Submittal Log Number conforming to Specification Section Numbers.
- K. The Contractor shall submit a minimum of eight (8) copies of shop drawing submittals to the Engineer, four of which will not be returned to the Contractor.
- L. The Contractor shall be responsible for and bear all costs of damages which may result from the ordering of any material or from proceeding with any part of work prior to the completion of the review by Engineer of the necessary Shop Drawings.
- M. The Contractor shall be fully responsible for observing the need for and making any changes in the arrangement of piping, connections, wiring, manner of installation, etc., which may be required by the materials/equipment he proposed to supply both as pertains to his work and any work affected under other parts, heading, or divisions of drawings and specifications at no cost to the Owner.
- N. All products and materials submitted shall be clearly identified with the appropriate equipment name and number as it appears in the Contract Document. Using a highlighter to identify products and material is not acceptable. Contracts shall cross out what is not being provided with a single line.

1.05 ENGINEER'S REVIEW OF SHOP DRAWINGS

- A. The Engineer's review of drawings, data and samples submitted by the Contractor will occur within a 30 day period and will be only for

conformance with the design concept of the Project and for general compliance with the information given in the Contract Documents. The Engineer's review and approval will not constitute an approval of dimensions, quantities, and details of the material, equipment, device, or item shown.

- B. The review of drawings and schedules will be general, and shall not be construed:
 - 1. as permitting any departure from the Contract requirements.
 - 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials.
 - 3. as approving departures from details furnished by the Engineer, except as otherwise provided herein.
 - 4. as approving Contractor's means, methods, techniques, sequences or procedures of construction or to safety precautions or programs incident thereto.
- C. If the drawings or schedules as submitted describe variations and show departure from the Contract requirements which the Engineer finds to be in the interest of the Owner and to be so minor as not to involve a change in Contract Price or time for performance, the Engineer may return the reviewed drawings without noting and exception.
- D. When reviewed by the Engineer, each of the Shop Drawings will be identified as having received such review being so stamped and dated. Shop Drawings stamped "REVISE AND RETURN" and with required corrections shown will be returned to the Contractor for correction and resubmittal.
- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, to revisions other than the corrections requested by the Engineer on previous submissions. The Contractor shall make any corrections required by the Engineer.
- F. If the Contractor considers any correction indicated on the drawings to constitute a change to the Contract Drawings or Specifications, the Contractor shall give written notice thereof to the Engineer.
- G. Shop drawings and submittal data shall be reviewed by the ENGINEER for each original submittal and first resubmittal; thereafter review time for subsequent resubmittals will be charged to the CONTRACTOR at the rate of \$95 per hour. The owner will extract the cost for the additional reviews from the Contractor prior to final payment.

- H. When the Shop Drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.
- I. No partial submittals will be reviewed. Submittals not complete will be returned to the Contractor for resubmittal. Unless otherwise specifically permitted by the Engineer, make all submittals in groups containing all associated items for:
 - 1. Systems
 - 2. Processes
 - 3. As indicated in specific specifications sections.

1.06 SHOP DRAWINGS

- A. When used in the Contract Documents, the term "Shop Drawings" shall be all drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams, and other information prepared by a Supplier and submitted by Contractor to illustrate material or equipment for some portion of the Work.
- B. Manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard descriptive data shall be of good quality, easy to read **CLEARLY MARKED TO IDENTIFY PERTINENT MATERIALS, PRODUCT OR MODELS**. Delete information which is not applicable to the Work by striking or cross-hatching. The use of a highlighter is prohibited.
- C. Drawings and schedules shall be checked and coordinated with the work of all trades involved, before they are submitted for review by the Engineer and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.
- D. Each Shop Drawing shall have a blank area 3-1/2 inches by 3-1/2 inches, located adjacent to the title block. The title block shall display the following:
 - 1. Project Title and Number
 - 2. Name of project building or structure

3. Number and title of the shop drawing
 4. Date of shop drawing or revision
 5. Name of contractor and subcontractor submitting drawing
 6. Supplier/manufacturer.
 7. Separate detailer when pertinent
 8. Specification title and number
 9. Specification section
 10. Application Contract Drawing Number
- E. If drawings show variations from Contract requirements because of standard shop practice or for other reasons, the CONTRACTOR SHALL DESCRIBE SUCH VARIATIONS IN HIS LETTER OF TRANSMITTAL. The transmittal letter shall delineate compliance and exceptions taken to Specifications and Contract Drawings. If acceptable, proper adjustment in the Contract shall be implemented where appropriate. If the Contractor fails to describe such variations, he shall not be relieved of the responsibility for executing the work in accordance with the Contract, even though such drawings have been reviewed.
- F. Data on materials and equipment include, without limitation, materials and equipment lists, catalog data sheets, cuts, performance curves, diagrams, materials of construction and similar descriptive material. Materials and equipment lists shall give, for each item thereon, the name and location of the supplier or manufacturer, trade name, catalog reference, size, finish and all other pertinent data.
- G. For all mechanical and electrical equipment furnished, the Contractor shall provide a list including the equipment name, and address and telephone number of the manufacturer's representative and service company so that service and/or spare parts can be readily obtained.
- H. All manufacturers or equipment suppliers who propose to furnish equipment or products shall submit an installation list to the Engineer along with the required shop drawings. The installation list shall include at least five installations where similar equipment has been installed and has been in operation for a period of at least one (1) year.

- I. Only the Engineer will utilize the color "red" in marking Shop Drawing submittals.
- J. Before the final payment is made, the Contractor shall furnish to Engineer one (1) set of record shop drawings all clearly revised, complete and up to date showing the permanent construction as actually made for all reinforcing and structural steel, miscellaneous metals, process and mechanical equipment, yard piping, electrical system and instrumentation system.

1.07 SAMPLES

- A. The Contractor shall furnish, for the approval of the Engineer, samples required by the Contract Documents or requested by the Engineer. Samples shall be delivered to the Engineer as specified or directed. The Contractor shall prepay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in work until approved by the Engineer.
- B. Samples shall be sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture and pattern.
 - 3. A minimum of three samples of each item shall be submitted.
- C. Each sample shall have a label indicating:
 - 1. Name of project
 - 2. Name of Contractor and Subcontractor
 - 3. Material or Equipment Represented
 - 4. Place of Origin
 - 5. Name of Producer and Brand (if any)
 - 6. Location of Project

(Samples of finished materials shall have additional marking that will identify them under the finished schedules).
- D. The Contractor shall prepare a transmittal letter in triplicate for each shipment of samples containing the information required in subparagraph

1.04, J above. He shall enclose a copy of this letter with the shipment and send a copy of this letter to the Engineer. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be constructed to change or modify any Contract requirements.

1.08 MANUFACTURER'S LIST

Within 30 days after receipt of a Notice to Proceed, and before ordering any equipment or materials, the Contractor shall submit to the Engineer for approval a complete list of proposed manufacturers and fabricators for all materials and equipment to be used in this Contract. The purpose of this submittal is to allow the Engineer to predetermine the acceptability of proposed suppliers before issuance of purchase orders by the Contractor. Submission and acceptance of the manufacturers' list shall neither relieve the Contractor from submitting detailed shop drawings and product data for all materials and equipment nor shall it constitute prior acceptance of any specific item of equipment prior to submittal of shop drawings. After submission and acceptance of the manufacturers' list, the Contractor shall not deviate from the named suppliers and manufacturers without written approval from the Engineer.

1.09 OPERATING AND MAINTENANCE INSTRUCTIONAL PERIODS

Particular sections of these Specifications require that the Contractor furnish qualified personnel to instruct the Owner's personnel in the proper operation and maintenance of equipment and systems provided in this Contract. Such instructional periods shall be for the duration of time specified and in accordance with the requirements of the individual sections of the Specifications and with the following paragraphs.

1.10 OPERATION AND MAINTENANCE MANUALS FOR EQUIPMENT AND PRODUCTS

A. General:

1. The Contractor shall furnish Operation and Maintenance Manuals for all products and equipment provided under this Contract.
2. Prior to completion of the work, and at least 30 days prior to the 50 percent payment, the Contractor shall furnish for the Engineer's review three (3) Operation and Maintenance Manual draft copies.
3. Prior to completion of the work, and at least 60 days prior the 85 percent payment, the Contractor shall furnish for the Engineer's review three copies of the final Operation and Maintenance Manual. The final manual must be approved by the Engineer before a final inspection of the work will be conducted, and prior to the issuance of

the Certificate of Substantial Completion. Three final hard copies and one electronic (pdf) copy will be required to be provided.

B. Manual Preparation:

1. Manuals shall include operation and maintenance information on all systems and items of equipment. The data shall consist of: catalogs, brochures, bulletins, charts, schedules, approved Shop Drawings corrected to as-built conditions and assembly drawings and wiring diagrams describing location, operation, maintenance, lubrication, operating weight, lubrication charts and schedules showing manufacturers recommended lubricants for each rotating or reciprocating unit, and other information necessary for the Owner to establish an effective operating maintenance program. The following data shall also be included:
 - a. Title page giving name and location of facility, Contract Drawings No(s). where shown and Specification Section where described.
 - b. Table of contents of each valve. Table of contents shall be provided for each valve.
 - c. Performance curves for all pumps and equipment.
 - d. Approved Shop Drawings of each piece of equipment.
 - e. Manufacturer's cuts and dimension drawings of each piece of equipment, and details of all replacement parts.
 - f. Manufacturer's erection, operation and lubrication instructions for all equipment and apparatus, and complete listing of nameplate data.
 - g. Complete wiring diagrams of all individual pieces of equipment and systems including one line diagrams, schematic or elementary diagrams, and interconnection and terminal board identification diagrams.
 - h. Complete piping and interconnecting drawings.
 - i. Complete parts list with parts assembly drawing (preferably by exploded view), names and addresses of spare parts suppliers, recommended list of spare parts to be kept "in

stock" and sample order forms for ordering spare parts. Lead time required for ordering parts shall be estimated.

- j. Instructions with easily understood schematics or diagrams for disassembling and assembling the equipment for overhaul or repair.
 - k. The Contractor shall complete the three Forms A, B and C entitled "Equipment Registration, Parts List, and Maintenance Procedures Sheet" for each piece of equipment furnished under the contract. These forms shall be included in the Operations and Maintenance Manual at the proper place. Example Forms A, B and C are included at the end of this section.
2. All items listed above that are of a sheet size of 8-1/2 inches by 11 inches or can be folded (no more than twice) to this size shall be bound in 4-inch maximum loose-leaf three-ring d-post type binders with black plastic-coated covers. The contents shall be fully indexed. Binders shall be Vernon Line Royal No. R-6372 or R-372, Sparco Brand Slanted Ring Presentation Binder 68140, Universal D-Ring View Binder 20747, K & M Division VS11-40 or approved equal. **PAGES SHALL BE LINEN REINFORCED ON BINDING EDGE.** The manual contents shall not exceed the capacity of the binders.
 3. Shop Drawings 24 inches by 36 inches in size shall be folded to approximately 12 inches by 9 inches with drawing title box exposed along either edge. Shop Drawings descriptive of a single item of equipment shall be grouped together. All Shop Drawings shall be placed in accordion-type folders similar to File Pocket No. 74CG (9-1/2 inches x 14-3/4 inches) as manufactured by the Cooke and Cobb Company, or approved equal, and fully indexed on the outside of the folders in a neat and uniform manner.
 4. All Shop Drawings included in the binders and/or folders shall be those copies previously submitted for review and approval and shall bear the Engineer's stamp of approval and comments as originally noted thereon.
 5. An electronic (pdf) copy of the complete O&M manual shall be submitted on CD.

C. Approval:

1. Subsequent to the Engineer's approval and return of the final manual, the Contractor shall submit four complete sets of manuals to the Engineer.
2. Substantial Completion certification will positively not be undertaken until approved Operation and Maintenance Manuals have been submitted. Partial approvals of the final manual will not be made.
3. Delivery of manufacturer's service (O&M) manuals and installation instructions satisfactory to the Engineer are an essential part of the equipment delivery. Incomplete or inadequate manuals will be returned to the Contractor for correction and/or resubmission.

1.11 MANUFACTURER'S CERTIFICATES

A. General:

1. As specified in the various sections of these Specifications, the Contractor shall furnish the Engineer with manufacturer's certificates stating that the equipment and products have been installed under either the continuous or periodic supervision of the manufacturer's field representative, that they have been adjusted and initially operated in the presence of the manufacturer's field representative, and that they are operating in accordance with the specified requirements, to the manufacturer's satisfaction. A copy of all manufacturer's certificates shall be bound in each Operation and Maintenance Manual.
2. A certificate submitted for equipment, a product, or component of a product, shall indicate test results proving that the equipment, product, or component of a product, meet the requirements of the Contract Documents.

B. Manufacturer's Representative:

1. The definition of "manufacturer's representative" shall be as follows: a representative familiar with the actual problems of manufacturing, installing and operating the particular equipment or product and with enough years of experience in this field to determine the successful operation of the equipment or product.
2. As related to his obtaining the manufacturer's certificates, the Contractor shall include in this contract price the cost of furnishing competent and experienced manufacturer's representatives who shall

represent the manufacturer on equipment and products furnished and installed under this Contract, to assist the Contractor to install, adjust, start up, and test the equipment and products in conformity with the Contract Documents. After the equipment and products have been operated through the trial period for each phase of construction and before being put into permanent service, such manufacturer's representatives shall make all adjustments and tests required to provide that such equipment and products are in proper and satisfactory operational condition.

C. Engineer's Responsibility

The Engineer will review with reasonable promptness all submittals with respect to the Contract Documents and will indicate a qualified approval, an approval as noted or a revise and return notation. The Engineer will return all submittals found incomplete without a review.

1.12 MIX DESIGNS

Mix designs shall be submitted for concrete, grout, and bituminous paving. Mix design shall indicate all materials used in the product and their respective relative quantities. In any one mix design all quantities shall be expressed either by weight or volume insofar as it is practical to do so. The Contractor's attention is directed to Section 03300 of these Specifications for proportioning and testing requirements of concrete.

1.13 DESIGN CALCULATIONS

Design calculations shall be presented in a neat, legible manner and shall bear the stamp and signature of a registered professional engineer, registered in the State of Delaware.

1.14 MILL TEST REPORTS

Mill test reports shall be submitted for structural steel and concrete reinforcement steel. Reports shall be on the mill's standard report form.

1.15 RECORD DRAWINGS

The Contractor will keep one copy of all Specifications, Drawings, Addenda, Change Orders and Shop Drawings in the field office at the site, in good order and annotated to show all changes made during the construction process. These shall be available to the Engineer and shall be delivered to him upon completion of the project. The

record drawings shall be submitted in hard copy and electronic (CD) format. If the Contractor fails to maintain the record drawings as required herein, final payment with respect to the Contract as a whole, will be withheld until proper record drawings have been furnished to the Engineer.

FORM A - EQUIPMENT REGISTRATION

EQUIPMENT NAME _____ NUMBER _____

LOCATION _____

MANUFACTURER _____ TELEPHONE _____

ADDRESS _____

SALES REPRESENTATIVE _____ TELEPHONE _____

MANUFACTURER'S MANUAL NUMBER _____

NAME PLATE DATA _____ MOTOR DATA _____

ADDITIONAL EQUIPMENT DATA _____ ADDITIONAL MOTOR DATA _____

CONTRACT NO _____

DRAWING NOS: _____ SPECIFICATION SECTION _____

FORM C- MAINTENANCE PROCEDURES SHEET

No.

EQUIPMENT NAME:

CRAFT

PLANT AREA

LEVEL

LOCATION

MAINTENANCE DESCRIPTION
FREQUENCY

ANNUALLY

SAFETY PRECAUTIONS

TOOLS, PARTS, MATERIALS TEST EQUIPMENT

(Separate sheet shall be filled out for each preventive maintenance procedure recommended by manufacturer, for each piece of equipment.)

END OF SECTION 01300

SECTION 01315

CPM SCHEDULES AND REPORTS

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PART 2 - NOT USED

PART 3 - NOT USED

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SECTION 01315

CPM SCHEDULES AND REPORTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The Work under this Contract shall be planned, scheduled, executed, reported and accomplished using the Critical Path Method (hereinafter referred to as CPM), in calendar days, unless otherwise specifically provided in the Contract Documents.
- B. The primary objectives of the CPM scheduling requirements are: (1) to ensure adequate planning and execution of the Work by Contractor; (2) to assist Owner in evaluating progress of the Work; (3) to provide for optimum coordination by the Contractor of his trades, Subcontracts and Suppliers, and of his work with the work or services provided by separate contractors; (4) to permit the timely prediction or detection of events or occurrences which may affect the timely prosecution of the Work; and (5) to provide a mechanism or tool for use by the Owner and Contractor in determining and monitoring any actions of the Contractor which may be required in order to comply with requirements of the Contract Documents relating to the completion of the various portions of the Work by the Milestone Dates specified in the Contract Documents.
- C. Contractor is responsible for determining the sequence of activities, the time estimates of the detailed construction activities and the means, methods, techniques and procedures to be employed. The Construction Schedule shall represent the Contractor's best judgment of how he will prosecute the Work in compliance with the Contract requirements. Contractor shall ensure that the Construction Schedule is current and accurate and is properly and timely monitored, updated and revised as Project conditions and the Contract Documents may require.
- D. Contractor shall consult with his principal Subcontractors and Suppliers relating to the preparation of his construction plan and Construction Schedule. Principal Subcontractors shall receive copies of those portions of Contractor's Construction Schedule which relates to their work and shall be continually advised of any updates or revisions to the Construction Schedule as the Work progresses. When Contractor submits his Construction Schedule or makes any proposed updates or revisions to such Schedule, it will be assumed by Owner that Contractor has consulted with and has concurrence of his principal Subcontractors and Suppliers. Contractor shall be solely

responsible for ensuring that all Subcontractors and Suppliers comply with the requirements of the Construction Schedule for their portions of the Work.

- E. Contractor will provide the basic data relating to activities, durations and sequences as part of the Construction Schedule. This data shall reflect the Contractor's actual construction plan for the Project, and shall fully comply with all requirements of the Contract Documents.
- F. When there are separate contractors working concurrently on the Project whose work must interface or be coordinated with the Work of Contractor, Contractor shall coordinate his activities of the separate contractors and shall, prior to the submission of his Construction Schedule, obtain written approval of his Construction Schedule by the separate contractors. If Contractor is unable to obtain such written approval by the separate contractors after his best efforts to do so, or if a conflict occurs that cannot be resolved by mutual agreement between Contractor and any separate contractor, the Owner shall make a determination of the schedule which will be binding upon Contractor and the separate contractors.
- G. It is understood and agreed that the Construction Schedule is to represent Contractor's best plan and estimate for the work; however, Contractor acknowledges that the Construction Schedule may have to be revised from time-to-time as progress proceeds. Contractor further acknowledges and agrees that the Owner does not guarantee that: (1) Contractor can start work activities on the "early start" or "late start" dates or complete work activities on the "early finish" or "late finish" dates shown in the schedule, or as same may be updates or revised; (2) Contractor can proceed at all times in the sequence established by the utilization of only the resources and manpower he initially plans for the performance of the Work; (3) Contractor's Construction Schedule will not have to be modified in order to obtain the agreement of any separate contractors to the schedule; or (4) Contractor's Construction Schedule will not have to be modified or changed by direction of the Construction Manager. Any changes, modifications or adjustments made by the Contractor to the Construction Schedule shall be in full compliance with all requirements of the Contract Documents.

- H. The Contractor acknowledges and agrees that his Construction Schedule must be flexible in order to accommodate and allow for his coordination with the operations of the Owner and the work of separate contractors relating to the Project. The Owner will review the Contractor's Construction Schedule for compatibility with Owner operations and the work of separate contractors. Contractor agrees to hold meetings with the Owner and separate contractors to resolve any conflicts between Contractor's Construction Schedule and the operations of the Owner or work of separate contractors. Contractor agrees to fully cooperate with Owner and separate contractors to resolve such conflicts and to revise his Construction Schedule as reasonably required.
- I. In order to maintain the orderly progress of the work performed on the Project, the Owner shall have the right to determine, in his sole discretion, the priority between the Work performed by Contractor and the work of any separate contractors or Owner's operations; this decision shall be final and binding upon Contractor and shall not be a cause for extra compensation or an extension of time, except where an extension of time is granted because of a delay for which Contractor is otherwise entitled to an extension under the Contract Documents.
- J. If Contractor's Construction Schedule indicates that Owner or a separate contractor is to complete an activity or perform certain preceding work by a particular date, or within a certain duration, Owner, or any separate contractor shall not be bound to said date or duration unless Owner expressly and specifically agrees in writing to same. The review and approval or acceptance by Owner of the Construction Schedule or any other schedule or plan of construction of Contractor, does not constitute an agreement by Owner of any start or finish date in the schedule or specific durations or sequences for activities of the Owner or any separate contractor; provided, however, that nothing herein shall be construed as modifying or changing, or excusing the performance of Contractor of required portions of the Work by the Milestone Dates as set forth in the Contract Documents.
- K. The Milestone Dates set forth in the Contract Documents represent only the major items of Work and may include interface dates with the operations of the Owner, the work of separate contractors or others. Milestone Dates are Contract requirements and are of the essence to this Contract and to the coordination of the Work by Contractor. Milestone Dates represent the latest allowable start or completion time for those portions of the Work to which each Milestone Date relates. The Milestone Dates are not intended to be a complete listing of all Work under this Contract or of all interfaces with work performed by other separate contractors, the Owner or others. Contractor shall determine the time requirements for all such interfaces and shall be responsible for planning, scheduling and coordinating the work in order to complete in accordance with those requirements.

- L. Approval or acceptance by the Owner of the Contractor's Construction Schedule, or any revisions or updates thereto, is advisory only and shall not relieve the Contractor of the responsibility for accomplishing each portion of the Work within each and every applicable Specific Date. Omissions and errors in the approved or accepted Construction Schedule, or any revisions or updates shall not excuse performance which is not in compliance with the Contract.
- M. Should Contractor intend or plan to complete the Work, or any portion thereof, earlier than any applicable Specific Date or Contract Time, Contractor shall give timely and reasonable notice of this fact to the Owner.
- N. Unless otherwise specifically provided in the Contract Documents, Contractor acknowledges that Owner has contemplated in planning and initial scheduling of the projects, that the work will be performed on a 5-day work week basis, utilizing a single 8-hour shift per day.

1.02 POST AWARD ACTIVITIES

- A. Orientation Session: Contractor shall, upon notification from the Owner, attend an orientation session relating to the Schedules and Reports requirements for this Project. This orientation meeting is designed to assist the Contractor in planning his work and in developing his Construction Schedule. This session will normally be held within fifteen (15) days after the date of the Notice to Proceed. Contractor shall arrange for his project manager and Superintendent, major Subcontractors and Suppliers, and any scheduling consultant that he may employ, to attend the orientation session.
- B. The Owner will review: the objectives of the Schedules and Reports requirements; the procedure and requirements for the preparation of the Construction Schedule and Schedule of Values by Contractor; and, how the requirements of the Contract Documents will be monitored and enforced. Long-lead items and time requirements for work by Subcontractors will be identified.

1.03 CONSTRUCTION SCHEDULE

- A. Within seven (7) days of the orientation session, (even though Contractor may not have completed Subcontractor negotiations and executed subcontractors) the Contractor shall complete a time-scaled network graphic. The Construction Schedule shall represent the Contractor's best judgment and intended plan for completion of the Work in compliance with Milestone Dates in the Contract Documents and the Contract Time. The Construction Schedule shall take into account all foreseeable activities to be accomplished

by any separate contractors, and interface dates with utility owners, the Owner's operations and others. The Construction Schedule shall anticipate all necessary manpower and resources to accomplish the activities within the durations set forth in the Construction Schedule.

- B. Owner shall have the right to require the Contractor to modify any Contractor data or any portion of the Contractor's Construction Schedule, Schedule of Values or Recovery Schedule, as herein required, with Contractor bearing the expense thereof, which the Engineer reasonably determines to be: (1) impracticable; (2) based upon erroneous calculations or estimates; (3) unreasonable; (4) required in order to ensure coordination by Contractor of the work of his Subcontractors and with the work or services being provided by any separate contractors; (5) necessary to avoid undue interference with the Owner's operations or those of any utility owners or adjoining property owners; (6) necessary to ensure completion of the Work by the Milestone Dates set forth in the Contract Documents or (8) not in accordance with the Contractor's actual operations.

1.04 SCHEDULE OF VALUES

- A. Within ten (10) days after completion of the Construction Schedule, the Contractor shall submit to the Owner a Schedule of Values for review, allocating a dollar value for the activities on the Construction Schedule. The dollar value for the activity shall be the cost of the work of the activity including labor, materials, and pro rata contribution of General Conditions requirements, overhead and profit. The sum of all activity costs shall equal the total Contract Sum. The Contractor shall revise the Schedule of Values as necessary to gain the approval of the Owner.
- B. The activity cost for the Schedule of Values shall be coded with a cost code corresponding to the trade, Subcontractor or Supplier performing the work so that subtotals for each division of the Work can be prepared.
- C. The Schedule of Values shall, in the best judgment of the Contractor, represent a fair, reasonable and equitable dollar (cost) allocation for each activity on the Construction Schedule.

1.05 CONSTRUCTION SCHEDULE CONTENT

- A. The Construction Schedule shall consist of a time-scaled, detailed network graphic representation of all activities which are part of the Contractor's construction plan and an accompanying computerized mathematical analysis of these activities. The graphic network shall include, but not be limited to, the following information:

1. Project Name;

2. Activities of completed work ready for use by next trade, Owner, etc;
 3. Activities relating to different areas of responsibility, such as subcontracted work which is distinctly separate from that being done by the Contractor directly;
 4. Different categories of work as distinguished by craft or crew requirements;
 5. Different categories of work as distinguished by equipment requirements;
 6. Different categories of work as distinguished by materials;
 7. Distinct and identifiable subdivisions of work such as structural slabs, beams, columns;
 8. Location of work within the Project that necessitates different times or crews to perform;
 9. Outage schedules for existing utility services that will be interrupted during the performance of the Work;
 10. Acquisition and installation of equipment and materials, supplies and/or installed by Owner or separate contractors;
 11. Material to be stored on site; and
 12. Milestone Dates.
- B. For all major equipment and materials to be fabricated or supplied for the Project, the Construction Schedule shall show a sequence of activities including:
1. Preparation of Shop Drawings and sample submissions;
 2. A reasonable time for review of Shop Drawings and samples or such times as specified in the Contract Documents;
 3. Shop fabrication, delivery, and storage;
 4. Erection or installation; and
 5. Testing of equipment and materials.

- C. The Construction Schedule shall include late completion dates for the Work that are not later than the required Milestone Dates. The time-scaled graphic network shall be drawn based upon the early start dates of activities shown on the graphic.
- D. All activity durations shall be given in calendar days.

1.06 UPDATING OF CONSTRUCTION SCHEDULE/PROGRESS REPORTS

- A. On or about the dates specified, Contractor shall arrange for his project manager and Superintendent to meet at the Project Site with the Owner to review Contractor's report of actual progress prepared by Contractor. Said report shall set forth up-to-date and accurate progress data, shall be based upon Contractor's best judgement and shall be prepared by Contractor in consultation with all principal Subcontractors and Suppliers.
- B. The progress report of Contractor shall show the activities or portions of activities, completed during the reporting period, the actual start and finish dates for these activities, remaining durations and/or estimated completion dates for activities currently in progress.
- C. Contractor shall submit a narrative report with the updated progress analysis which shall include, but not be limited to, a description of problem areas, current and anticipated delaying factors and their impact, explanations of corrective actions taken or planned, any newly planned activities or changes in sequence, and proposed logic for a Recovery Schedule, if required, as further described herein. The report shall also include:
 - 1. A narrative describing actual work accomplished during the reporting period;
 - 2. A list of major construction equipment used on the Work during the reporting period and any construction equipment idle during the reporting period;
 - 3. The total number of men by craft actually engaged in the Work during the reporting period, with such total stated separately as to office, supervisory, and field personnel;
 - 4. A manpower and equipment forecast for the succeeding thirty (30) days, stating the total number of men by craft, and separately stating such total as to office, supervisory and field personnel;
 - 5. A list of Contractor-supplied materials and equipment, indicating current availability and anticipated jobsite delivery dates;

6. Changes or additions to Contractor's supervisory personnel since the preceding progress report.
- D. The Contractor will provide initial computer reports and monthly reports thereafter, in accordance with the following:
1. Schedule Reports: Initial and subsequent Schedule Reports will contain the following minimum information for each activity:
 - a. Activity number, description and estimated duration in days;
 - b. Early and late finish dates;
 - c. Percentage of each activity complete as of each report;
 - d. Remaining float/days behind schedule;
 - e. Responsibility for activity. Actual start and finish dates shall be indicated for each activity, as appropriated. Dummies and completed activities will be omitted from remaining Float and Late Start Sorts.
 2. Cost Reports: Initial and subsequent Cost Reports will include the following information on each activity, sorted by trade activity:
 - a. Activity number and description;
 - b. Percentage of value of Work in place against total value;
 - c. Total cost of each activity;
 - d. Value of Work in place since last report;
 - e. Value of Work in place to date;
 - f. Value of uncompleted Work.
 3. As part of the updating process, the Contractor will calculate, the value of work done for each activity based on percentage complete for each activity less the amount previously paid for past percentages completed. Summation of all values of each activity less the appropriate percent of retainage shall be the amount payable to the Contractor, provided that Contractor has complied with all requirements of the Contract Documents.

- E. Contractor shall be solely responsible for expediting the delivery of all materials and equipment to be furnished by him so that the progress of construction shall be maintained according to the currently approved Construction Schedule for the Work. Contractor shall notify the Owner in writing, and in a timely and reasonable manner, whenever Contractor determines or anticipates that the delivery date of any material or equipment to be furnished by Contractor will be later than the delivery date indicated by the Construction Schedule, or required consistent with the completion requirements of this Contract, subject to updates as herein provided.
- F. Contractor shall ensure that the critical path runs through on-site activities and that off-site activities do not control the critical path of the Construction Schedule.

1.07 RECOVERY SCHEDULE

- A. Should the updated Construction Schedule show at any time that the Contractor is fourteen (14) or more days behind schedule for any Specific Date, the Contractor shall prepare a Recovery Schedule explaining and displaying how Contractor intends to reschedule his Work in order to regain compliance with the Construction Schedule.
- B. If the Contractor believes that all of the time can be recovered during the subsequent pay period the Contractor will be permitted to prepare a Recovery Schedule as set forth below. However, if the Contractor believes it will take more than thirty (30) days to recover all of the lost time, he shall prepare and submit a revision to the Construction Schedule.
 - 1. The Contractor shall prepare and submit to the Construction Manager a one-month maximum duration Recovery Schedule, incorporating best available information from Subcontractors and others which will permit return to Construction Schedule at the earliest possible time. The Contractor shall prepare a Recovery Schedule to same level of detail as the Construction Schedule for a maximum duration of one month. This Recovery Schedule shall be prepared in coordination with other separate contractors on the Project;
 - 2. Within two (2) days after submission of Recovery Schedule, the Contractor shall participate in a conference with the Owner to review and evaluate the Recovery Schedule. Within two (2) days of conference, the Contractor shall submit the revisions necessitated by the review for review and approval. The Contractor shall use the approved Recovery Schedule as his plan for returning to the Construction Schedule.

3. Contractor shall confer continuously with the Owner to assess the effectiveness of the Recovery Schedule. As a result of this conference:
 - a. If the Contractor is still behind schedule, the Contractor shall prepare a Schedule Revision and comply with all of the requirements of a Schedule Revision as stated herein and the other requirements of the Contract Documents; provided, however, that nothing herein shall limit in any way the rights and remedies of the Owner and as provided elsewhere in the Contract Documents.
 - b. If the Contractor has successfully complied with provisions of the Recovery Schedule, the Contractor shall return to the use of the approved Construction Schedule.

1.08 SCHEDULE REVISIONS

- A. Should Contractor desire to or otherwise be required under the Contract Documents to make modification or changes in his method of operation, his sequence of Work or the durations of the activities in his Construction Schedule, he shall do so in accordance with the requirements of the Contract Documents. Revisions to the approved Construction Schedule must be approved in writing by the Owner.

1.09 FLOAT TIME

- A. Float or slack time associated with one chain of activities is defined as amount of time between earliest start date and latest start date or between earliest finish date and latest finish date for such activities, as calculated as part of the Construction Schedule. Float or slack time shown on the Construction Schedule is not for exclusive use or benefit of either the Owner or the Contractor. Contractor specifically agrees that float time may be used by the Owner in conjunction with their review activities or to resolve for any modification of the Milestone Dates or an extension of the Contract Time, or a claim for additional compensation as a result of any Project problem, Change Order or delay which only results in the loss of available positive float on the Construction Schedule.
- B. Float time shown on the Construction Schedule shall not be used arbitrarily by Contractor in a manner which unnecessarily delays separate contractors from proceeding with their work or in a way which is detrimental to the interests of the Owner.

1.10 CPM PERSONNEL

- A. Contractor shall maintain a competent staff of sufficient size who are knowledgeable in the use, application and implementation of CPM as required by the Contract Documents. It shall be the responsibility of the Contractor to prepare input information for the Construction Schedule, monitor progress, provide input for updating and revising logic diagrams when necessary and otherwise assist the Contractor in fulfilling his obligations hereunder.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 01315

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SECTION 01380

CONSTRUCTION PHOTOGRAPHS

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SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall have construction record photographs taken prior to start of the Work and periodically during the course of the Work.

1.02 PHOTOGRAPHY REQUIRED

- A. Photographs taken in conformance with this Section shall be furnished to the Engineer with each Application for Payment.
- B. Photographs shall be taken at each of the major stages of construction listed below.
 - 1. Site before any contract work begins.
 - 2. Completion of site clearing for each structure.
 - 3. Completion of excavations of each structure.
 - 4. Completion of foundations of each structure.
 - 5. Completion of framing of each structure.
 - 6. Completion of enclosure of each structure.
 - 7. Completion of pipe laying prior to backfilling.
 - 8. Completion of site restoration and landscaping.
 - 9. Installation of equipment and facilities as directed by Engineer.

C. Views and Quantities Required:

1. Two views of each item listed in Article 1.02(B) above.
2. Five views of overall project site monthly, as directed by the Engineer.
3. Upload picture and video files to the file share site.

D. Compact Disk:

1. A compact disk shall be provided at the end of the job containing digital copies of all project photos.
2. Photographer shall agree to furnish additional prints to Owner and the Engineer at commercial rates applicable at time of purchase.

1.03 COSTS OF PHOTOGRAPHY

The Contractor shall pay costs for specified photography and prints.

A. Parties requiring additional photography or prints will pay photographer directly.

PART 2 - PRODUCTS

2.01 2.01 Photos and Videos

A. Electronic media shall be named as follows:

1. File Name: Year- Month- Day- Subject of the picture

PART 3 - EXECUTION

3.01 TECHNIQUE

A. Factual Presentation.

B. Correct exposure and focus.

1. High resolution and sharpness
2. Maximum depth-of-field
3. Minimum distortion

3.02 VIEWS REQUIRED

Photograph from locations to adequately illustrate condition of construction and state of progress.

- A. At successive periods of photography, take at least one photograph from the same overall view as previously.
- B. Consult with the Engineer at each period of photography for instructions concerning views required.

3.03 DELIVERY OF PRINTS

- A. Upload prints to the Engineer to accompany each Application for Payment.
- B. Distribution of prints as soon as processed is anticipated to be as follows:
 - 1. Owner (one set prints and one CD)
 - 2. Engineer (two sets of prints and one CD)
 - 3. Funding Agency (one set prints and one CD)

END OF SECTION

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SECTION 01400

QUALITY CONTROL

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PART 2 - PRODUCTS	Not Used.	
PART 3 - EXECUTION	Not Used.	

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SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.01 CODES, RULES, PERMITS AND FEES

A. General:

1. The Contractor shall comply with the Sussex County Delaware Building Codes, Air Quality Permits as well as the requirements of all permits obtained by the Owner.
2. The Contractor shall give all necessary notices, obtain all permits (except as otherwise noted herein) and pay all governmental taxes, fees, and other costs in connection with the work, file all necessary plans, prepare all documents and obtain all necessary approvals of all government departments having jurisdiction, obtain all required Certificates of Inspection and Approval for the work and deliver same to the Engineer, except as otherwise noted herein.

B. Included Items:

1. The Contractor shall include in his work, all labor, materials, services, apparatus, and drawings required to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings or specified.

C. Compliance:

1. All materials furnished and all work installed shall comply with the rules and regulations of the National Fire Protection Association with all requirements of local utility companies, with the recommendations of the fire insurance rating organization having jurisdiction, and with the requirements of all governmental departments having jurisdiction.
2. The Contractor shall arrange for inspection and approval by the Electrical Inspectors and shall pay all costs of these services.

D. Permits to be obtained by Owner

1. Erosion and Sediment Control Permit

1.02 MATERIALS AND WORKMANSHIP

- A. All materials and equipment required for the work shall be new, unless otherwise specified, and of the best quality and especially adapted to the services required.
- B. The Contractor shall furnish a superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen and labor required to unload, transfer, erect, connect up, adjust, start, operate, and test each system.
- C. The Contractor shall locate and install all equipment which must be serviced, operated, or maintained in fully accessible positions. Such equipment shall include, but not be limited to, valves, pumps, unions, cleanouts, drain points, pressure gages, and controls. Minor deviations from the Drawings may be made to allow for better accessibility, but changes of significant magnitude or changes involving extra cost shall not be made without approval of the Engineer.

1.03 STANDARDS

- A. Any reference to standards in the Contract Documents shall always imply the latest issue in effect including all amendments and errata at the time bids are taken, of said standards unless otherwise stated.
- B. Abbreviations for various organizations and terms which may be used in these Specifications are as follows:

<u>Abbreviation</u>		<u>Organization or Term</u>
AASHTO	-	American Assoc. of State Hwy. and Transportation Officials
ACI	-	American Concrete Institute
AASHO	-	The American Association of State Highway Officials
AI	-	The Asphalt Institute
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standards Institute
APWA	-	American Public Works Association
<u>Abbreviation</u>		<u>Organization or Term</u>
ASA	-	American Standards Association (Now ANSI)
ASCE	-	American Society of Civil Engineering
ASSCBC	-	American Standard Safety Code for Building Construction
ASTM	-	American Society of Testing and Materials
AWWA	-	American Water Works Association
CIPRA	-	Cast Iron Pipe Research Association

DIPRA	-	Ductile Iron Pipe Research Association
DOT Spec	-	Road and Bridge Specifications Md. Dept. of Transportation
E/A	-	Engineer and/or Architect
EPA	-	U.S. Environmental Protection Agency
FS	-	Federal Specifications
GPM	-	Gallons Per Minute
ID	-	Inside Diameter
MBE	-	Minority Business Enterprise
MSS	-	Manufacturers Standardization Soc. of Valve and Fittings Ind.
NBS	-	National Bureau of Standards
NCPI	-	National Clay Pipe Institute
NFPA	-	National Fire Protection Association
NPT	-	National Pipe Threads
NSF	-	National Science Foundation
OD	-	Outside Diameter
OFCCP	-	Office of Federal Contracts Compliance Programs
OSHA	-	U. S. Dept. of Labor, Occupational Safety and Health Admin.
PCA	-	Portland Cement Association
PS	-	United States Products Standards
PSIG	-	Pounds Per Square Inch Gauge
SAE	-	Society of Automotive Engineers
STA	-	Station (100 feet)
UL	-	Underwriter's Laboratories
USASI or	-	United States of America Standards Institute
USAS	-	(Now ANSI)
USGS	-	United States Geological Survey
USC&GS	-	United States Coast and Geodetic Survey

- C. The CONTRACTOR shall be responsible to obtain and pay for a copy, if required, of each standard identified and maintain a copy of each for reference in the field office throughout the duration of the Work.

1.04 VERIFICATION OF DIMENSIONS

The Contractor shall be responsible for field verification of all dimensions of existing facilities and other items which are shown on the Contract Drawings.

1.05 TESTS OF MATERIALS AND EQUIPMENT

All material before being incorporated in the work shall be subject to inspection, testing and approval of the Engineer and any work in which such materials are used without prior test and approval shall be considered defective and unauthorized and will not be paid for. The Contractor shall perform such tests as required by the

Specifications in a timely fashion taking into account when the items will be incorporated in the work.

PART 2 - PRODUCTS Not Used.

PART 3 - EXECUTION Not Used.

END OF SECTION 01400

SECTION 01453

SPECIAL INSPECTION SERVICES

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SECTION 01453

SPECIAL INSPECTION SERVICES

PART 1 - GENERAL

1.01 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.

1.02 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. ACI 318 “Building Code Requirements for Structural Concrete” (2011)
 - 2. ACI 530 “Building Code Requirements for Masonry Structures” (2011)
 - 3. ACI 530.1 “Specification for Masonry Structures” (2011)
- B. American Institute of Steel Construction (AISC):
 - 1. AISC 360 “Steel Construction Manual – 14th Edition” (2010)
- C. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 “Minimum Design Loads for Buildings and Other Structures” (2010)
- D. American Welding Society (AWS)
 - 1. B5.1: Specification for the Qualification of Welding Inspectors (AWS B5.1).
 - 2. D1.1: Structural Welding Code – Steel (AWS D1.1/D1.1M).
 - 3. D1.3: Structural Welding Code – Sheet Steel (AWS D1.3).
 - 4. D1.4: Structural Welding Code – Reinforcing Steel (AWS D1.4).
- E. International Code Council:
 - 1. 2012 International Building Code (IBC).

1.03 DEFINITIONS

- A. **Approved Agency:** An established and recognized agency that is regularly engaged in conducting tests or furnishing inspection services, where such agency has been approved by the Building Official.
- B. **Approved Fabricator:** An established and qualified person, firm, or corporation approved by the Building Official per the qualifications required in this Section.
- C. **Architect of Record (AR):** The Registered Design Professional retained by the Owner to design and specify architectural construction and whose signature and seal appears on the Owner-approved architectural construction documents.
- D. **Building Official:** The officer or other designated authority charged with the administration and enforcement of the Sussex County, DE Building Code, or a duly authorized representative.
- E. **Certificate of Compliance:** A certificate stating that materials and products meet specified standards or that work was done in compliance with approved construction documents.
- F. **Certification:** A statement of professional opinion by a registered design professional that indicates that the item(s) under consideration meet the requirement of the approved construction document. Certifications shall bear the original seal and signature of the design professional making the statement.
- G. **Completion Letter:** A certification letter signed and sealed by the design professional(s) of record who performed special inspections stating that the construction elements specified for special inspections have been inspected and conform to the approved Construction Documents and specifications.
- H. **Construction Documents:** Plans, specifications, and other documents prepared for the purposes of obtaining a building permit.
- I. **Owner-Approved Documents:** Construction documents approved by the Owner and Building Official.
- J. **Fabrication and Erection Documents:** Written, graphic and pictorial documents prepared or assembled after issuance of a building permit describing the design, location and physical characteristics of building components or materials necessary for fabrication, assembly or erection of project elements.

- K. Final Report of Special Inspections: A certification by the Special Inspector (SI) indicating that specified special inspections are completed and meet the requirements of the approved construction documents and project specifications.
- L. Inspection: The observation of work and the performance of tests for certain building or structure components.
- M. Inspection and Testing Agency: Agency or agencies retained by the Owner to perform special inspections and materials testing as required by IBC. Contractors are barred from retaining the services of inspection and testing agencies for Special Inspections.
- N. Mechanical Engineer of Record (MER): The registered mechanical engineer retained by the owner to have ultimate responsibility to design or specify mechanical systems and specifications.
- O. Non-Structural Elements: Elements of a building that are not primary or secondary structural elements such as exterior curtain walls and cladding, non-load-bearing partitions, stair railings, etc.
- P. Quality Control Inspector (QCI): Individual designated by the erector or fabricator to perform controls and inspections implemented by the erector or fabricator, as applicable, to ensure that the material provided and work performed meet the requirements of the approved construction documents and referenced standards.
- Q. Special Inspection: Inspection of construction requiring the expertise of an approved Special Inspector in order to ensure compliance with the Sussex County, DE Building Code and the approved Construction Documents.
 - 1. Continuous Special Inspection: Special Inspection by the Special Inspector who is present when and where the work to be inspected is being performed.
 - 2. Periodic Special Inspection: Special Inspection by the Special Inspector who is intermittently present where the work to be inspected has been or is being performed.
- R. Special Inspector: A qualified person employed or retained by an Approved Agency, hired by the Owner as having the competence necessary to inspect a particular type of construction requiring Special Inspection.
- S. Statement of Special Inspections (SSI): A statement prepared by the Owner, appropriate registered design professionals in responsible charge, and

Special Inspector and submitted by the Contractor for review and approval by the Building Official. The SSI indicates the scope of special inspections applicable to a construction project and identifies the names and qualifications of the design professionals and inspection and testing agencies that will provide those services.

- T. Structural Engineer of Record (SER): The registered structural engineer retained by the Owner to have ultimate responsibility to design or specify structural documents and specifications.

1.04 SUMMARY

- A. This Section includes the following:
 - 1. Administrative and procedural requirements for Special Inspection services.
 - 2. Statement of Special Inspections, including a Schedule of Special Inspections
- B. Requirements for Special Inspections are outlined in the Statement and Schedule of Special Inspections included in this Section.
- C. The Owner will procure and bear all costs of the Special Inspections and Special Inspector's testing laboratory, except as otherwise noted. The Special Inspector will be the manager of the Special Inspection process. The Special Inspector checks the certification of all other inspecting agents required by Special Inspections and coordinates their activities. The Special Inspector carries the exclusive responsibility for assuring that the inspections indicated are performed. The Statement of Special Inspections will be required by the Building Official as a condition for building permit issuance.
- D. Special Inspections are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

1.05 STRUCTURES AND BUILDING ELEMENTS SUBJECT TO SPECIAL INSPECTIONS

- A. This section shall apply to newly constructed building elements and modifications to existing building elements, newly constructed and modifications to foundation elements, and element fabrication procedures that are subject to special inspections as required by the IBC. Special inspections are required for:

1. Inspection of fabricators in accordance with IBC 1704.2.5
 2. Structural steel construction in accordance with IBC 1705.2.1 and the quality assurance inspection requirements of AISC 360.
 3. Steel construction other than structural steel in accordance with IBC 1705.2.2
 4. Concrete construction in accordance with IBC 1705.3.
 5. Masonry construction in accordance with IBC 1705.4 and the quality assurance inspection requirements of TMS 402/ACI 530/ASCE 5 and TMS 602/ACI 530.1/ASCE 6.
 6. Soils and foundation construction in accordance with IBC 1705.6.
 7. Sprayed fire-resistant materials in accordance with IBC 1705.13.
 8. Mastic and intumescent fire-resistant coatings in accordance with IBC 1705.14.
 9. Fire-resistant penetrations and joints in accordance with IBC 1705.16.
- B. Special inspections shall also be required for proposed work that is, in the opinion of the Building Official, unusual in its nature, such as, but not limited to, the following examples:
1. Construction materials and systems that are alternatives to materials and systems prescribed by this code.
 2. Unusual design applications of materials described in this code.
 3. Materials and systems required to be installed in accordance with additional manufacturer's instructions that prescribe requirements not contained in this code or in standards referenced by this code.
 4. Sheeting and shoring, underpinning, curtain walls, facade, light gage metal framing, etc.
- C. Where a task is noted to be performed by both QC and special inspection, it is permitted to coordinate the inspection function between the QCI and special inspector so that the inspection functions are performed by only the one party. Where special inspection relies upon inspection functions performed by the QC, the approval of the engineer and the owner is required.

1.06 QUALIFICATIONS

- A. Approved Agency:
1. The Approved Agency must meet one of the following requirements:
 - a. Agency maintains current accreditation as a special inspection agency by the IAS within the scope of accreditation issued by IAS, and in accordance with ASTM E329.

- b. Agency must be objective, competent and independent from the contractor responsible for the work being inspected. The agency must disclose possible conflicts of interest so that objectivity can be confirmed
- c. Agency must have adequate equipment to perform required tests. The equipment must be periodically calibrated.
- d. Agency must employ experienced personnel educated in conducting, supervising and evaluating tests and/or inspections.
- e. Provide for review and Building Official approval, the agency's project history/experience of comparable projects as applicable for the special inspections required for the submitted project.

B. Special Inspectors:

1. Prior to the start of construction, the Approved Agencies shall provide written documentation to the Building Official demonstrating the competence and relevant experience or training of the Special Inspectors who will perform the Special Inspections and tests during construction. Experience or training shall be considered relevant where the documented experience or training is related in complexity to the same type of Special Inspection or testing activities for projects of similar complexity and material qualities.
2. Special Inspectors of welding shall be qualified to the satisfaction of the Approved Agency's written practice, and in accordance with either of the following:
 - a. Welding inspectors (WIs) or senior welding inspectors (SWIs), as defined in AWS B5.1, Standard for the Qualification of Welding Inspectors, except associate welding inspectors (AWIs) are permitted to be used under the direct supervisions of WIs, who are on the premises and available when weld inspection is being conducted, or
 - b. Qualified under the provisions of AWS D1.1, subclause 6.1.4.
3. Special Inspectors of bolting shall be qualified on the basis of documented training and experience in structural bolting inspection.
4. Special Inspectors performing nondestructive testing, other than visual inspections, shall be qualified in accordance with their employer's written practice, which shall meet or exceed the criteria of AWS D1.1 Structural Welding Code-Steel, subclause 6.14.6, and the following:

- a. American Society for Nondestructive Testing (ASNT) SNT-TC-1A, Recommended Practice for the Qualification and Certification of Nondestructive Testing Personnel.
- b. ASNT CP-189, Standard for the Qualification and Certification of Nondestructive Testing Personnel

1.07 RESPONSIBILITIES

A. Owner Responsibilities: Provide funding of the Special Inspection program and contract with an Approved Agency.

1. General:

- a. Submit permit applications that include a complete Statement of Special Inspections (SSI).
- b. Retain all professionals involved in the process of special inspection including the Special Inspector (SI).
- c. Submit time schedules.
- d. Schedule and conduct pre-construction meeting.
- e. Oversee the design, construction, and permitting for the project to ensure that the project is in compliance with approved construction documents.
- f. Assure prompt distribution of inspection activity reports.
- g. Submit all structural revisions to the Structural Engineer of Record (SER) for review and approval, prior to commencement of the work. A copy of the SER approved revisions must also be submitted to the SI and the Owner (when required) prior to commencement of the work.

B. Contractor Responsibilities: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.

1. Acknowledge receipt and understanding of the submitted Statement of Special Inspections form approved by the Building Official.
2. The Contractor shall correct deficiencies in work that inspections and laboratory test reports have indicated to be not in compliance with requirements.
3. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

4. Special Inspections 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.
 - a. 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.

5. Associated Services: The Contractor shall cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable services as requested. Notify the agency in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
 - a. Conduct a meeting with the Special Inspector, applicable sub-contractors, Owner, and Building Official at the beginning of the job in order to coordinate anticipated inspection schedules, notification of inspections required by the special inspections program and those required by the Building Official, job access, location access, report filing/storage/delivery, response to deficiency reports, and special inspection final reporting.
 - b. ii. Provide safe access for the Special Inspector to inspect and test the work.
 - c. iii. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 - d. iv. Provide and maintain for the sole use of the Special Inspector or Special Inspectors adequate facilities for safe storage and proper curing of test samples on the Project Site.
 - e. v. Provide the Special Inspector(s) with access to the approved plans, shop drawings, and submittals and the location of the area(s) to be inspected.
 - f. vi. Retain, at the jobsite, all special inspection records submitted by the Special Inspector(s) and providing access to these records for review by the Owner or Building Official upon request.
 - g. vii. Provide security and protection of samples and test equipment at the Project Site.
 - h. viii. The Contractor shall designate a representative (the superintendent or an assistant to the superintendent) who shall be the direct point-of-contact with the Special Inspector during each phase of the work. Discrepancies noted during the progress of the work will be reported to the Contractor's

representative for corrective action. Communications given by the Special Inspector to the Contractor's representative shall be as binding.

- i. Coordinate all construction and management efforts in response to correcting items described within deficiency and/or discrepancy reports.
- j. Provide the Building Official and Special Inspector an opportunity to witness the approved repairs identified in reports.

6. Coordination:

- a. Contractor shall coordinate sequence of activities to accommodate the required Special Inspections with a minimum of delay and to avoid removing and/or replacing construction to accommodate testing and inspections.
- b. Contractor shall be responsible for scheduling Special Inspections. Schedule times for tests, inspections, obtaining samples, and all other required activities due to special inspections.
- c. Contractor shall notify the Special Inspector(s) 48 hours prior to the need for field inspections and 7 days prior to the need for off-site shop or plant inspections. Contractor shall reimburse the Owner for cancelled or postponed special inspections, except as due to unforeseen weather conditions or other circumstances beyond the control of the Contractor and/or subcontractor(s).
- d. Contractor shall schedule Special Inspections as efficiently as possible. Contractor shall reimburse the Owner for Special Inspection fees where the Approved Agency(s) is not utilized or is under-utilized for the scheduled Special Inspections. The Owner shall reserve the right to cancel Special Inspections requests where the quantity of testing and inspections is insufficient and/or not specifically itemized.

C. Special Inspector Responsibilities:

1. General:

- a. Shall be retained by the Owner.
- b. Review included Schedule of Special Inspections, revise as necessary, and submit a final version to the Building Official as a condition for permit issuance.
- c. Shall be a qualified person who shall demonstrate competence, to the satisfaction of the Owner, for the inspection of the particular type of construction or operation requiring

-
- special inspection. The Special Inspector shall provide written documentation to the Owner demonstrating his or her competence and relevant experience or training. Experience or training shall be considered relevant when the documented experience or training is related in complexity to the same type of special inspection activities for projects of similar complexity and material qualities.
- d. Provide construction inspection and testing services of required scope and frequency to offer a professional opinion that the constructed project was built in accordance with the Owner-approved construction documents, and that construction has been tested and inspected in accordance with the SSI and applicable codes and standards.
 - e. Work with the Owner and with other members of the design team to develop the statement of special inspections.
 - f. Verify that all fabricators of structural elements comply with applicable quality assurance programs.
2. Conduct and interpret tests, state in each report whether test specimens comply with requirements, specifically state any deviations therefrom, and record work required and performed to correct deficiencies.
 3. Keep records of all inspections and tests which will be furnished to the Building Official, the Architect, and the Structural Engineer of Record.
 4. Notify the Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services. All discrepancies will be brought to the immediate attention of the Contractor for correction. If discrepancies are not corrected, the discrepancies will be brought to the attention of the Building Official and the Structural Engineer of Record.
 5. Prepare a final report documenting completion of all required Special Inspections and corrections of any discrepancies noted will be submitted to the Building Official prior to, and as a condition of, issuance of the Certificate of Use and Occupancy.
 6. Do not perform any duties of the Contractor.
- D. Special Inspections Testing Agent Responsibilities: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location 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 any duties of Contractor.

1.08 SUBMITTALS

- A. The Special Inspector and the Independent Testing Agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Engineer.
 1. Submit additional copies of each written report directly to the governing authority.
 2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to the following:
 - a. Date of issue.
 - b. Project title and number.
 - c. Name, address and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.
 - g. Identification of product and Specification Section.
 - h. Complete inspection and test data.
 - i. Test results and an interpretation of test results.
 - j. Ambient conditions at the time of sample taking and testing.
 - k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
 - l. Name and signature of laboratory inspector.
 - m. Recommendations on retesting.
- B. Submit, to the Engineer, proposed revisions to the Contract Documents as a result of deficiency reports.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 SPECIAL INSPECTIONS

- A. Special Inspector and Special Inspections Agency must perform Special Inspections per attached “Schedule of Special Inspections”, as revised and submitted for permit issuance.

3.02 STRUCTURAL STEEL

- A. Special Inspections for structural steel, except nondestructive testing (NDT), may be waived when the work is performed in a fabricating shop or by an erector approved by the Building Official to perform the work without special inspections. NDT of welds completed in an approved fabricator’s shop may be performed by that fabricator when approved by the Building Official. When the fabricator performs the NDT, the Special Inspection Agency must review the fabricator’s NDT reports.
- B. Inspection of High-Strength Bolting:
 - 1. For snug-tight joints, pre-installation verification testing and monitoring of the installation procedures are not applicable. The QCI and Special Inspector need not be present during the installation of fasteners in snug-tight joints.
 - 2. For pretensioned joints and slip-critical joints, when the installer is using turn-of-nut method with matchmarking techniques, the direct-tension-indicator method, or the twist-off-type tension control bolt method, monitoring of bolt pretensioning procedures shall be as specified in the Schedule of Special Inspections. The QCI and Special Inspector need not be present during the installation of fasteners when these methods are used by the installer.
 - 3. For pretensioned joints and slip-critical joints, when the installer is using the calibrated wrench method or the turn-of-nut method without matchmarking, monitoring of bolt pretensioning procedures shall be as specified in the Schedule of Special Inspections. The QCI and Special Inspector shall be engaged in their assigned inspection duties during installation of fasteners when these methods are used by the installer.
- C. At completion of fabrication, the approved fabricator must submit a certificate of compliance to the Building Official stating that the materials supplied and work performed by the fabricator are in accordance with the

Construction Documents. At completion of erection, the approved erector must submit a certificate of compliance to the Building Official stating that the materials supplied and work performed by the erector are in accordance with the Construction Documents.

3.03 CONCRETE

- A. Special Inspections are not required for the following:
 - 1. Isolated spread footings
 - 2. Slabs-on-ground

3.04 STEEL OTHER THAN STRUCTURAL STEEL, MASONRY, CONCRETE, SOILS, FOUNDATIONS, AND FIRE-RESISTANT CONSTRUCTION

- A. SI shall perform required verifications and inspections listed in applicable tables “Schedule of Special Inspections.”
- B. See Section 1.3 for definitions of “Periodic Special Inspection” and “Continuous Special Inspection.”
- C. Provide special inspections of sprayed fire-resistant materials in accordance with IBC 1705.13; mastic and intumescent fire-resistant coatings in accordance with IBC 1705.14; fire-resistant penetrations and joints in accordance with IBC 1705.15; and smoke control in accordance with IBC 1705.17.

3.05 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes.
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor’s responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01453

SCHEDULE OF SPECIAL INSPECTIONS

Observe – Observe these items on a random basis. Operations need not be delayed pending these inspections. Frequency of observations shall be adequate to confirm that the work has been performed in accordance with the applicable documents. In the event that observations determine that the materials and/or workmanship are not in conformance with the applicable documents, additional inspections shall be performed to determine the extent of non-conformance.

Perform – Perform these tasks for each welded joint or member, each bolted connection, or each steel element

Continuous – Continuous Special Inspection

Periodic – Periodic Special Inspection

Document – Within the listed tasks, shall mean the Special Inspector shall prepare reports or other appropriate written documentation indicating that the work has or has not been performed in accordance with the Construction Documents

STRUCTURAL STEEL

INSPECTION TASKS PRIOR TO WELDING (Table N5.4-1, AISC 360-10)				
Required	Task	Perform	Observe	Description
☒	1. Welding procedure specifications (WPSs) available	X	-	
☒	2. Manufacturer certifications for welding consumables available	X	-	
☒	3. Material identification (type/grade)	-	X	
☒	4. Welder identification system	-	X	Fabricator or erector shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.

INSPECTION TASKS PRIOR TO WELDING (Table N5.4-1, AISC 360-10)				
Required	Task	Perform	Observe	Description
☒	5. Fit-up groove welds (including joint geometry)	-	X	<ul style="list-style-type: none"> • Joint preparation • Dimensions (alignment, root opening, root face, bevel) • Cleanliness (condition of steel surfaces) • Tacking (tack weld quality and location) • Backing type and fit (if applicable)
☒	6. Configuration and finish of access holes	-	X	
☒	7. Fit-up of fillet welds	-	X	<ul style="list-style-type: none"> • Dimensions (alignment, gaps at root) • Cleanliness (condition of steel surfaces) • Tacking (tack weld quality and location)

INSPECTION TASKS DURING WELDING (Table N5.4-2, AISC 360-10)				
Required	Task	Perform	Observe	Description
☒	1. Use of qualified welders	-	X	
☒	2. Control and handling of welding consumables	-	X	<ul style="list-style-type: none"> • Packaging • Exposure control.
☒	3. No welding over cracked tack welds	-	X	
☒	4. Environmental conditions	-	X	<ul style="list-style-type: none"> • Wind speed within limits • Precipitation and temperature

☒	5. WPS followed	-	X	<ul style="list-style-type: none"> • Settings on welding equipment • Travel speed • Selected welding materials • Shielding gas type/flow rate • Preheat applied • Interpass temperature maintained (min./max.) • Proper position (F, V, H, OH)
☒	6. Welding techniques	-	X	<ul style="list-style-type: none"> • Interpass and final cleaning • Each pass within profile limitations • Each pass meets quality requirements

INSPECTION TASKS AFTER WELDING (TABLE N5.4-3, AISC 360-10)				
Required	Task	Perform	Observe	Description
☒	1. Welds cleaned	-	X	
☒	2. Size, length, and location of welds	X	-	
☒	3. Welds meet visual acceptance criteria	X	-	<ul style="list-style-type: none"> • Crack prohibition • Weld/base-metal fusion • Crater cross section • Weld profiles • Weld size • Undercut • Porosity
☒	4. Arc strikes	X	-	
☒	5. k-area	X	-	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks within 3 in. of the weld.

<input checked="" type="checkbox"/>	6. Backing removed and weld tabs removed (if required)	X	-	
<input checked="" type="checkbox"/>	7. Repair activities	X	-	
<input checked="" type="checkbox"/>	8. Document acceptance or rejection of welded joint or member	X	-	

NONDESTRUCTIVE TESTING (SECTION N5.5, AISC 360-10)				
Required	Task	Perform	Observe	Description
<input type="checkbox"/>	1. CJP welds (Risk Cat. II)	-	X	Ultrasonic testing shall be performed on 10% of CJP groove welds in butt, T- and corner joints subject to transversely applied tension loading in materials 5/16-inch thick or greater. Testing rate must be increased if > 5% of welds tested have unacceptable defects.
<input checked="" type="checkbox"/>	2. CJP welds (Risk Cat. III or IV)	X	-	Ultrasonic testing shall be performed on all CJP groove welds in butt, T- and corner joints subject to transversely applied tension loading in materials 5/16-inch thick or greater.
<input checked="" type="checkbox"/>	3. PJP welds	-	X	Ultrasonic testing shall be performed on 10% of PJP groove welds in butt, T- and corner joints subject to transversely applied tension loading in materials 5/16-inch thick or greater. Testing rate must be increased if > 5% of welds tested have unacceptable defects.
<input checked="" type="checkbox"/>	4. Fillet welds	-	X	Magnetic particle testing shall be performed on 10% of fillet welds > 5/16"

<input checked="" type="checkbox"/>	5. Access holes (flange thickness > 2")	-	X	Thermally cut surfaces of access holes shall be magnetic particle tested or penetrant tested when the flange thickness exceeds 2 in. for rolled shapes, or when the web thickness exceeds 2 in. for built-up shapes. Any cracks shall be deemed unacceptable regardless of size or location.
<input type="checkbox"/>	6. Welded joints subject to fatigue	-	X	Radiographic or Ultrasonically inspect welded joints identified on the contract documents to be subject to fatigue per sections 5.1, 5.2, 5.3, 5.4, 6.1, 6.2, and 6.3 of Table A-3.1, AISC 360-10.
<input checked="" type="checkbox"/>	7. K-area NDT	X	-	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.

NONDESTRUCTIVE TESTING (SECTION N5.5, AISC 360-10)				
Required	Task	Perform	Observe	Description
<input checked="" type="checkbox"/>	8. Base metal NDT for lamellar tearing and laminations	-	X	After joint completion, base metal thicker than 1 1/2 in. loaded in tension in the through-thickness direction in tee and corner joints, where the connected material is greater than 3/4 in. and contains CJP groove welds, shall be ultrasonically tested for discontinuities behind and

				adjacent to the fusion line of such welds.
<input checked="" type="checkbox"/>	9. Beam cope and access hole	-	X	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing or penetrant testing, when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
<input type="checkbox"/>	10. Reduced beam section repair	-	X	Magnetic particle testing shall be performed on any weld and adjacent area of the reduced beam section (RBS) cut surface that has been repaired by welding, or on the base metal of the RBS cut surface if a sharp notch has been removed by grinding.
<input checked="" type="checkbox"/>	11. Weld tab removal sites	-	X	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT.

INSPECTION TASKS PRIOR TO BOLTING (TABLE N5.6-1, AISC 360-10)				
Required	Task	Perform	Observe	Description
<input checked="" type="checkbox"/>	1. Manufacturer's certifications available for fastener materials	X	-	
<input checked="" type="checkbox"/>	2. Fasteners marked in accordance with ASTM requirements	-	X	
<input checked="" type="checkbox"/>	3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	-	X	
<input checked="" type="checkbox"/>	4. Proper bolting procedure selected for joint detail	-	X	

☒	5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	-	X	
☒	6. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used	-	X	
☒	7. Proper storage provided for bolts, nuts, washers, and other fastener components	-	X	

INSPECTION TASKS DURING BOLTING (TABLE N5.6-2, AISC 360-10)

Required	Task	Perform	Observe	Description
☒	1. Fastener assemblies, of suitable condition, placed in all holes and washers (if required) are positioned as required	-	X	
☒	2. Joint brought to the snug-tight condition prior to pretensioning operations	-	X	
☒	3. Fastener component not turned by the wrench prevented from rotating	-	X	
☒	4. Fasteners are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	-	X	

INSPECTION TASKS AFTER BOLTING (TABLE N5.6-3, AISC 360-10)

Required	Task	Perform	Observe	Description
☒	1. Document acceptance or rejection of bolted connections	X	-	

OTHER STEEL INSPECTION TASKS (SECTION N5.7, AISC 360-10)

Required	Task	Perform	Observe	Description
☒	1. Anchor rods and other embedments supporting structural steel	X	-	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
☒	2. Fabricated steel or erected steel frame	-	X	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.

CONCRETE CONSTRUCTION

SPECIAL INSPECTIONS AND TESTS OF CONCRETE CONSTRUCTION (IBC TABLE 1705.3)				
Required	Task	Continuous	Periodic	Description
☒	1. Inspect reinforcement, including prestressing tendons, and placement	-	X	
☒	2. Inspect reinforcement steel welding in accordance with Table 1705.2.2, Item 2b.	-	-	
☒	3. Inspect anchors cast in concrete where allowable loads have been increased or where strength design is used	-	X	
☒	4. Inspect anchors post-installed in hardened concrete members	-	X	ICC ES Reports shall be available indicating that anchors are approved for intended application/installation
☒	5. Verify use of required mix design	-	X	

<input checked="" type="checkbox"/>	6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of concrete	X	-	
<input checked="" type="checkbox"/>	7. Inspect concrete and shotcrete placement for proper application techniques	X	-	
<input checked="" type="checkbox"/>	8. Verify maintenance of specified curing temperature and techniques	-	X	
	9. Inspect prestressed concrete for:			
<input checked="" type="checkbox"/>	a. Application of prestressing forces	X	-	
<input checked="" type="checkbox"/>	b. Grouting of bonded prestressing tendons	X	-	
<input checked="" type="checkbox"/>	10. Inspect erection of precast concrete members	-	X	
<input checked="" type="checkbox"/>	11. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs	-	X	
<input checked="" type="checkbox"/>	12. Inspect formwork for shape, location and dimensions of the concrete member being formed	-	X	

MASONRY CONSTRUCTION – LEVEL B

TESTS (SPEC ARTICLE 1.4 AND 1.5, TMS-602/ACI 530.1-11):				
Required	Task	Continuous	Periodic	Description
<input checked="" type="checkbox"/>	Verification of Slump flow and Visual Stability Index (VSI) as delivered to project	X	-	As determined by ASTM C1611

	site for self-consolidating grout			
<input checked="" type="checkbox"/>	Verification of f'_m by unit strength method	X	-	

SPECIAL INSPECTIONS (TABLE 1.19.2, TMS-402/ACI 530-11):					
Required	Task	Continuous	Periodic	TMS 602/ACI 530/ASCE 5 Reference	TMS 602/ACI 530.1/ASCE 6 Reference
<input checked="" type="checkbox"/>	1. Verify compliance with the approved submittals	-	X		Art. 1.5
	2. As masonry construction begins, verify that the following are in compliance:				
<input checked="" type="checkbox"/>	a. Properties of site-prepared mortar	-	X		Art. 2.1, 2.6A
<input checked="" type="checkbox"/>	b. Construction of mortar joints	-	X		Art. 3.3 B
<input type="checkbox"/>	c. Grade and size of prestressing tendons and anchorages	-	X		Art. 2.4B, 2.4H
<input type="checkbox"/>	d. Location of reinforcement, connectors, and prestressing tendons and anchorages	-	X		Art. 3.4, 3.6A
<input type="checkbox"/>	e. Prestressing technique	-	X		Art. 3.6B
<input type="checkbox"/>	f. Properties of thin-bed mortar for AAC masonry	X	X		Art. 2.1C
	3. Prior to grouting, verify that the following are in compliance:				
<input checked="" type="checkbox"/>	a. Grout Space		X		Art. 3.2D, 3.2F
<input type="checkbox"/>	b. Grade, type, and size of	-	X	Sec. 1.16	Art. 2.4, 3.4

SPECIAL INSPECTIONS (TABLE 1.19.2, TMS-402/ACI 530-11):					
Required	Task	Continuous	Periodic	TMS 602/ACI 530/ASCE 5 Reference	TMS 602/ACI 530.1/ASCE 6 Reference
	reinforcement and anchor bolts, and prestressing tendons and anchorages				

SPECIAL INSPECTIONS (TABLE 1.19.2, TMS-402/ACI 530-11):					
Required	Task	Continuous	Periodic	TMS 602/ACI 530/ASCE 5 Reference	TMS 602/ACI 530.1/ASCE 6 Reference
☒	c. Placement of reinforcement, connectors, and prestressing tendons and anchorages	-	X	Sec. 1.16	Art. 3.2E, 3.4, 3.6A
☒	d. Proportions of site-prepared grout and prestressing grout for bonded tendons	-	X		Art. 2.6B, 2.4G.1.b
☒	e. Construction of mortar joints	-	X		Art. 3.3B
	4. Verify during construction:				
☒	a. Size and location of structural elements	-	X		Art. 3.3F
☒	b. Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction	-	X	Sec. 1.16.4.3, 1.17.1	
☒	c. Welding of reinforcement	X	-	Sec. 2.1.8.7.2, 3.3.3.4(c), 8.3.3.4(b)	

SPECIAL INSPECTIONS (TABLE 1.19.2, TMS-402/ACI 530-11):					
Required	Task	Continuous	Periodic	TMS 602/ACI 530/ASCE 5 Reference	TMS 602/ACI 530.1/ASCE 6 Reference
<input checked="" type="checkbox"/>	d. Preparation, construction, and protection of masonry during cold weather (temperature below 40 deg F) or hot weather (temperature above 90 deg F)	-	X		Art. 1.8C, 1.8D
<input type="checkbox"/>	e. Application and measurement of prestressing force	X	-		Art. 3.6B
<input checked="" type="checkbox"/>	f. Placement of grout and prestressing grout for bonded tendons in compliance	X	-		Art. 3.5, 3.5C
<input type="checkbox"/>	g. Placement of AAC masonry units and construction of thin-bed mortar joints	X	X		Art. 3.3. B.8
<input checked="" type="checkbox"/>	5. Observe preparation of grout specimens, mortar specimens, and/or prisms	-	X		Art. 1.4B.2.a.3, 1.4B.2.b.3, 1.4B.2.c.3, 1.4B.3, 1.4B.4

SOILS CONSTRUCTION

SPECIAL INSPECTIONS AND TESTS OF SOILS (IBC TABLE 1705.6)			
Required	Task	Continuous	Periodic
<input checked="" type="checkbox"/>	1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity	-	X
<input checked="" type="checkbox"/>	2. Verify excavations are extended to proper depth and have reached proper material	-	X
<input checked="" type="checkbox"/>	3. Perform classification and testing of compacted fill materials	-	X
<input checked="" type="checkbox"/>	4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	X	-
<input checked="" type="checkbox"/>	5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly	-	X

END OF SECTION 01453

SECTION 01510

TEMPORARY UTILITIES

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SECTION 01510

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

Furnish, install and maintain temporary utilities required for construction, remove on completion of Work.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with National Electric Code.
- B. Comply with Federal, State, and local codes and regulations and with utility company requirements.
- C. Comply with Health Department Regulations.

PART 2 - PRODUCTS

2.01 MATERIALS

Materials may be new or used, but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING

- A. Arrange with the utility company and the Owner to provide service required for power and lighting, and pay all costs for service and for power used.
- B. Provide temporary lighting in all work areas sufficient to maintain a lighting level during working hours not less than the lighting level required by applicable codes, OSHA Standards, and safety regulations.

2.03 TEMPORARY TELEPHONE SERVICE

- A. As a minimum, provide cellular telephone service at the construction site for the use of the construction superintendent.

2.04 TEMPORARY WATER

- A. The Contractor shall arrange for adequate supply of potable water for his operations and use of employees at the work sites.

2.05 TEMPORARY SANITARY FACILITIES

- A. Approved sanitary conveniences for the use of laborers and others employed on the work, properly secluded from public observation shall be provided and maintained by the Contractor, in such manner and at such points as shall be approved or directed, and their use shall be strictly enforced. The collections in the same shall be disinfected and/or removed when and as required.
- B. The Contractor shall provide and maintain, in a neat and sanitary condition, such accommodations for the use of his employees, as may be necessary to comply with the requirements and regulations of the Department of Health or of other bodies or tribunals having jurisdiction thereof. He shall commit no public nuisance. Use of Owner's facilities is prohibited.

2.06 TEMPORARY PUMPING AND SITE DRAINAGE

Keep the site free from water at all times to permit continuous access and to prevent damage to the work.

2.07 SECURITY

Full time watchmen will not be specifically required as a part of the Contract, but the Contractor shall provide inspection of work area daily and shall take whatever measures are necessary to protect the safety of the public, workmen, and materials, and provide for the security of the construction site, both day and night.

2.08 DUST AND MUD CONTROL

Take all necessary precautions to control dust and mud associated with the Work of this Contract, subject to the review of the Engineer. In dry weather, spray dusty areas daily with water or provide other approved means in order to control dust. Take necessary steps to prevent the tracking of mud onto adjacent streets and highways.

2.09 CONTRACTOR'S STAGING AREA

- A. The Contractor's staging area shall be coordinated with the Owner.
- B. Provide storage sheds as required for the performance of the work and protection of materials and equipment.

PART 3 - EXECUTION

3.01 GENERAL

- A. Maintain and operate systems to assure continuous service.
- B. Modify and extend systems as work progress requires.

3.02 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore permanent facilities used for temporary services to specified condition.

END OF SECTION 01510

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SECTION 01540

BYPASS PUMPING OPERATIONS

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SECTION 01540

BYPASS OPERATIONS

PART 1 - GENERAL

1.01 SCOPE

- A. Under this item the Contractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area as required.
- B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who can demonstrate to the Engineer that he specializes in the design and operation of temporary bypass pumping systems. The vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed by his firm within the past three years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

1.02 SUBMITTALS

- A. The Contractor shall prepare with the vendor a specific, detailed description of the proposed pumping system and submit it and the vendor's references with his bid proposal.
- B. During shop drawings, the Contractor shall submit to the Engineer detailed plans and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. This plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. No construction shall begin until all provisions and requirements have been reviewed by the Engineer.
- C. The plan shall include but not be limited to details of the following:
 - 1. Staging areas for pumps;
 - 2. Sewer plugging method and types of plugs;
 - 3. Number, size, material, location and method of installation of suction

4. piping;
4. Number, size, material, method of installation and location of installation of discharge piping;
5. Bypass pump sizes, capacity, number of each size to be on site and power requirements;
6. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
7. Standby power generator size, location;
8. Standby pumping units, location(s);
9. Downstream discharge plan;
10. Method of protecting discharge manholes or structures from erosion and damage;
11. Thrust and restraint block sizes and locations;
12. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill;
13. Method of noise control for each pump and/or generator;
14. Any temporary pipe supports and anchoring required;
15. Design plans and computation for access to bypass pumping locations indicated on the drawings;
16. Calculations for selection of bypass pumping pipe size;
17. Schedule for installation of and maintenance of bypass pumping lines;
18. Plan indicating selection location of bypass pumping line locations.

PART 2 - PRODUCTS

2.01 GENERAL TREATMENT PLANT BACKGROUND

The treatment plants current plant flows are 1.0 mgd (700 gpm), with peak design rates estimated at 9 mgd. Bypass pumping shall be provided by the Contractor around given unit processes as required for the construction and testing of facilities.

2.02 EQUIPMENT

- A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. All primary pumps shall be diesel powered with a solids handling capability of 3 ¼”.
- B. The Contractor shall include one stand-by backup pump of each size to be maintained on site. All back-up pumps shall be on-line and available in an emergency situation and shall be critically silenced diesel operated.
- C. Discharge Piping - In order to prevent the accidental spillage of flows, all discharge systems shall be temporarily constructed of rigid pipe with positive, restrained joints. Under no circumstances will aluminum “irrigation” type piping or glued PVC pipe be allowed. Discharge hose will only be allowed in

short sections and by specific permission from the Engineer.

- D. The Contractor shall be responsible for providing adequate electrical service for all pumping units during the pumping station bypass operations.
- E. The Contractor shall make all arrangements for bypass pumping during the time when the individual components of the treatment plant must be shut down as necessary to perform the treatment plant work.
- F. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- G. The Contractor shall provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the main flows under any circumstances.

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Test:

The Contractor shall perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. The Engineer will be given 24 hours notice prior to testing.

- B. Inspection:

Contractor shall inspect bypass pumping system every 6 hours to ensure that the system is working correctly.

- C. Maintenance Service:

The Contractor shall insure that the temporary pumping system is properly maintained.

- D. The Contractor shall coordinate with the Owner in installing and maintaining an alarm indication that will communicate to the Sussex County SCADA system. Said alarm shall monitor all necessary points to prevent an overflow condition. All alarmed will be transmitted directly to the Contractor's cell phone. The Contractor shall be solely responsible for responding to and making any correcting the alarm condition. The Contractors response time to the site shall not exceed 30 minutes. A list of emergency contacts shall be supplied to the county for 24 hours a day 7 days a week response.

- E. Extra Materials:
 - 1. Spare parts for pumps and piping shall be kept on site as required.
 - 2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.02 PREPARATION

Precautions

- A. Contractor is responsible for locating any existing utilities in the area the Contractor selects to locate the bypass pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the County and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor.
 - . During all bypass pumping operation, the Contractor shall protect the Treatment Plant and from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the Treatment Plant caused by human or mechanical failure.

3.03 INSTALLATION AND REMOVAL

- A. The Contractor shall make connections to the existing system and construct temporary bypass pumping structures as may be required to provide adequate suction conduit.
- B. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance or work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.
- C. The Contractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.

END OF SECTION 01540

SECTION 01590

FIELD OFFICES

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PART 3 - EXECUTION

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SECTION 01590

FIELD OFFICES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Prior to installation of offices, consult with the Engineer and Owner on location, access and related facilities.
- B. Furnish, install and maintain a temporary field office for the Contractor during the entire construction period, defined as Notice to Proceed through Conditional Acceptance.
- C. Furnish, install and maintain storage and work sheds needed for construction.

1.02 REQUIREMENTS FOR FACILITIES

A. Contractor's Field Office:

- 1. Attractive appearance, structurally sound, weather tight, with floors raised above ground.
- 2. At Contractor's option, portable or mobile buildings may be used. Mobile trailers, when used, shall be modified for office use.
- 3. At the Contractor's option, storage units within the staging area may be used as long as sufficient space is allocated to display required construction posters and other work related information and adequate access is provided to as-built drawings.
- 4. Do not use mobile trailers for living quarters.
- 5. Facilities shall comply with requirements of Federal, State, and Local codes and regulations.

B. Owner's Field Office

- 1. The Contractor shall provide, within the lump sum price bid and without extra cost to the Owner, suitable field offices in an approved

location on the site of the project, separate from his own field office, for the exclusive use of the Engineer and the Owner. The office shall be a trailer or suitable building set up, equipped and made ready for use prior to the beginning of work on the project and shall remain until all field records pertinent to the project have been completed. The trailer shall consist of two offices, one for the Engineer and one for the Owner. The Owners space shall be 25% of the total space with a lockable door. It shall be separated from any building used by the Contractor. The Contractor shall, within the lump sum price bid and without extra cost to the Owner, pay all costs of operating and maintaining the field office including but not limited to charges for electric and telephone service local and long distance calls), sanitary facilities, drinking water, heating fuel, etc. See Section 01510 for utilities.

2. The Engineers field office shall be equipped with the following:
 - a. Two (2) standard size desks, 3 foot x 5 foot with desk chair, and three drawers.
 - b. One (1) drafting table: 39 inches x 72 inches x 36 inches high with one equipment drawer.
 - c. One (1) drafting table stool.
 - d. One (1) 3 foot x 6 foot folding table.
 - e. One (1) plan rack to hold a minimum of six sets of project drawings.
 - f. Two (2) standard four-drawer legal-size metal filing cabinet with locks and keys.
 - g. Eight (8) chairs.
 - h. One (1) eight foot (8') folding leg table.
 - i. One (1) fire extinguisher.
 - j. Two (2) wastebaskets.
 - k. One (1) tackboard, 36 inches x 30 inches.

- l. Outside thermometers
 - m. Canon image class D420 Laser Multifunction Copier with reduction capability, “or equal”.
 - n. One (1) personal computer, with the following minimum requirements: Microsoft Windows 10, Microsoft Office 2016 Professional, Core 2 Duo Processor 2.0 GHz, 2 GB RAM, 100 GB Hard drive, CD/DVD- RW drive 48X, 17” monitor, Modem (phone or DSL) UPS, Inkjet printer, and maintenance agreement, set up and ready to use.
 - o. Telephone: One (1) direct line instrument with local access and one (1) answering machine separate from the Contractor’s phone number. Telephones supplied by the Contractor for the Engineer’s Field Office shall have speaker phone capability.
 - p. Three phone lines shall be provided, one, which serves the office phone, one, which shall serve the combination FAX/Copier, and one for computer / internet access.
 - q. Contractor shall substitute DSL or cable service for one of the above required phone lines if DSL or cable service is available.
 - r. Internet service with WIFI connection from Notice to proceed until Substantial Completion at no additional cost to the Owner.
3. The Owner’s field office shall be equipped with the following:
 - a. One (1) office type desk.
 - b. One (1) drafting board.
 - c. One (1) plan rack.
 - d. One (1) four-drawer fire resistant file cabinet.
 - e. Two (2) chairs.
 - f. One (1) fire extinguisher.

- g. One (1) telephone.
 - h. One (1) telephone answering machine.
 - 4. The field offices shall be heated during the cold weather and have sufficient window area to furnish natural light. The windows shall be constructed to open and close to allow ventilation. The offices shall be suitably air conditioned if used during summer months. Minimum office floor space shall be 600 square feet, minimum 12' wide. Private doors to each field office shall be keyed separately.
 - 5. Two portable toilets shall be supplied, one (1) for women and one (1) for men. These facilities will be off limits to the Contractor's personnel.
 - 6. The Contractor shall maintain the field office in good condition and appearance for the duration of the project. It shall be removed upon Final Acceptance and the site cleaned and left in a neat and acceptable manner.
 - 7. Services:
 - a. Lighting: 50 foot candles at desk top height.
 - b. Exterior lighting at entrance door.
 - c. Automatic heating and mechanical cooling equipment sufficient to maintain comfortable conditions.
 - d. Minimum of four 110 volt duplex electric convenience outlets, at least one on each wall.
 - e. Electric distribution panel: Two circuits minimum, 110-volt, 60 Hertz service.
 - f. Convenient access to drinking water (water cooler) and toilet facilities. Contractor shall furnish water cooler refills as required.
 - g. Telephone: Two (2) direct line instruments with local access and two (2) answering machines separate from the Owner's

phone number. Telephones supplied by the Contractor for the Engineer's Field Office shall have speaker phone capability.

- h. Fax: One fax machine. Provide a unit on a separate direct line.
- i. One 10-inch outdoor-type thermometer.
- j. One rain gauge

PART 2 – PRODUCTS – Not Used.

PART 3 – EXECUTION

3.01 PREPARATION

Fill and grade sites to accommodate field offices and provide adequate surface drainage.

3.02 INSTALLATION

- a. Set up mobile field offices on proper foundations, provide and complete connections for utility services.
- b. Secure portable or mobile buildings when used.
- c. Provide steps and landings at entrance doors.
- d. Provide high wind tie-downs.

3.03 MAINTENANCE AND CLEANING

Provide weekly maintenance and cleaning for all field contractor offices, furnishings, and equipment.

3.04 REMOVAL

- A. Remove temporary field offices, sheds, contents and stored materials in accordance with the construction and inspection periods.
- B. Remove foundations and debris; fine grade site to required elevations and clean the areas. Re-seed site if necessary.

END OF SECTION

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SECTION 01650

START-UP

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SECTION 01650

START-UP

PART 1 - GENERAL

1.01 DESCRIPTION

The work outlined in this section shall provide a procedure for the start-up of each of the three construction phases. It is the intent of this procedure to demonstrate that the work, or individual facility as applicable, is complete and ready for acceptance.

1.02 SUBMITTALS

- A. Shop Drawings shall be submitted for all items specified herein in accordance with Division 1.
- B. The Contractor shall submit for approval a detailed Schedule of Operational Circumstances as specified herein, for the WORK prior to 50% payment.
- C. The Schedule of Operational Circumstances and Certificate of Completed Demonstration shall be provided in the Operation and Maintenance Manual in accordance with Division 1.

1.03 DEFINITIONS

- A. WORK: the WORK includes everything that the Contractor and his Sub-Contractors has installed.
- B. Process: the Process is the complete system which includes all components that are required to operate under normal and emergency operation of the WORK.
- C. Initial Start-Up (Start-Up): During the start-up the Contractor shall test and make adjustments to the WORK to ensure that it is operating as intended prior to the Process Demonstration and Testing
- D. Process Demonstration and Testing (Demonstration): The Process Demonstration and Testing is to show that the WORK can operate properly over the intended range of Operational Circumstances for a specified amount of time without any failures.

1.04 DEMONSTRATION OF SYSTEMS

- A. Demonstrate the essential features of all systems as they apply to the WORK.
- B. Each system shall be demonstrated only after satisfactory completion of initial start-up.
- C. All manufacturer's certificates required in paragraph 1.11 in section 1300 shall be supplied before equipment is placed into on-line wastewater service.

1.05 DATE - TIME

Contractor shall schedule the Process Demonstration and Testing. The demonstration shall be held at a date and time to be agreed upon in writing by the OWNER or his representative.

1.06 ATTENDING PARTIES

The demonstration shall be held by the Contractor in the presence of the OWNER, and the manufacturer's representative (if applicable).

1.07 CERTIFICATE OF COMPLETED DEMONSTRATION

Submit five (5) copies of Certificate of Completed Demonstration memo signed by the Contractor, Subcontractor and OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PRELIMINARY MATTERS

- A. Prior to system start-up, successfully complete all testing required of the individual components of the WORK. Provide equipment manufacturers certification that their components have been properly installed and are ready for the start-up and Owners inspection.
- B. Demonstrate to the Engineer that all temporary jumpers and/or bypasses have been removed and that all of the components are operating under their controls as designated.
- C. Coordinate start up activities with the Owner's operating personnel and with the Engineer prior to commencing system start-up.

3.02 START UP

- A. Confirm that all equipment is properly energized, that the valves are set to their normal operating condition and that the flow path through the new work is unobstructed.
- B. Slowly fill each hydrostatic structure in the process flow stream with water.
- C. Initiate start up in accordance with the operation and maintenance manual.
- D. Observe the component operation and make adjustments as necessary to optimize the performance of the WORK.
- E. Coordinate with Owner for any adjustments desired or operational problems requiring debugging.
- F. Make adjustments as necessary.

3.03 PROCESS DEMONSTRATION AND TESTING

- A. After all WORK components have been constructed, field tested and started-up in accordance with the individual specifications and manufacturer requirements, perform the Process Demonstration and Testing in the presence of the Engineer and the Owner.
- B. The Process Testing will be conducted for seven consecutive days or as required to complete all equipment certificates. The WORK must operate during the testing period in the manner intended. If the WORK does not operate successfully, the problems will be corrected and the Process Test will start over from day one.
- C. During the Process Demonstration period, operate the WORK, instruct designated operating personnel in the function and operation of the WORK, and cause various operational circumstances to occur. As a minimum, these circumstances will include average and peak daily flows, random equipment failures, and overflows, surcharges and bypasses. The Contractor shall submit a detailed Schedule of Operational Circumstances. Coordination of the various contract schedules will be accomplished through the Engineer.
- D. All materials and chemicals required for the testing shall be provided by the Contractor. The Contractor shall replace the quantity of chemicals, fuel, etc used during the testing period.
- E. Acceptability of the WORK's performance will be based on the WORK performing as specified, under these actual and simulated operating

conditions. The intent of the Process Demonstration and Testing is for the Contractor to demonstrate to the Owner and the Engineer that the Work will function as a complete and operable system under normal as well as emergency operating conditions and is ready for acceptance.

3.04 SUBSTANTIAL COMPLETION

- A. Upon Successful completion of the start-up Demonstration and Testing, the Contractor may request a certificate of Substantial completion in accordance with the General Conditions for the segment of work involved. The Contractor shall be responsible for operating the facility under the conditions of the Land Treatment System (LTS) Permit using a certified operator from the beginning of the start-up, Demonstration and Testing Period until the certificate of Substantial completion is issued. Upon issue of the Certificate of Substantial completion, the Owner will take over the operation of the segment of work for which the certificate was issued, and the guarantee period will begin as of that date.

- B. All major components of the new facility (including the headworks, aeration lagoons, distribution boxes and yard piping, clarifiers, Pump & Blower Building and equipment herein, chlorine contact tank, intermediate pumping station (if awarded), irrigation pumping station, storage lagoon, chemical tank and feed systems, electrical power and control systems, potable and non-potable water systems, irrigation rigs, and irrigated fields) are to be placed into service at the same time. No major component of the new facility shall be placed into service until it has been properly installed and clear-water tested, until manufacturers installation certificates are received from all designated equipment, until specified manufacturer's training has taken place for all designated equipment, until final draft O&M manuals are received for all equipment, and until all control systems are fully operational and tested."

3.05 CERTIFICATE OF COMPLETED DEMONSTRATION

CERTIFICATE OF COMPLETED DEMONSTRATION MEMO

Note to Contractor: Do not submit this form at the time Operation and Maintenance Manual is submitted. Submit five copies of all information listed below for checking at least one week before scheduled completion of Work. After information has been approved and inserted in each brochure, give the Owner a demonstration of completed mechanical systems and have him sign five copies of this form. Provide one signed copy for each brochure. After this has been done, a written request for a final inspection of the system shall be made.

RE: _____

(Name of Project)

(Division Number and Name)

This memo is for the information of all concerned that the Owner has been given a Demonstration of Completed System on the work covered under this Division. This demonstration consisted of the system operation, a tour on which all major items of equipment were pointed out, and the following items were given to the Owner:

- (a) Owner's copy of Operation and Maintenance Manual containing approved submittals on all items, including the following: (To be inserted in the Operation and Maintenance Manual after the correct tab).
 - (1) Maintenance Information published by manufacturer on equipment items.
 - (2) Printed Warranties by manufacturers on equipment items.
 - (3) Performance verification information as recorded by the Contractor.
 - (4) Manufacturer's Certificate.
 - (5) Written operating instructions on any specialized items.
 - (6) Explanation of guarantees and warranties on the system.
 - (7) Approved shop drawings.
- (b) Prints showing actual "As-Built" conditions.
- (c) A demonstration of the System in Operation and of the maintenance procedures which will be required.

(Name of General Contractor)

By:

(Authorized Signature, Title & Date)

(Name of Subcontractor)

By:

(Authorized Signature, Title & Date)

Operations and Maintenance Manual, Instruction Prints, Demonstration and Instruction in
Operation Received:

(Name of Owner)

By: _____
(Authorized Signature, Title & Date)

xc: Owner, Engineer, Contractor, Subcontractor, and General Contractor

END OF SECTION 01650

SECTION 01740

WARRANTIES AND BONDS

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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01740

WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Compile specified warranties and bonds.
- B. Co-execute submittals when so specified.
- C. Review submittals to verify compliance with Contract Documents.
- D. Submit to the Engineer for review and transmittal to Owner.

1.02 SUBMITTAL REQUIREMENTS

- A. Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Number of original signed copies required: Two each.
- C. Table of Contents: Neatly typed, in orderly sequence. Provide complete information for each item.
 - 1. Product or work item.
 - 2. Firm, with name of principal, address and telephone number.
 - 3. Scope.
 - 4. Date of beginning of warranty, bond or service and maintenance contract.
 - 5. Duration of warranty, bond or service maintenance contract.
 - 6. Provide information for Owner's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances which might affect the validity of warranty or bond.
 - 7. Contractor and Subcontractors name, street address and telephone number of

responsible principal.

1.03 FORM OF SUBMITTALS

- A. Prepare in duplicate packets.
- B. Format:
 - 1. Size 8-1/2 inch x 11 inches, punch sheets for standard three post binder.
 - a. Fold larger sheets to fit into binders.
 - 2. Cover: Identify each packet with typed or printed title "WARRANTIES AND BONDS". List:
 - a. Title of Project
 - b. Name of Contractor
- C. Binders: Commercial quality, three post binder, with durable and cleanable plastic covers and maximum post width of two inches.

1.04 WARRANTY SUBMITTALS REQUIREMENTS

- A. For all major pieces of equipment, submit a warranty from the equipment manufacturer. The manufacturer's warranty period shall be concurrent with the Contractor's for one (1) year, unless otherwise specified, commencing at the time of the completion of the conditional acceptance period.
- B. The Contractor shall be responsible for obtaining certificates for equipment warranty for all major equipment specified under all Divisions and which have at least a 1 hp motor or which lists for more than \$1,000. The Engineer reserves the right to request warranties for equipment not classified as major. The Contractor shall still warrant equipment not considered to be "major" in the Contractor's one year warranty period even though certificates of warranty may not be required.
- C. In the event that the equipment manufacturer or supplier is unwilling to provide a one year warranty commencing at the time of the completion of the conditional acceptance period, the Contractor shall obtain from the manufacturer, a two (2) year warranty commencing at the time of equipment delivery to the job site. This two year warranty from the manufacturer shall not relieve the Contractor of the one year warranty starting at the time of the completion of the conditional acceptance period.
- D. All work shall be guaranteed for a period of one year as described in paragraph SC-

7.17 of specification section 00800. In addition, all work within Delaware Department of Transportation (DelDOT) and County Sub-division rights-of-way shall have a warranty period of three (3) years, commencing at the time the roads are accepted by DelDOT. The warranty shall be in the form of a Maintenance Bond which shall represent 15% of the installed pipeline costs (including final pavement restoration) for all pipelines installed within roadways within the rights of ways as described above for a three-year period.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 02050

DEMOLITION

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SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes requirements for demolition and removal of structures, equipment and utilities to the limits as indicated, in accordance with the Contract Documents.
- B. The demolition work is shown, but is not necessarily limited to noted items, on the Contract Drawings.
- C. Removal and protection of trees and shrubbery shall be as shown on the Contract Drawings and per the Technical Specifications.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Prior to execution of any demolition work, coordinate with the County and the appropriate utility companies.
 - 2. Provide warning signs, barricades and safety barriers required to protect personnel. Provide fire safety measures at all times in areas where burning torches are being used.
 - 3. Before demolition begins, disconnect all mechanical and electrical services affected by the work. Interconnecting piping and electrical services that are to remain in service either permanently or temporarily shall be capped, rerouted or reconnected in a manner that will not interfere with the operation of the existing facilities to remain and the demolition work.

1.03 SUBMITTALS

- A. Before the start of any demolition, submit the following in accordance with Section 01300 of these Technical Specifications.
 - 1. Demolition work schedule and coordination with other work in progress including disconnection schedule of utility services and sequence of operations.
 - 2. Method of demolition, removal of waste and removal of items to be salvaged including detailed description of methods and equipment.
 - 3. Submit inspection reports of existing structures, items to be salvaged and equipment that will remain after demolition in accordance with Section 01300 of these Technical Specifications.

1.04 SITE CONDITIONS

- A. Existing Conditions
 - 1. Coordinate disconnections and disruptions of utility services with requirements of utility company and the Engineer.
- B. Protection
 - 1. Provide scaffolding, protective coverings, temporary walks, shoring and bracing during demolition to protect personnel, structures and equipment.
 - 2. Provide adequate lighting at all times during demolition operations.
 - 3. Provide and maintain barriers of cloth, plastic or wood to prevent debris and dust associated with the demolition work from leaving the demolition area.
 - 4. Provide warning signs as required, for personnel and the public.

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

3.01 INSPECTION

Before demolition begins, the Contractor shall inspect existing structures, equipment and paving that will remain in-place within and adjacent to the demolition area for existing defects and damage. Record and notify the Engineer of defects and damage found during this inspection.

3.02 GENERAL

- A. Perform demolition so adjacent structures, equipment, paving and materials, which are to remain, shall not be damaged. If damage occurs, Contractor shall repair or replace the adjacent structures, equipment, paving and materials as directed by the Engineer. Existing utilities damaged by demolition shall be replaced with the same material and quality as the existing utilities.

3.03 DEMOLITION OPERATIONS

- A. Before the demolition operation begins, provide and have in-place all protective devices and dust covers.
- B. Disconnect and deactivate all mechanical and electrical connections before demolition begins.
- C. As required, wet down areas being demolished to control dust.
- D. Leave the work area at the end of each day broom clean. Remove waste, litter and debris from the work site and place in dumpster type containers.
- E. As required, confine demolition apparatus, equipment and operations of workers to areas that will not interfere with continued use and operation of the facility.
- F. As required for partially dismantled structures, provide protection from inclement weather for materials, equipment and personnel.

3.04 CLEANUP

- A. Provide dumpster type containers located in convenient locations approved by the Engineer for offsite removal of waste, litter and debris. Empty containers offsite as soon as they are full or at regular intervals of at least once a week. Keep area around containers clean. During filling and emptying of containers, spillage shall be immediately picked up and area cleaned.

- B. After demolition is complete, remove protective devices and dust covers. Remove dust created from demolition operation that may have passed dust covers.

3.05 FIELD QUALITY CONTROL

- A. Engineer will visually inspect demolition and adjacent areas for completeness of demolition, damage that may have resulted from the demolition operation and for completeness of clean-up.
- B. New construction shall not begin until the inspection by the Engineer is completed and accepted.

END OF SECTION

SECTION 02200

**EARTHWORK, EXCAVATION, TRENCHING
AND BACKFILLING**

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SECTION 02200

EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING

PART 1 – GENERAL

1.01 DESCRIPTION

- A. The Contractor shall provide all labor, materials, equipment and services necessary for, and incidental to, preparing the site, excavating, trenching, excavation support and dewatering systems, drainage, pumping, proofrolling, backfilling, compacting, grading, paving, topsoiling, seeding, mulching and protection of the work as shown on the Drawings, as herein specified, and in accordance with the STANDARD SPECIFICATIONS.
- B. The Contractor shall accept the site in the condition in which it exists at the time of the award of the Contract.
- C. All materials excavated shall be unclassified. The Engineer will determine whether materials that are to be used in the work are suitable or unsuitable after reviewing the test results, as required in Paragraph 1.04 MONITORING AND TESTING. All excess or unsuitable materials excavated shall be removed from the site by the Contractor and disposed of at a permitted off-site disposal location of its own choosing, at no additional expense to the County.

1.02 RELATED WORK INCLUDED ELSEWHERE:

Section 01130 MEASUREMENT AND PAYMENT
Section 01300 SUBMITTALS
Section 02930 FINE GRADING, SEEDING AND LANDSCAPING

1.03 QUALITY ASSURANCE

- A. Standard Specifications and Details

Reference in this Section to STANDARD SPECIFICATIONS or STANDARD DETAILS shall mean the following, and are hereby made part of this specification:

Delaware Department of Transportation (DelDOT), "Standard Specifications, Specifications for Road and Bridge Construction", dated August 2016, with the latest incorporated revisions.

In case of conflict between the STANDARD SPECIFICATIONS or STANDARD DETAILS and this contract specification, this contract specification shall govern.

B. Codes and Standards

The following Standards in effect on the date bids are received form a part of this Specification to the extent indicated by the following references:

American Association of State Highway and Transportation Officials (AASHTO):

M 6	Fine Aggregate for Portland Cement Concrete
M 43	Standard Sizes of Coarse Aggregate for Highway Construction
M 145	Classification of Soils and Soil-Aggregate Mixtures
T 88	Particle Size Analysis of Soils
T 89	Determining the Liquid Limit of Soils
T 90	Determining the Plastic Limit and Plasticity Index of Soils
T 119	Slump of Portland Cement Concrete
T 180	Moisture-Density Relations of Soils Using a 10-lb. Ram and 18-inch Drop
T 191	Density of Soil In-Place by the Sand-Cone Method
T 206	Penetration Test and Split-Barrel Sampling of Soils
T 238	Density of Soils and Soil-Aggregate In-Place by Nuclear Methods
T 239	Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods
T 265	Laboratory Determination of Moisture Contents of Soils

American Society for Testing and Materials (ASTM):

D421-85(98)	Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
D422-63(98)	Standard Test Method for Particle-Size Analysis of Soils
D1557-00	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³ (2,700 kN-m/m ³))
D2216-98	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
D2487-00	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2922-01	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D3740-01	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4318-00	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
E329-00b	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
E548-94e1	Standard Guide for General Criteria Used for Evaluating Laboratory Competence

All work shall comply with Occupational Safety and Health Regulations for Construction of the Code of Federal Regulations.

1.04 MONITORING AND TESTING

A. Monitoring

The Contractor shall perform excavation, subgrade preparation, and construction of fills and backfills under the direct monitoring and approval of the Engineer. The Contractor shall allow safe access for the Engineer to all parts of the project at all times.

B. Testing

The Contractor shall be responsible for all testing of soils, including field sampling, laboratory testing, and inspection and field testing. The Contractor shall employ the services of an independent, professional testing consultant to perform the work. Inspections and test results shall be certified by the testing consultant's licensed professional engineer, stating that the tests and observations were performed by the consultant and that the results are representative of the materials or conditions being certified by the tests, and that the results are in conformance with these Specifications. All eligible costs for soils inspection and testing will be paid for as a contingent item in accordance with specification Section 01130.

C. Testing Facilities

The testing consultant shall provide the services of an approved commercial testing laboratory. Approval of testing facilities shall be based on requirements described in ASTM D 3740 and ASTM E 329.

D. Laboratory Testing

Test reports or material certifications shall be submitted to the Engineer prior to use of any material in the work. Any change in the source or change in the character of the material shall require the Contractor to retest and resubmit for approval. Material certifications and laboratory test reports shall include the following:

1. Source of Material
2. Particle Size Analysis (AASHTO T88)
3. Modified Proctor (AASHTO T180)
4. Natural Moisture (AASHTO T265)
5. Atterberg Limits (AASHTO T89 and T90)

E. In-Place Field Compaction Testing

1. Nuclear gauge calibration checks of both density and moisture shall be performed by the Contractor's consultant at the beginning of the project, and at intervals as directed by the Engineer. The calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922 paragraph "Adjusting Calibration Curve". Copies of calibration curves and results of calibration tests shall be furnished to the Engineer within 24 hours of the conclusion of tests.
2. The Contractor's consultant shall perform inspection and in-place field compaction tests of the density and moisture content of fill and backfill as directed by the Engineer. Copies of test results shall be furnished to the Engineer within 24 hours of the conclusion of tests.
3. The Engineer or Engineer's qualified testing consultant may perform and pay for additional tests to check the Contractor's work. The Contractor shall provide a smooth surface at any point requested by the Engineer on which to perform the compaction test.
4. Tests performed by the Contractor's consultant shall be in randomly selected locations and in sufficient numbers to ensure that the specified density is being obtained. The following number of field density tests shall be as specified by the Engineer, but in general will be as follows, subject to adjustment by the Engineer.
 - a. Fills: One test per lift per 10,000 square feet or fraction thereof.
 - b. Backfill Against Structures: One test per lift per 100 linear feet.
 - c. Trench Bedding and Backfill: One test per 100-300 linear feet.

5. If the compaction test results do not meet those specified, the material shall be removed, replaced, recompact, and retested to meet the specification requirements.

1.05 JOB CONDITIONS

A. Subsurface Investigations

1. If subsurface test borings have been made specifically for this project, Driller's boring logs are included in the Appendix. Driller's boring logs have been included for informational purposes to the Contractor. The Contractor shall be responsible for making any interpretations or conclusions drawn from the information contained therein. Neither the Engineer nor the County will be responsible for the conclusions drawn by the Contractor from the information presented or implied.
2. The Contractor shall be responsible for reading the Driller's boring logs, and shall become familiar with the site and the subsurface conditions. Ignorance of conditions will not be accepted as a basis of claim for additional compensation. The County does not warrant or guarantee that the conditions actually encountered in the prosecution of the work under this contract will be the same as the conditions indicated by the Driller's boring logs. No additional compensation will be allowed the Contractor because of subsurface conditions actually encountered in the work.
3. The Contractor shall determine to its own satisfaction the ground water conditions and character and type of soil, decomposed rock, rock and other material to be encountered in the work to be done under this Contract.
4. If the Bidder determines, after visiting the site and reading the Driller's boring logs and laboratory test results, that the data is not sufficient for bid preparation, the bidder may make its own investigation and tests, at a time acceptable to the County and as specified elsewhere. All government and private approvals and/or permits shall be obtained in writing by the Contractor prior to performing any investigations or tests.

B. Existing Utilities

1. The existing utilities shown on the Drawings are from available records and field surveys. The Contractor shall verify all information to its own satisfaction, and shall notify the Engineer of any impact to the work. The Contractor shall test pit existing

utilities that impact construction, at no additional expense to the County. These test pits shall be performed two weeks in advance of excavation and are considered to be part of the lump sum or unit price bid items.

2. Should uncharted piping or other utilities be encountered during excavation, the Contractor shall notify the Engineer and the utility owner immediately. The Contractor shall cooperate with the Engineer and the utility owners in keeping services and facilities in operation.
3. Utilities designated to remain in place or which serve adjacent structures are to be protected and maintained at all times during construction. Active utility lines damaged in the course of construction operations shall be repaired or replaced immediately at no cost to the County, the Engineer, or utility owner.
4. The Contractor shall demolish and completely remove from the site existing underground utilities that are designated to be removed. Where existing utilities interfere with placement of the work, the Contractor shall relocate utilities as a part of the work, as directed by the Engineer.

1.06 DEWATERING, DRAINAGE AND PUMPING

- A. The Contractor shall provide and continuously operate and maintain all temporary dewatering, drainage and pumping systems required to satisfactorily perform all work under the Contract. Water shall be controlled to such an extent as may be necessary to keep excavations free from water during construction and to maintain a minimum of 12 inches below the bottom of pipes and structures. The Contractor will not necessarily be permitted to use any particular type of dewatering system it selects. The Contractor shall be entirely responsible for the design and adequacy of the dewatering system.
- B. Should soil, ground water or local conditions require dewatering systems other than ditches, sumps, and pumps, such systems shall be provided, operated and maintained by the Contractor at no additional expense to the County.
- C. The Contractor shall exercise every precaution to prevent flotation of any of the work constructed under this Contract, and the Contractor shall be responsible for all damage due to flotation.
- D. Such grading shall be done as necessary to prevent surface water from flowing into trenches or other utility excavations, and any water

accumulating therein shall be continuously removed and properly filtered to remove sediment.

- E. The method of water disposal shall be in compliance with erosion and sediment control regulations and all other regulatory agencies.
- F. Methods of dewatering excavations shall be at the Contractor's discretion. Continuous investigations and checks shall be made by the Contractor to assure that the dewatering system employed is functioning properly, not causing damage or settlement to adjacent surfaces or structures. Temporary pipes or flumes shall be used to carry surface water across open and/or unstabilized construction areas. The system shall be modified as required and repairs for damage caused by the system shall be the responsibility of the Contractor.
- G. Should the Contractor's dewatering operations affect any existing private water supply well or spring used as a potable water source, the Contractor shall, at no additional cost to the County, take whatever steps are necessary to provide uninterrupted water service, including the installation of temporary water lines or the installation of permanent wells with treatment systems, if required. Bottled water shall be provided immediately to residents whose private wells are damaged during construction.

1.07 TEMPORARY EXCAVATION SUPPORT SYSTEMS

- A. The Contractor shall temporarily support the sides and ends of all excavations, where necessary, with braces, sheeting, shoring, stringers or other methods of the type, size and quality required. The Contractor will not necessarily be permitted to use any particular type of excavation support system it selects. The Contractor shall be entirely responsible for the design and adequacy of the excavation support system. There will be no extra compensation to the Contractor for use of the required temporary excavation support systems.
- B. Unless otherwise specified on the Drawings or directed by the Engineer, temporary excavation support systems shall be removed as refilling proceeds, in a manner so as not to damage any structures, roadbed, fill or private property.
- C. Where specified on the Drawings, excavation support systems, to be left in-place after backfill has been completed, shall be cut off 2 feet below finished grade. Payment for excavation support systems specified on the Drawings to be left in-place is included in the lump sum price bid in the Proposal.

- D. Pile driving hammers or vibratory hammers shall only be used to drive or extract temporary excavation support systems when approved in writing by the Engineer. However, the Contractor shall be responsible for any damage caused by its operations involving vibrations.

1.08 RESPONSIBILITY FOR CONDITION OF EXCAVATIONS

- A. The Contractor shall be entirely responsible for the condition of all excavations performed by the Contractor, for the entire period of the Contract. All slides, caves or other unacceptable conditions shall be promptly corrected whenever they occur, without extra compensation.
- B. The neglect, failure or refusal of the Engineer to order or approve any excavation support system shall not in any way or to any extent relieve the Contractor of any responsibility concerning the conditions of excavations or of any of its obligations under the Contract; nor shall any delay whether caused by an action or want of action on the part of the Contractor or by any action or want of action of the County or its agents or employees, or the Engineer, resulting in the keeping of an excavation open longer than would otherwise have been necessary, relieve the Contractor from the necessity of properly and adequately protecting the excavation from caving or slipping, nor from any of its obligations under the Contract relating to injury of persons or property nor entitle it to any claim for extra compensation.

1.09 PROTECTION OF PROPERTY, STRUCTURES AND UTILITIES

- A. The Contractor shall, at its own risk and at no additional expense to the County, maintain, support-in-place, and protect all pipes, poles, cables, utilities, walls, buildings, roads, and other structures or property in the vicinity of its work, whether above or below ground, or that may appear in the excavation. The Contractor shall at all times have available on site sufficient quantity of timber, planks, beams, chains, ropes, etc., and shall use them as necessary for supporting any structures and utilities that are uncovered, undermined, endangered, threatened or weakened. The Contractor shall be responsible for all damage, shall take all risks, and shall assume all expense for injury or damage, to any person or property of every kind and description, caused directly or indirectly by the Contractor's work, whether such structures or utilities are or are not shown on the Drawings.
- B. In the event that the Contractor damages any existing utility line, report thereof shall be made immediately to the Engineer.

1.10 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01300 - Submittals.

- A. Sources of borrow, aggregate, porous fill, and furnished topsoil shall be submitted to the Engineer for approval.
- B. Gradation curves for all borrow, aggregate, porous fill, and furnished topsoil to be used shall be submitted to the Engineer for approval.
- C. Modified Proctor (AASHTO T180), Natural Moisture Content (AASHTO T265), and Atterberg Limits (AASHTO T89 and T90), Particle Size Analysis, test results for all proposed on-site material, borrow and aggregate shall be submitted to the Engineer for approval.
- D. Delivery tickets shall be submitted by the Contractor for each load of borrow, aggregate, porous fill, and furnished topsoil material brought to the site under the authorization of the Engineer showing the following information:
 - 1. Name and location of supplier or source.
 - 2. Type and amount of material delivered by volume and weight.
 - 3. Test information on the material as required by this Specification.
- E. Manufacturer's product catalog data for filter fabric to be furnished, shall be submitted to the Engineer for approval, showing compliance with the specification requirements of PART 2 - PRODUCTS.
- F. Excavation Support Systems and Dewatering Systems
 - 1. For all excavations requiring excavation support systems and dewatering systems, the Contractor shall submit working drawings and calculations for the design of the systems. The working drawings and calculations shall be performed by an engineer and a licensed well driller obtained and paid for by the Contractor. The Contractor's engineer shall be a professional engineer and to practice in the State of Delaware and shall sign and seal all excavation support drawings and calculations. All dewatering systems shall be signed by a licensed Delaware well driller. Signed and sealed Drawings or calculations submitted will be for information only.
 - 2. The working drawings and calculations for the dewatering systems shall include the following information:

- a. Planned method of dewatering.
 - b. Excavation plan.
 - c. Location of the water table before and during dewatering.
 - d. Location and capacity of such facilities as dewatering wells, well points, sumps, collection and discharge lines, proposed standby unit, and protective fills and ditches required for control of ground water and surface water.
3. The Contractor shall obtain and submit copies of all permits that may be required for installation of well points and dewatering wells.
 4. The Contractor shall be responsible for determining the existing subsurface conditions for the excavation support systems and dewatering systems. The County does not guarantee or warrant the conditions actually encountered on this project. The County will not be held responsible for the basis of claims by the Contractor or any other parties in the execution of these systems. The Contractor's submittals of the excavation support systems and dewatering systems, prepared by the Contractor's engineer, are for information purposes only.

PART 2 – PRODUCTS

2.01 FILL AND BACKFILL MATERIAL

- A. All fill and backfill material for trenches shall meet DelDOT requirements in accordance with the STANDARD SPECIFICATIONS. All fill and backfill material in private rights of ways, shall generally meet DelDOT standards. However, at the County's discretion material requirements may be modified from the STANDARD SPECIFICATIONS, while still providing an adequate, firm subgrade with material within moisture and density requirements as determined by the Engineer. All embankment fill material placed for support of structures shall consist of AASHTO soil classification type A-2-4 or better. In addition, all materials installed shall meet the following additional criteria.
- B. Fill and backfill material shall be suitable material from on-site excavations or from other sources. The material shall be clean earth. The material shall be free from vegetable matter, organic material, sludge, grit, trash, muck, roots, logs, stumps, frozen material or other deleterious substances. Rubber, ashes, cinders and other miscellaneous inorganic fill substances removed from required excavations within the project and which in the judgment of the Engineer will decompose, consolidate further, or shrink appreciably within the fill may not be incorporated in the fill. Rubble and construction debris shall not be used in the work.

- C. Except as otherwise specified or approved, the material shall not contain rocks or lumps larger than 4 inches in greatest dimension. No rocks or lumps larger than 2 inches in greatest dimension will be permitted within 12 inches of subgrade, or within 12 inches of pipes in all directions, or within 24 inches of any structure during backfill. The material shall not contain mica in quantities that, in the judgment of the Engineer, are sufficient to affect compaction characteristics. Materials having a maximum dry density of less than 100 pounds per cubic foot (AASHTO T180), and materials having a plasticity index (AASHTO T90) greater than 30, shall not be used unless specifically approved in writing by the Engineer.
- D. Suitable material is any material meeting the quality requirements specified above, for the particular location and application specified, which is not frozen and which has a moisture content at the time it is placed that enables the material to be compacted to the density specified. Unsuitable material is any material not meeting all the requirements for suitable material.

2.02 BORROW MATERIAL

Borrow material, from off-site sources, shall meet the following requirements and shall be used only where specified on the Drawings or as required by the Engineer, and shall be furnished from a specific source or sources approved in writing by the Engineer:

DelDOT Borrow Type "B" (Special Fill)
DelDOT Borrow Type "C" (Backfill)

2.03 DENSE GRADED AGGREGATE (DGA) MATERIAL

Dense Graded Aggregate material shall meet the following requirements and shall be used only where specified on the Drawings or as required by the Engineer, and shall be furnished from a specific source or sources approved in writing by the Engineer:

DelDOT Graded Aggregate Type "B" (Crusher Run)

2.04 OPEN GRADED COURSE AGGREGATE (OGCA) MATERIAL

Open Graded Course Aggregate (OGCA) Material shall meet the following requirements and shall be used only where specified on the Drawings or as required by the Engineer, and shall be furnished from a specific source or sources approved in writing by the Engineer:

DelDOT Coarse Aggregate SP-57 (No. 57 Stone) (AASHTO M43)

2.05 TOPSOIL

Topsoil shall meet the requirements of Paragraph 3.11 TOPSOIL, SEEDING, AND MULCHING.

2.06 GEOTEXTILE

Geotextile shall be used only where specified on the Drawings or as required by the Engineer, and shall meet the following requirements:

- A. Geotextile shall be a nonwoven fabric consisting of continuous filaments of polyester or polypropylene formed into a stable network by needle punching. It shall be inert to commonly encountered chemicals and hydrocarbons, mildew and rot resistant, and insect and rodent resistant. The fabric shall have a mass per unit area of at least 12 ounces per square yard as determined by ASTM D5261.
- B. The geotextile shall provide a permeable layer or media, while retaining the soil matrix. It shall be provided in rolls wrapped with protective covering to protect the fabric from mud, dirt, and debris.

PART 3 - EXECUTION

3.01 SITE PREPARATION

All rubble, trash, unusable and unsuitable material, pavements, concrete structures, piping, sludge, grit, etc. within areas required to be filled, excavated or graded, except as otherwise specified or shown, shall be fully removed from the site and disposed of by the Contractor, at no additional expense to the County. Such material may exist on the site. The Contractor shall obtain and pay for all necessary permits related to this disposal.

3.02 CLEARING AND GRUBBING

- A. All trees, stumps, roots, brush, etc., within the areas required to be filled, excavated or graded, shall be fully removed. Trees outside of the immediate area of construction shall be protected from damage.
- B. All materials resulting from the clearing and grubbing operation shall be disposed of by the Contractor off the site, at its expense. The Contractor shall obtain and pay for all necessary permits related to this disposal.

3.03 ROCK EXCAVATION

Blasting is prohibited on this project.

3.04 EXCAVATION AND SUBGRADE PREPARATION

- A. Excavation for grading, pavements, walls, piers, slabs, footings, structures, trenches, utility systems and their appurtenances shall be unclassified and shall consist of the excavation of whatever material is encountered to the lines, grades, and sections shown on the Drawings and specified, including such excavation as is necessary for all ditches, curbs and other features. No additional compensation will be made for Rock Excavation. Payment for excavation is included in the lump sum bid item in accordance with Section 01130 - MEASUREMENT AND PAYMENT of this Specification.
- B. Suitable material removed from the excavation shall be reused in the grading, filling, backfilling and preparation of subgrade for pavements, structures, and trenches and at such other places as directed, to the extent required to complete the work. The Contractor shall properly store or stockpile and protect in approved manner, all materials that are to be reused in the work. If on-site excavated material is determined to be unsuitable due to inadequate or excessive moisture content, such material shall be made suitable by the Contractor prior to placing and compacting the material as fill and backfill by bringing the moisture content into acceptable ranges by either aerating the material if it is too wet or spraying the material if it is too dry. The material shall be thoroughly mixed before compaction for uniform distribution of moisture content.

The Contractor shall replace, at his own expense, material that was suitable when excavated, which has subsequently become unsuitable because of careless, neglectful, wasteful or unprotected storage. All unsuitable or excess material removed from the excavation shall be removed from the site and disposed of by the Contractor, at no additional expense to the County, except where disposal on the site is specifically provided for and approved in writing by the Engineer.

- C. During construction, the grading operations shall be performed in such a manner that the excavations shall be well drained at all times. Sufficient grading shall be performed during the progress of the work so that no water, at any time, is allowed to flow towards the walls of the structures or trenches. The entire site shall be well drained and free from water pockets. When necessary, sumps shall be provided and pumped continuously. The Contractor shall maintain and keep all ditches open and free from soil and debris while in service or until final acceptance of the work, and all grading shall be done on neat, regular lines. All work shall be done in proper sequence with all other associated operations. Before any slab or surfacing is placed, all utilities to be covered shall be installed

and all drainage facilities shall be installed which are required to permit free and uninterrupted flow of the surface and ground water from the site or to pumping sumps, etc.

- D. Preparation of the surface: Before depositing fill material, the surface of the ground shall be cleared of all refuse, rubble, and other debris. All organic matter, mud, muck, sludge and unsuitable soils shall be removed from the surfaces upon which fills are to be placed and the surface shall be leveled. Openings, animal burrows, stump holes, old pipes and other holes and depressions shall be eliminated, filled or cleaned as required.
- E. Where fills are made on hillsides or slopes, the slope of the original ground upon which the fill is to be placed shall be plowed or scarified deeply or where the slope ratio of the original ground or rock surface is steeper than five horizontal to one vertical, the ground or rock shall be stepped or benched.
- F. All areas where controlled fill is placed shall then be proofrolled with a minimum of 3 slow passes of a large, smooth drum, vibratory roller capable of exerting a dynamic force of 4500 lbs/LF resulting in a net minimum dynamic force of 20,000 lbs (10 tons) or greater. In addition, all areas under roadways shall be proofrolled to densify the areas and to locate soft areas. Soft areas shall be removed, under direction of the Engineer, and replaced with controlled, compacted fill as hereinafter specified.
- G. Where, in the opinion of the Engineer, unsuitable subgrade conditions are encountered under foundations, slabs, footings, pavements, structures, or utilities, a determination will first be made by the Engineer whether the condition is due to the in-situ condition, or is caused by the Contractor's construction methods.
 - 1. Unsuitable foundation materials, which in the judgment of the Engineer are due to in-situ conditions, shall be excavated when ordered in writing by the Engineer, to the extent directed by the Engineer. All unsuitable material shall be removed to a firm bottom below subgrade elevations. The excavation below subgrade shall be refilled using suitable material as defined in PART 2 - PRODUCTS, and compacted in accordance with Paragraph 3.05 - COMPACTED FILLS AND BACKFILLS. Under these conditions, payment for excavation below subgrade and backfill will be made in accordance with the applicable contingent unit price item(s) of Section 01130 - MEASUREMENT AND PAYMENT of this Specification.

2. Unsuitable foundation conditions or areas disturbed or rendered unstable, which in the judgment of the Engineer are caused by the Contractor's construction methods or equipment, shall be corrected by the Contractor to the satisfaction of the Engineer, at no additional expense to the County. These corrections shall include the necessary excavations and backfills.
 3. Overexcavation: Where excavations are made to a depth below the subgrade elevations shown on the Drawings or specified, without authorization, the excess excavation shall be filled, at no additional expense to the County to the required level as described above.
- H. Subgrade for all foundations, slabs, footings, pavements, structures, and utility excavations, shall be firm, undisturbed earth or rock except where drainage courses or compacted fills are specified or are required in areas where unsuitable material has been removed. All disturbed and undisturbed subgrade areas shall be proofrolled in accordance with these specifications prior to final installation of all foundations, slabs, footings, pavements, roadways, and structures.
- I. Whenever a condition is encountered where subgrade is at the bottom of a structure and subgrade is part rock and part soil, the rock shall be removed to a depth of 6 inches below subgrade and replaced with suitable material as directed by the Engineer and as defined in PART 2 - PRODUCTS, and compacted in accordance with Paragraph 3.05 - COMPACTED FILLS AND BACKFILLS.
- J. Subgrade Definitions
1. Subgrade for structures shall be as defined in Paragraph 3.06 - FILLS AND BACKFILLS FOR STRUCTURES.
 2. Subgrade for trenches shall be as defined in Paragraph 3.07 - TRENCH EXCAVATION.
 3. Subgrade for areas to receive topsoil shall be as defined in Paragraph 3.11 - TOPSOIL, SEEDING AND MULCHING.
 4. Subgrade for pavement shall be defined as the bottom of the pavement cross section as shown on the Drawings.

3.05 COMPACTED FILLS AND BACKFILLS

- A. Prior to placing any fill or backfill, notice shall be given the Engineer so that the work may be inspected, and filling or backfilling shall not proceed without the Engineer's approval.

B. Placing, spreading and compacting suitable material for fills and backfills:

1. Fill and backfill material shall be placed in approximately horizontal layers that, before compaction, shall not exceed 8 inches in thickness. Fill and backfill material within 5 feet of structures shall be placed in approximately horizontal layers that, before compaction, shall not exceed 6 inches in thickness. Each layer shall be spread uniformly and evenly. All rocks shall be distributed throughout the earth materials and all voids shall be carefully filled and the material properly compacted by rolling, tamping, vibratory compactors, or other methods specified herein and approved by the Engineer. Compaction by heavy rollers or other heavy equipment is prohibited within 5 feet of any structure.
2. Moisture content and compaction requirements of the fill material shall be in accordance with the STANDARD SPECIFICATIONS, except that compaction to 95-percent or more of the maximum dry density as determined by AASHTO T 180 shall be required.

Cohesionless soils are defined as granular soils containing less than 15% by weight passing the No. 200 sieve. Optimum moisture content and maximum dry density shall be determined in accordance with the STANDARD SPECIFICATIONS. Weaving or creeping of the soil beneath the roller shall be sufficient evidence that the moisture content of the fill or subsoils is excessive, and that required compaction has not been achieved.

3. The fill or backfill shall be constructed in such a manner that the surface will be sloped to drain at all times and shall be sealed by rolling at the completion of each day or prior to rain. No fill or backfill shall be placed, spread or rolled while it is frozen or thawing or be placed upon frozen or thawing ground or during unfavorable weather conditions. Any compacted layer that has been previously frozen shall be reworked or removed before the next layer is placed. Materials containing free water or having a moisture content higher than specified shall not be deposited upon the fill or backfill until after they have been dried to the specified moisture content.

3.06 FILLS AND BACKFILLS FOR STRUCTURES

- A. Subgrade for structures is defined as 6 inches below the underside of the slab, unless otherwise noted on the Drawings.

- B. Bedding for structures shall be 6 inches of porous fill No. 57 Aggregate, as defined in PART 2 - PRODUCTS, unless otherwise noted on the Drawings.
- C. After completing the construction of structure foundations, footings, walls, etc., below finished grade, all forms shall be removed and the excavation cleaned of all trash and debris. The excavation shall not be used for the disposal of refuse. Any refuse or other foreign materials shall be removed before backfilling. Prior to placing any backfill, notice shall be given the Engineer so that the work may be inspected, and backfilling shall not proceed without its approval. No backfill shall be placed against any structure until 7 days after the concrete has reached its design strength or is sufficiently braced, and all forming materials have been removed.
- D. The fill or backfill shall consist of AASHTO soil classification type A-2-4 or better and may include suitable on-site material originating on the job as defined in PART 2 - PRODUCTS, unless otherwise noted. Payment for backfill of structures, using contingent items, shall be measured as the actual in-place volume of material not exceeding vertical planes 18 inches outside of the structure. Compaction shall be in accordance with Paragraph 3.05 - COMPACTED FILLS AND BACKFILLS.

3.07 TRENCH EXCAVATION

- A. Subgrade for trenches is defined as the bottom of the granular bedding material, as shown on the Drawings, and as described in Paragraph 3.08 - TRENCH BACKFILL.
- B. Trenches shall be excavated to the necessary widths, depths, and clearances as may be shown on the Drawings. The maximum width between each face of trench and external surface of barrel of pipe or hubs, however, shall not be greater than indicated on the Drawings. The sides of the trenches from trench subgrade to an elevation 12 inches above the crown of the pipe shall be practically plumb and under no circumstances will they be permitted to be sloped.
- C. If contingent unit price items are used, payment for trench backfill shall be measured as the actual in-place volume of material as approved by the Engineer, but in no instance greater than the maximum width for payment, as shown on the Drawings, for the full depth of the trench. Payment shall be in accordance with Paragraph 3.10 CONTINGENT BORROW AND AGGREGATE.
- D. No trench length greater than 75 feet at any location shall be left open in advance of the complete pipe placed therein. The Engineer shall be empowered, at any time, to require the backfilling of open trenches over

completed pipelines or structures if, in its judgment, such action is necessary. The Contractor shall have no claim for extra compensation even though to accomplish this backfilling it is compelled temporarily to stop excavation or other work at any place. If work is stopped on any trench for any reasons except by order of the Engineer, and the excavation is left open for an unreasonable length of time in advance of construction, the Contractor shall, if so directed, backfill such trench at no additional expense to the County, and shall not again open this trench until it is ready to complete the construction therein. If the Contractor shall refuse or fail to backfill such trench completely within 48 hours after said notice, the Engineer shall be authorized to have the work done and the County shall charge the expense thereof to the Contractor and retain the same out of any moneys due or to become due it under the Contract.

- E. In roadway areas, length of open trench shall be limited to only that length sufficient to advance the trench box or sheeting ahead of the pipe construction operation and to provide a minimum safe working distance between the backfilling operation and the pipe construction operation. No trenches are to be left open at night or weekends. Trenches shall be backfilled or plated in such a manner as to not impede pedestrians or vehicles.

3.08 TRENCH BACKFILL

- A. During backfilling, great care shall be taken not to disturb the pipes by dropping or throwing anything on them from the bank above, or by walking on top or alongside of them.
- B. If a soft or unstable trench subgrade is encountered in the opinion of the Engineer, remove the unsuitable material to a firm bottom, and replace up to trench subgrade using suitable material compacted as a controlled fill, as described elsewhere, or remove the unsuitable material to the extent directed by the Engineer and replace up to trench subgrade using compacted on-site material excavated from the trench or borrow material, either material meeting the requirements of DeIDOT Borrow Type "B" (Special Fill), or DeIDOT Coarse Aggregate SP-57 stone as defined in PART 2- PRODUCTS. Payment will be in accordance with the contingent unit price item(s) included in Section 01130 MEASUREMENT AND PAYMENT of this Specification.
- C. Pipe bedding depth shall be as indicated on the Drawing details. Pipe bedding material shall be on-site material excavated from the trench or borrow material, either material meeting the requirements of DeIDOT Borrow Type "C" (Special Fill), or DeIDOT Coarse Aggregate SP-57 stone, as defined in PART 2- PRODUCTS, and as indicated on the Drawing details for each trench condition.

The bedding material shall be thoroughly compacted by approved hand-operated mechanical tampers or approved compaction equipment before laying the pipe to provide a uniform and continuous bearing and support for the pipe. Bell holes shall be excavated in the bottom wherever necessary to permit the proper making of joints.

- D. Initial backfill, from the top of the pipe bedding to one foot above the crown of the pipe, shall be placed in 6-inch layers and compacted by approved hand-operated mechanical tampers or approved compaction equipment, in accordance with Paragraph 3.05 - COMPACTED FILLS AND BACKFILLS.

Initial backfill material shall meet the material requirements, as defined in paragraph 2.01A in PART 2 – PRODUCTS, and as indicated on the Drawing details for each trench condition.

- E. Final backfill shall be from one foot above the crown of the pipe to finish subgrade, as defined in Paragraph 3.04 - EXCAVATION AND SUBGRADE PREPARATION. No rock or lump greater than 6 inches in greatest dimension shall be used for final trench backfill.

Final backfill, for this project, shall be placed in 6-inch layers and compacted in accordance with Paragraph 3.05 - COMPACTED FILLS AND BACKFILLS, using full trench compaction. Final backfill material shall meet the material requirements, as defined in paragraph 2.01A in PART 2 – PRODUCTS, and as indicated on the Drawing details for each trench condition.

3.09 CHANGE OF TRENCH LOCATION

In case the Engineer shall direct that the location of a trench be changed from that shown on the Drawings on account of the presence of an obstruction or from other cause, or if changed location shall be authorized upon the Contractor's request, the Contractor shall not be entitled to extra compensation or to a claim for damage provided that the change is made before the excavation is begun.

3.10 CONTINGENT BORROW AND AGGREGATE

- A. If the Engineer determines that sufficient suitable, on-site, fill or backfill material is not available from the required excavations to perform the work as specified on the Drawings or in the STANDARD SPECIFICATIONS, borrow material, as defined in PART 2 - PRODUCTS, shall be furnished by the Contractor from approved off-site sources. Payment will be in accordance with the contingent unit price item

of Section 01130 MEASUREMENT AND PAYMENT of this Specification.

- B. No approvals for Contingent Borrow Material will be granted until all suitable and properly dewatered materials removed from the excavations throughout the project site have been used in the required grading, backfilling, and preparation of sub-grades for pavements, structures, trenches, and at such other required places, as directed, and as to the extent required to complete all Contract work. If on-site excavated material is determined to be unsuitable due to inadequate or excessive moisture content, the material shall be made suitable as specified in section 3.04 EXCAVATION AND SUBGRADE PREPARATION. Contingent borrow and aggregate will not be paid for such material.
- C. The Engineer may direct the use of any additional quantity of borrow and/or aggregate, as specified in PART 2 - PRODUCTS, to be used below subgrade or at locations other than as specified on the Drawings. Payment will be in accordance with the contingent unit price item(s) of Section 01130 - MEASUREMENT AND PAYMENT of this Specification.
- D. Placement and compaction of these materials shall be in accordance with Paragraph 3.05 - COMPACTED FILLS AND BACKFILLS.

3.11 TOPSOIL, SEEDING AND MULCHING

- A. The Contractor shall be responsible for stripping all topsoil to depths in which found. The topsoil shall be carefully segregated from the trench materials and stockpiled for reuse in the work. Upon completion of the excavation work, the Contractor shall replace the topsoil to the depths in which found and to a minimum of 4 inches. The Contractor shall provide topsoil, as needed, from approved off-site sources at the Contractor's expense and at no additional cost to the County, provide the hauling, grading and topsoil required and necessary to provide the needed topsoil depth.
- B. Subgrade for topsoil is defined as the surface upon which the topsoil is placed. Salvaged topsoil shall be existing topsoil stripped from the site within the prescribed limits. Furnished topsoil shall be the Contractor's responsibility to obtain from approved off-site sources.
- C. For all non-paved disturbed areas of the site, place a 4-inch depth of topsoil on areas to be seeded, unless otherwise noted on the Drawings, or specified. The Contractor shall provide grading and fine grading as required to restore the site. Upon completion of grading and prior to final seeding and mulching all debris shall be cleaned up and removed from the site.

- C. Fine grading and placement of salvaged or furnished topsoil, solid sodding, seeding and mulching shall conform to Section 02930 FINE GRADING, SEEDING AND LANDSCAPING, of these Specifications. Payment shall be included in the lump sum or unit price bid items of Section 01130 - MEASUREMENT AND PAYMENT of these Specifications.

END OF SECTION 02200

SECTION 02210

GEOMEMBRANES

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SECTION 02210

GEOMEMBRANES

PART 1 - GENERAL

1.01 SCOPE

- A. This specification includes furnishing and installing an HDPE geomembrane for Effluent Lagoon No. 3 with 3:1 slopes, and for Aeration Lagoons No. 3 and No. 4 with 2:1 side slopes.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 1. D 638, Standard Test Method for Tensile Properties of Plastics.
 2. D 751, Standard Test Methods for Coated Fabrics.
 3. D 792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 4. D 1004, Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
 5. D 1204, Standard Test Method for Linear Dimensional Changes of Non Rigid Thermoplastic Sheeting or Film at Elevated Temperature.e
 6. D 1238, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
 7. D 1505, Standard Test Method for Density of Plastics by Density-Gradient Technique.
 8. D 1603, Standard Test Method for Carbon Black in Olefin Plastics.
 9. D 3895, Test Method for Oxidative Induction Time of Poly ole fins by Thermal Analysis.
 10. D 4218, Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
 11. D 4437, Standard Practice for Nondestructive testing for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

12. D 4833, Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
13. D 5199, Standard Test Method for Measuring Nominal Thickness of Smooth Geomembranes.
14. D 5397, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefins using Notched Constant Tensile Load Test.
15. D 5596, Standard Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds.
16. D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
17. D 5721, Practice for Air-Oven Aging of Poly-olefin Geomembranes.
18. D 5820, Test Method for Air Testing.
19. D 5885, Test Method for Oxidative Induction Time of Poly olefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
20. D 5994, Standard Test Method for Measuring Nominal Thickness of Textured Geomembranes
21. D 6365, Standard Practice for the Nondestructive Testing of Geomembrane Seams using The Spark Test
22. D5820-95, Pressurized Air Channel Test for Dual Seamed Geomembranes

B. Geosynthetic Research Institute (GRI):

1. GRI GM 9, Cold Weather Seaming of Geomembranes
2. GRI GM 10, The Stress Crack Resistance of HDPE Geomembrane Sheet
3. GRI GM 13, Test Properties, Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
4. GRI GM 14, Test Frequencies for Destructive Seam Testing
Selecting, variable intervals for taking geomembrane destructive samples using the method of attributes.

5. GRI GM 12, Measurement of the Asperity Height of Textured Geomembranes Using a Depth Gage
6. GRI GM 19, Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300, Submittals.
- B. Submit the following to the Engineer or Owner, for review and approval, within a reasonable time so as to expedite shipment or installation of the Geomembrane:
 1. Documentation of manufacturer's qualifications as specified in subsection 1.04A of this Section.
 2. Manufacturer's Quality Control program manual or descriptive documentation.
 3. A material properties sheet, including at a minimum all properties specified in GRI GM 13, including test methods used.
 4. Sample of the material.
 5. Documentation of Installer's qualifications, as specified below and in subsection 1.04B of this Section
 - a. Submit a list of at least ten completed facilities. For each installation, provide: name and type of facility; its location; the date of installation; name and telephone number of contact at the facility; type and thickness of geomembrane and; surface area of the installed geomembrane.
 - b. Submit resumes or qualifications of the Installation Supervisor, Master Seamer and Technicians to be assigned to this project.
 - c. Quality Control Program.
 6. Example Material Warranty and Liner Installation Warranty
- C. Shop Drawing
 1. Submit copies of shop drawings for engineer's approval within a reasonable time so as not to delay the start of geomembrane installation. Shop drawings shall show the proposed panel layout identifying seams and

- details. Seams shall generally follow the direction of the slope. Butt seams or roll-end seams shall not occur on a slope unless approved by the Engineer. Butt seams on a slope, if allowed, shall be staggered.
2. Placement of geomembrane shall not be allowed to proceed until the Owner has received and approved the shop drawings.

D. Additional Submittals (In-Progress and at Completion)

1. Manufacturer's warranty.
2. Geomembrane installation warranty.
3. Daily written acceptance of subgrade surface.
4. Prequalification test seam samples.
5. Field seam non-destructive test results.
6. Field seam destructive test results.
7. Daily field installation reports.
8. Installation record drawing

1.04 QUALITY CONTROL

- A. **Manufacturer's Qualifications:** The manufacturer of geomembrane of the type specified or similar product shall have at least five years experience in the manufacture of such geomembrane. In addition, the geomembrane manufacturer shall have manufactured at least 10,000,000 square feet of the specified type of geomembrane or similar product during the last five years.
- B. **Installer's Qualifications**
1. The Geomembrane Installer shall be the Manufacturer, approved Manufacturer's Installer or a contractor approved by the Engineer to install the geomembrane.
 2. The Geomembrane Installer shall have at least three years experience in the installation of the specified geomembrane or similar. The Geomembrane Installer shall have installed at least 10 projects involving a total of 5,000,000 square feet of the specified type of geomembrane or similar during the last three years.

3. Installation shall be performed under the direction of a field Installation Supervisor who shall be responsible throughout the geomembrane installation, for geomembrane panel layout, seaming, patching, testing, repairs, and all other activities of the Geomembrane Installer. The Field Installation Supervisor shall have installed or supervised the installation and seaming of a minimum of 10 projects involving a total of 5,000,000 square feet of geomembrane of the type specified or similar product.
4. Seaming shall be performed under the direction of a Master Seamer (who may also be the Field Installation Supervisor or Crew Foreman) who has seamed a minimum of 3,000,000 square feet of geomembrane of the type specified or similar product, using the same type of seaming apparatus to be used in the current project. The Field Installation Supervisor and/or Master Seamer shall be present whenever seaming is performed.
5. All seaming, patching, other welding operations, and testing shall be performed by qualified technicians employed by the Geomembrane Installer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Each roll of geomembrane delivered to the site shall be labeled by the manufacturer. The label shall be firmly affixed and shall clearly state the manufacturer's name, product identification, material thickness, roll number, roll dimensions and roll weight.
- B. Geomembrane shall be protected from mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions.
- C. Rolls shall be stored away from high traffic areas. Continuously and uniformly support rolls on a smooth, level prepared surface.

1.06 PROJECT CONDITIONS

- A. Geomembrane shall not be installed in the presence of standing water, while precipitation is occurring, during excessive winds, or when material temperatures are outside the limits specified in Section 3.03.

1.07 GEOMEMBRANE INSTALLATION WARRANTY

- A. Installation shall be warranted against defects in workmanship for a period of 1 year from the date of geomembrane completion.
- B. Material shall be warranted, on a pro-rata basis against Manufacturer's defects for a period of 5 years from the date of geomembrane installation.

1.08 GEOMEMBRANE PRE-CONSTRUCTION MEETING

- A. A Geomembrane Pre-Construction Meeting shall be held at the site prior to installation of the geomembrane. At a minimum, the meeting shall be attended by the Geomembrane Installer, Owner, Engineer, and the Contractor.
- B. Topics for this meeting shall include:
 - 1. Health and Safety
 - 2. Lines of authority and communication
 - 3. Methods for documenting, reporting and distributing documents and reports.
 - 4. Procedures for packaging and storing archive samples.
 - 5. Review of time schedule for all installation and testing.
 - 6. Review of panel layout and numbering systems for panels and seams including details for marking on geomembrane.
 - 7. Procedures and responsibilities for preparation and submission of as-built panel and seam drawings.
 - 8. Temperature and weather limitations. Installation procedures for adverse weather conditions. Defining acceptable sub-grade, geomembrane, or ambient moisture and temperature conditions for working during liner installation.
 - 9. Subgrade conditions, dewatering responsibilities and sub-grade maintenance plan.
 - 10. Deployment techniques including allowable sub-grade for the geomembrane.
 - 11. Plan for controlling expansion/contraction and wrinkling of the geomembrane.
 - 12. Covering of the geomembrane and cover soil placement.
 - 13. Responsibilities of each party.

PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Manufacturing Quality Control
 - 1. The test methods and frequencies used by the manufacturer for quality control/quality assurance of the above geomembrane prior to delivery shall

be in accordance with GRI GM 13 for HDPE geomembrane or modified as required for project specific conditions.

2. The manufacturer's geomembrane quality control certifications, including results of quality control testing of the products, as specified in subsection. 2.01.A.3 of this Section, must be supplied to the Owner to verify that the materials supplied for the project are in compliance with all product and or project specifications in this Section. The certification shall be signed by a responsible party employed by the manufacturer, such as the QA/QC Manager, Production Manager, or Technical Services Manager. Certifications shall include lot and roll numbers and corresponding shipping information.
3. The manufacturer will provide Certification that the geomembrane and welding rod supplied for the project are made from the same material type and are compatible.

2.02 GEOMEMBRANE PROPERTIES

- A. Material shall be single sided textured polyethylene geomembrane as shown on the drawings. Material shall be manufactured by GSE or approved equal.
- B. Resin
 1. Resin shall be new, first quality, compounded and manufactured specifically for producing geomembrane.
 2. Natural resin (without carbon black) shall meet the following requirements:

Table 1: Raw Material Properties

Property	Test Method	HDPE
Density (g/cm ³)	ASTM D 1505	≥0.932
Melt Flow Index (g/10 min)	ASTM D 1238 (190/2.16)	≤1.0
OIT (minutes)	ASTM D 3895 (1 atm/200 ^o C)	≥100

- C. Geomembrane Rolls
 1. Do not exceed a combined maximum total of 1 percent by weight of additives other than carbon black.
 2. Geomembrane shall be free of holes, pinholes as verified by on-line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.
 3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating roll number, thickness, length, width and Manufacturer.
 4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Table 1.2 and be tested by an acceptable method of inspecting for pinholes. If pinholes are

located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

Table 2

TESTED PROPERTY	TEST METHOD	FREQUENCY	MINIMUM AVERAGE VALUE				
			30 mil	40 mil	60 mil	80 mil	100 mil
Thickness, (minimum average) mil (mm) Lowest individual reading (-10%)	ASTM D 5994	every roll	30 (0.75) 27 (0.69)	40 (1.00) 36 (0.91)	60 (1.50) 54 (1.40)	80 (2.00) 72 (1.80)	100 (2.50) 90 (2.30)
Density, g/cm ³	ASTM D 1505	200,000 lb	0.94	0.94	0.94	0.94	0.94
Tensile Properties (each direction) Strength at Break, lb/in-width (N/mm) Strength at Yield, lb/in-width (N/mm) Elongation at Break, % Elongation at Yield, %	ASTM D 6693, Type IV Dumbbell, 2 ipm G.L. 2.0 in (51 mm) G.L. 1.3 in (33 mm)	20,000 lb	66 (11) 68 (11) 100 12	75 (13) 90 (15) 100 12	115 (20) 132 (23) 100 12	155 (27) 177 (31) 100 12	230 (40) 225 (39) 100 12
Tear Resistance, lb (N)	ASTM D 1004	45,000 lb	24 (106)	32 (142)	45 (200)	60 (266)	75 (333)
Puncture Resistance, lb (N)	ASTM D 4833	45,000 lb	65 (289)	95 (422)	130 (578)	160 (711)	190 (845)
Carbon Black Content, % (Range)	ASTM D 1 603*/421 8	20,000 lb	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0	2.0 - 3.0
Carbon Black Dispersion	ASTM D 5596	45,000 lb	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾	Note ⁽¹⁾
Asperity Height, mil (mm)	ASTM D 7466	second roll	16 (0.40)	18 (0.45)	18 (0.45)	18 (0.45)	18 (0.45)
Notched Constant Tensile Load ⁽²⁾ , hr	ASTM D 5397, Appendix	200,000 lb	1000	1000	1000	1000	1000
Oxidative Induction Time, min	ASTM D 3895, 200° C; O ₂ , 1 atm	200,000 lb	>140	>140	>140	>140	>140
TYPICAL ROLL DIMENSIONS							
Roll Length ⁽³⁾ , ft (m)	Double-Sided Textured Single-Sided Textured		830 (253) 840 (256)	700 (213) 650 (198)	520 (158) 540 (128)	400 (122) 320 (98)	330 (101) 250 (76)
Roll Width ⁽³⁾ , ft (m)			22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)	22.5 (6.9)
Roll Area, ft ² (m ²)	Double-Sided Textured Single-Sided Textured		18,675 (1,735) 18,900 (1,755)	15,750 (1,463) 14,625 (1,359)	11,700 (1,087) 12,150 (878)	9,000 (836) 7,200 (669)	7,425 (690) 5,625 (523)

NOTES:

- ⁽¹⁾Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view from Category 3.
- ⁽²⁾NCTL for Textured is conducted on representative smooth membrane samples.
- ⁽³⁾Roll lengths and widths have a tolerance of ± 1%.

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

- A. The subgrade shall be prepared in accordance with the project specifications. A nonwoven geotextile shall be placed on the approved subgrade followed by geomembrane placement over the geotextile. The subgrade shall be uniform and free of sharp or angular objects that may damage the geomembrane.
- B. The Geomembrane Installer, Contractor, and Owner’s Representative shall

inspect the surface to be covered with the geomembrane on each day's operations prior to placement of geomembrane to verify suitability.

- C. The Geomembrane Installer, Contractor, and Owner's Representative shall provide daily written acceptance for the surface to be covered by the geomembrane in that day's operations. The surface shall be maintained in a manner, during geomembrane installation, to ensure subgrade suitability.
- D. All subgrade damaged by construction equipment and deemed unsuitable for geomembrane deployment shall be repaired prior to placement of the geomembrane. All repairs shall be approved by the Owner's Representative and the Geomembrane Installer. This damage, repair, and the responsibilities of the Contractor and Geomembrane Installer shall be defined in the preconstruction meeting.

3.02 GEOMEMBRANE PLACEMENT

- A. No geomembrane shall be deployed until the applicable certifications and quality control certificates listed in Section 1.03 of this Section are submitted to and approved by the Engineer within the timeframe specified in the Contract Documents. If the material does not meet project specifications it shall be removed from the work area.
- B. The geomembrane shall be installed on a nonwoven geotextile placed on the approved subgrade, to the limits shown on the project drawings and as shown on approved panel layout drawings.
- C. No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0 degrees C (32 degrees F) unless otherwise approved by the Engineer. The specified minimum temperature for material deployment may be adjusted by the Engineer. Temperature limitations shall be defined in the preconstruction meeting. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day shall be deployed.
- D. No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure vehicle or equivalent.
- E. Sand bags or equivalent ballast shall be used as necessary to temporarily hold the geomembrane material in position under the foreseeable and reasonably - expected wind conditions. Sand bag material shall be sufficiently close-knit to prevent soil fines from working through the bags and discharging on the geomembrane.
- F. Geomembrane placement shall not be done if moisture prevents proper sub grade

preparation, panel placement, or panel seaming. Moisture limitations shall be defined in the preconstruction meeting.

- G. Damaged panels or portions of the damaged panels which have been rejected shall be marked and their removal from the work area recorded.
- H. The geomembrane shall not be allowed to "bridge over" voids or low areas in the subgrade. The geomembrane shall rest in intimate contact with the subgrade.
- I. Wrinkles caused by panel placement or thermal expansion shall be minimized in accordance with Section 1.08.
- J. Considerations on Site Geometry: In general, seams shall be oriented parallel to the line of the maximum slope. In comers and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade unless geometry requires seaming at such locations and if approved by the Engineer.
- K. Overlapping: The panels shall be overlapped prior to seaming to whatever extent is necessary to affect a good weld and allow for proper testing. In no case shall this overlap be less than 4 in.

3.03 SEAMING PROCEDURES

- A. Cold weather installations shall follow guidelines as outlined in GRI GM9.
- B. No geomembrane material shall be seamed when liner temperatures are less than 0 degrees C (32 degrees F).
- C. No geomembrane material shall be seamed when the sheet temperature is above 75 degrees C (170 degrees F) as measured by an infrared thermometer or surface thermocouple unless otherwise approved by the Engineer. This approval will be based on recommendations by the manufacturer and on a field demonstration by the Geomembrane Installer using pre qualification test seams to demonstrate that seams comply with the specification.
- D. Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as at pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.
- E. Fishmouths or excessive wrinkles at the seam overlaps shall be minimized and when necessary cut along the ridge of the wrinkles back into the panel so as to effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (1/2 in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.04 PIPE AND STRUCTURE PENETRATION SEALING SYSTEM

- A. Cold weather installations shall follow guidelines as outlined in GRI GM9.

- B. Penetrations shall be constructed from the base geomembrane material, flat stock, prefabricated boots and accessories as shown on the Project Drawings. The prefabricated or field fabricated assembly shall be field welded to the geomembrane as shown on the Project Drawings so as to prevent leakage. This assembly shall be tested as outlined in Section 3.05.B. Alternatively, where field non-destructive testing can not be performed, attachments will be field spark tested by standard holiday leak detectors in accordance with ASTM 6365. Spark testing shall be done in areas where both air pressure testing and vacuum testing are not possible.
 - 1. Equipment for Spark testing shall be comprised of but not limited to: A hand held holiday spark tester and conductive wand that generates a high voltage.
 - 2. The testing activities shall be performed by the Geomembrane Installer by placing an electrically conductive tape or wire beneath the seam prior to welding. A trial seam containing a non-welded segment shall be subject to a calibration test to ensure that such a defect (non-welded segment) will be identified under the planned machine settings and procedures. Upon completion of the weld, enable the spark tester and hold approximately 25mm (1 in) above the weld moving slowly over the entire length of the weld in accordance with ASTM 6365. If there is no spark the weld is considered to be leak free.
 - 3. A spark indicates a hole in the seam. The faulty area shall be located, repaired and retested by the Geomembrane Installer.
 - 4. Care shall be taken if flammable gases are present in the area to be tested.

3.05 FIELD QUALITY CONTROL

- A. Prequalification Test Seams
 - 1. Test seams shall be prepared and tested by the Geomembrane Installer to verify that seaming parameters (speed, temperature and pressure of welding equipment) are adequate.
 - 2. Test seams shall be made by each welding technician and tested in accordance with ASTM D 4437 at the beginning of each seaming period. Test seaming shall be performed under the same conditions and with the

same equipment and operator combination as production seaming. The test seam shall be approximately 3.3 meters (10 feet) long for fusion welding and 1 meter (3 feet) long for extrusion welding with the seam centered lengthwise. At a minimum, tests seams shall be made by each technician 1 time every 4-6 hours; additional tests may be required with changes in environmental conditions.

3. Two 25 mm (1 in) wide specimens shall be die-cut by the Geomembrane Installer from each end of the test seam. These specimens shall be tested by the Geomembrane Installer using a field tensiometer testing both tracks for peel strength and also for shear strength. Each specimen shall fail in the parent material and not in the weld, "Film Tear Bond"(F.T.D. failure). Seam separation equal to or greater than 25% of the track width shall be considered a failing test.
4. The minimum acceptable seam strength values to be obtained for all specimens tested are listed in Section 3.05.CA. Four specimens shall pass for the test seam to be a passing seam.
5. If a test seam fails, an additional test seam shall be immediately conducted. If the additional test seam fails, the seaming apparatus shall be rejected and not used for production seaming until the deficiencies are corrected and a successful test seam can be produced.
6. A sample from each test seam shall be labeled. The label shall indicate the date, geomembrane temperature, number of the seaming unit, technician performing the test seam and pass or fail description. The sample shall then be given to the Engineer for archiving.

B. Field Seam Non-destruction Testing

1. All field seams shall be non-destructively tested by the Geomembrane Installer over the full seam length before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of tester and outcome of all non-destructive testing shall be recorded and submitted to the Engineer.
2. Testing shall be done as the seaming work progresses, not at the completion of all field seaming; unless agreed to in advance by the Engineer. All defects found during testing shall be numbered and marked immediately after detection. All defects found shall be repaired, retested and remarked to indicate acceptable completion of the repair.
3. Non-destructive testing shall be performed using vacuum box, air pressure or spark testing equipment.

4. Non-destructive tests shall be performed by experienced technicians familiar with the specified test methods. The Geomembrane Installer shall demonstrate to the Engineer all test methods to verify the test procedures are valid.
5. Extrusion seams shall be vacuum box tested by the Geomembrane Installer in accordance with ASTM D 4437 and ASTM D 5641 with the following equipment and procedures:
 - a. Equipment for testing extrusion seams shall be comprised of but not limited to: a vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the base, port hole or valve assembly and a vacuum gauge; a vacuum pump assembly equipped with a pressure controller and pipe connections; a rubber pressure/vacuum hose with fittings and connections; a plastic bucket; wide paint brush or mop; and a soapy solution.
 - b. The vacuum pump shall be charged and the tank pressure adjusted to approximately 35 kPa (5 psig).
 - c. The Geomembrane Installer shall create a leak tight seal between the gasket and geomembrane interface by wetting a strip of geomembrane approximately 0.3m (12 in) by 1.2m (48 in) (length and width of box) with a soapy solution, placing the box over the wetted area, and then compressing the box against the geomembrane. The Geomembrane Installer shall then close the bleed valve, open the vacuum valve, maintain initial pressure of approximately 35 kPa (5 psig) for approximately 5 seconds. The geomembrane shall be continuously examined through the viewing window for the presence of soap bubbles, indicating a leak. If no bubbles appear after 5 seconds, the area shall be considered leak free. The box shall be depressurized and moved over the next adjoining area with an appropriate overlap and the process repeated.
 - d. All areas where soap bubbles appear shall be marked, repaired and then retested.
 - e. At locations where seams cannot be non-destructively tested, such as pipe penetrations, alternate nondestructive spark testing (as outlined in Section 3.04.B) or equivalent shall be substituted.
 - f. All seams that are vacuum tested shall be marked with the date tested, the name of the technician performing the test and the results of the test.
6. Double Fusion seams with an enclosed channel shall be air pressure tested by the Geomembrane Installer in accordance with ASTM D

5820 and ASTM D 4437 and the following equipment and procedures:

- a. Equipment for testing double fusion seams shall be comprised of but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 210 kPa (30 psig), mounted on a cushion to protect the geomembrane; and a manometer equipped with a sharp hollow needle or other approved pressure feed device.
- b. The Testing activities shall be performed by the Geomembrane Installer. Both ends of the seam to be tested shall be sealed and a needle or other approved pressure feed device inserted into the tunnel created by the double wedge fusion weld. The air pump shall be adjusted to a pressure of 210 kPa (30 psig), and the valve closed. Allow 2 minutes for the injected air to come to equilibrium in the channel, and sustain pressure for 5 minutes. If pressure loss does not exceed 28 kPa (4 psig) after this five minute period the seam shall be considered leak tight. Release pressure from the opposite end verifying pressure drop on needle to ensure testing of the entire seam. The needle or other approved pressure feed device shall be removed and the feed hole sealed.
 - a. If loss of pressure exceeds 28 kPa (4 psig) during the testing period or pressure does not stabilize, the faulty area shall be located, repaired and retested by the Geomembrane Installer.
 - b. Results of the pressure testing shall be recorded on the liner at the seam tested and on a pressure testing record.

C. Destructive Field Seam Testing

1. One destructive test sample per 150 linear m (500 linear ft) seam length or another predetermined length in accordance with GRI GM 14 shall be taken by the Geomembrane Installer from a location specified by the Engineer. The Geomembrane Installer shall not be informed in advance of the sample location. In order to obtain test results prior to completion of geomembrane installation, samples shall be cut by the Geomembrane Installer as directed by the Engineer as seaming progresses.
2. All field samples shall be marked with their sample number and seam number. The sample number, date, time, location, and seam number shall be recorded. The Geomembrane Installer shall repair all holes in the geomembrane resulting from obtaining the seam samples. All patches shall be vacuum box tested or spark tested. If a patch cannot be permanently installed over the test location the same day of sample

collection, a temporary patch shall be tack welded or hot air welded over the opening until a permanent patch can be affixed.

3. The destructive sample size shall be 300 mm (12 in) wide by 1 m (36 in) long with the seam centered lengthwise. The sample shall be cut into three equal sections and distributed as follows: one section given to the Engineer as an archive sample; one section given to the Engineer for laboratory testing as specified in paragraph 5 below; and one section retained by the Geomembrane Installer for field testing as specified in paragraph 4 below.
4. For field testing, the Geomembrane Installer shall cut 10 identical 25 mm (1 in) wide replicate specimens from his sample. The Geomembrane Installer shall test five specimens for seam shear strength and five for peel strength. Peel tests will be performed on both inside and outside weld tracks. To be acceptable, 4 of 5 test specimens must pass the stated criteria in section 2.02 with less than 25% separation. If 4 of 5 specimens pass, the sample qualifies for testing by the testing laboratory if required.
5. If independent seam testing is required by the specifications it shall be conducted in accordance with ASTM 5820 or ASTM D4437 or GRIGM 6.
6. Reports of the results of examinations and testing shall be prepared and submitted to the Engineer.
7. For field seams, if a laboratory test fails, that shall be considered as an indicator of the possible inadequacy of the entire seamed length corresponding to the test sample. Additional destructive test portions shall then be taken by the Geomembrane Installer at locations indicated by the Engineer; typically 3 m (10 ft) on either side of the failed sample and laboratory seam tests shall be performed. Passing tests shall be an indicator of adequate seams. Failing tests shall be an indicator of non-adequate seams and all seams represented by the destructive test location shall be repaired with a cap-strip extrusion welded to all sides of the capped area. All cap-strip seams shall be non-destructively vacuum box tested until adequacy of the seams is achieved. Cap strip seams exceeding 50 M in length (150 FT) shall be destructively tested.

D. Identification and Defects

1. Panels and seams shall be inspected by the Installer and Engineer during and after panel deployment to identify all defects, including holes, blisters, undispersed raw materials and signs of contamination by foreign matter.

- E. Evaluation of Defects: Each suspect location on the liner (both in geomembrane seam and non-seam areas) shall be non-destructively tested using one of the methods described in Section 3.05.B. Each location which fails non-destructive testing shall be marked, numbered, measured and posted on the daily "installation" drawings and subsequently repaired.
1. If a destructive sample fails the field or laboratory test, the Geomembrane Installer shall repair the seam between the two nearest passed locations on both sides of the failed destructive sample location.
 2. Defective seams, tears or holes shall be repaired by reseaming or applying a extrusion welded cap strip.
 3. Reseaming may consist of either:
 - a. Removing the defective weld area and rewelding the parent material using the original welding equipment; or
 - b. Reseaming by extrusion welding along the overlap at the outside seam edge left by the fusion welding process.
 4. Blisters, larger holes, and contamination by foreign matter shall be repaired by patches and/or extrusion weld beads as required. Each patch shall extend a minimum of 150 mm (6 in) beyond all edges of the defects.
 5. All repairs shall be measured, located and recorded.
- F. Verification of Repairs on Seams: Each repair shall be non-destructively tested using either vacuum box or spark testing methods. Tests which pass the non-destructive test shall be taken as an indication of a successful repair. Failed tests shall be reseamed and retested until a passing test results. The number, date, location, technician and test outcome of each patch shall be recorded.
- G. Daily Field Installation Reports: At the beginning of each day's work, the Installer shall provide the Engineer with daily reports for all work accomplished on the previous work day. Reports shall include the following:
1. Total amount and location of geomembrane placed;
 2. Total length and location of seams completed, name of technicians doing seaming and welding unit numbers;
 3. Drawings of the previous days installed geomembrane showing panel numbers, seam numbers and locations of non-destructive and destructive testing;
 4. Results of pre-qualification test seams;

5. Results of non-destructive testing; and 6. Results of vacuum testing of repairs.

H. Destructive test results shall be reported prior to covering of liner or within 48 hours.

3.06 GEOMEMBRANE ACCEPTANCE

A. Geomembrane liner will be accepted by the Engineer when:

1. The entire installation is finished or an agreed upon subsection of the installation is finished;
2. All Installer's QC documentation is completed and submitted to the Owner
3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

3.07 ANCHOR TRENCH

A. Construct as specified on the project drawings.

3.08 DISPOSAL OF SCRAP MATERIALS

A. On completion of installation, the Geomembrane Installer shall dispose of All trash and scrap material in a location approved by the Owner, remove equipment used in connection with the work herein, and shall leave the premises in a neat acceptable manner. No scrap material shall be allowed to remain on the geomembrane surface.

END OF SECTION

SECTION 02500

PAVEMENT AND TRAFFIC CONTROL

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SECTION 02500

PAVEMENT AND TRAFFIC CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide all labor, materials, equipment and services necessary to perform all paving and surfacing to the finished grades as shown on the Contract Documents. Roadway pavement disturbed by construction shall be restored as shown on the Contract Documents. The type of material, thickness and typical section, unless otherwise shown on the Contract Documents, shall be as follows:

1. Dense Graded Aggregate Base Course shall consist of DelDOT Graded Aggregate Subbase Type "B" (Crusher Run) compacted to a density of at least 95% of maximum dry density as determined by AASHTO T180.
2. Bituminous Courses

Roadway Type	Base Course	Surface Course
Facility roads	Type B 160 Gyrations, PG 64-22	Type C 160 Gyrations, PG 64-22

All Bituminous Courses shall be Superpave and shall be in accordance with the DelDOT Standard Specifications.

B. Related work specified elsewhere: Section 02200, EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING of this Specification.

1.02 QUALITY ASSURANCE

A. Specifications: Delaware Department of Transportation (DelDOT) "Standard Specifications for Road and Bridge Construction", dated August 2016, with the latest incorporated revisions, also referred to as the STANDARD SPECIFICATIONS.

B. Traffic Manual: Delaware Department of Transportation (DelDOT) "Delaware Manual on Uniform Traffic Control Devices (MUTCD)", dated 2011, with the latest incorporated revisions, also referred to as the TRAFFIC MANUAL.

- C. Source Quality Control: Maintain quality in products by using those of a qualified bituminous concrete producer have qualified plant operating personnel.
- D. Experience: The bituminous concrete producer shall be a bulk producer regularly engaged in production of hot-mixed, hot-laid bituminous concrete conforming to the standards referenced herein.
- E. Workmen Qualifications: Provide at least one person thoroughly trained and experienced in the skills required who readily understands the design and is completely familiar with the application of stone base and bituminous concrete paving work. Said person shall be present at all times during progress of the stone base and bituminous concrete paving work and shall direct the performance of said work. For actual finishing of bituminous concrete surfaces and operation of the equipment, use only personnel thoroughly trained and experienced in the skills required.
- F. Maintenance of Roadways: The Contractor shall maintain the existing roadway surface in good condition throughout the duration of the project, in order to limit inconvenience to the residents. The Contractor shall keep all roadways clean of debris or sediment and shall be required to sweep streets or perform dust control measures as necessary to maintain roads. Such measures shall be performed on an as needed basis or when directed by the Engineer. The final pavement restoration of all roadways shall be completed within a maximum of 60 days of initial pavement disturbance. Prior to installing final pavement, the Contractor shall make all repairs to the existing pavement or prepared subbase, as required by the Engineer, to allow proper placement of final restoration surface

1.03 JOB CONDITIONS

- A. Weather Limitations: Apply tack coats only when ambient temperature is above 50°F, and when temperature has not been below 35°F for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.
- B. Construct bituminous concrete surface course only when atmospheric temperature is above 40°F, and when base is dry. Binder course may be placed when air temperature is above 32°F and rising.
- C. Grade Control: Establish and maintain required lines and elevations.

1.04 SUBMITTALS

Mix designs for bituminous concrete shall be submitted in writing by the Contractor sufficiently in advance of paving operations to allow three weeks for review and approval. The design information shall include the following:

1. The use of which the material is proposed.
2. The designation, source and anticipation gradation if each of the component aggregates.
3. The estimated percentage of each aggregate required to yield the desired blend.
4. The resulting percentage passing each sieve size stipulated by the appropriate band.
5. The source of the asphalt material to be used.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Dense Graded Aggregate Base Course shall consist of DelDOT Graded Aggregate Subbase Type "B" (Crusher Run) compacted to a density of at least 95% of maximum dry density as determined by AASHTO T180.
- B. Bituminous Concrete Base Course shall consist of Superpave Type "B" in accordance with Section 401 of the STANDARD SPECIFICATIONS.
- C. Bituminous Concrete Surface Course shall consist of Superpave Type "C" in accordance with Section 401 of the STANDARD SPECIFICATIONS.
- D. Base Course and Surface Course materials shall be as specified in Section 1014 of the STANDARD SPECIFICATIONS.
- E. Asphalt Cement: Comply with Section 1012 of the STANDARD SPECIFICATIONS, AASHTO M320, Table 1.
- F. Tack Coat: Comply with Section 1011 of the STANDARD SPECIFICATIONS, Asphalt emulsion per AASHTO M316 CRS-2P.

2.02 PAVEMENT MIXES

Composition of Mixtures: Base Course and Surface Course mixture compositions shall conform to the requirements of the above-referenced specifications and the following:

- A. Establish a job mix formula prior to beginning work which shall not be changed during the progress of work without the Engineer's approval. Job

mixing tolerances shall not be presumed to permit acceptance of materials whose graduations fall outside the master ranges set forth in the above-referenced specifications.

- B. The approved job mix formula shall lie within the specification limits and be suitable for the layer thickness and other conditions prevailing. It shall not be changed after work has started without the approval of the Engineer.

2.03 PERMANENT PAVEMENT STRIPING

All existing road striping if disturbed shall be replaced upon completion of pavement replacement. Permanent pavement striping shall be in accordance with DeIDOT STANDARD SPECIFICATIONS for epoxy resin paint striping.

2.04 TRAFFIC CONTROL

- A. The materials and construction of all traffic control signs and devices shall meet all requirements, including reflectorization, of the DeIDOT TRAFFIC MANUAL. Warning signs and temporary warning signs shall be retroreflective and shall have rounded comers as per FHWA publication "Standard Highway Signs".
- B. Unless specified on the Plans, all traffic control devices shall be either new or restored to a satisfactory condition. All reconditioned and/or restored traffic control devices must be approved by the Engineer before their use. Bases of warning signs, when required, shall be weighted with sandbags to resist overturning.
- C. Temporary traffic control devices used on all highways open to the public in this State shall be crashworthy in accordance with the National Cooperative Highway Research Program (NCHRP) Report 350 and the memorandum issued August 28, 1998 by The USDOT Federal Highway Administration Information: Crash Tested Work Zone Traffic Control Devices. It is the requirement of the Department that such certification be submitted for traffic control devices used on all projects, not just those involving the National Highway System.
- D. Certification of compliance with NCHRP report 350 IS required for the following categories of traffic control devices:

Category I contains small and lightweight channelizing and delineating control devices which includes cones, tubular markers, flexible delineator post and drums, all without any accessories or attachments.

Category II includes traffic control devices that are not expected to produce significant vehicular velocity changes to impacting vehicles. These devices which shall weigh 100 pounds (45 kg) or less, include Type I, IT and III barricades, portable sign supports with signs, and intrusion alarms. Also

included are drums, cones, and vertical panels with accessories or attachments.

The schedule for implementation of certification is as follows:

Category I - Effective October 1, 1998, all devices shall be certified as conforming to NCHRP Report 350 criteria.

Category II - Effective October 1, 2000, all new devices shall be certified as conforming to NCHRP Report 350 criteria. Prior to October 1, 2002, the Contractor may use devices acquired before October 1, 2000, that have not been crash tested in accordance with NCHRP Report 350 criteria, provided the Contractor certified the such devices were acquired prior to October 1, 2000. If such devices are crash tested and fail, the Department reserves the right to have them replaced with approved devices. Effective October 1, 2002, all devices shall be certified as conforming to NCHRP Report 350 criteria.

- E. For DelDOT administered projects the certification shall be submitted to the Engineer prior to installation or use of traffic control devices. For Category I devices, the manufacturer may self-certify that the devices meet NCHRP-350 criteria. For Category II and Category III devices, the Contractor shall supply the Federal Highway Administration's NCHRP-350 acceptance letter for each type of device.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall install final permanent bituminous concrete pavement surface within a maximum of 60 days of initial pavement disturbance. At building and pit construction sites, all heavy equipment operations (cranes, track excavators, concrete truck traffic, etc.) shall be complete prior to the installation of the bituminous concrete pavements.
- B. Lane closings necessary for the installation of paving, barricades and the placement of other traffic protection devices shall be in accordance with the requirements of the DelDOT Traffic Manual.

3.02 INSPECTION

Examine areas and conditions under which asphalt concrete paving is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.03 PAVEMENT BASE

Grade Control: During construction, follow lines and grades of the existing surface, including cross-slope. Vary only to avoid "bird baths" or areas of poor drainage.

3.04 SURFACE PREPARATION

- A. Subgrades shall be prepared and proof rolled in accordance with Section 02200, EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING of this specification.
- B. For pavement to be installed over existing pavements, the full width of surface to be paved shall be swept with a power broom or cleaned by use of compressed air, or both, to remove all loose soil, debris, and other objectionable material or impediments. After sweeping and cleaning, all potholes and areas of broken pavement shall be filled to grade with hot-mix bituminous concrete compacted in place to provide a stable base.
- C. Apply tack coat in accordance with Section 401.03 of the STANDARD SPECIFICATIONS.

3.05 PLACING MIX

- A. General: Place bituminous concrete mixes as specified in Section 401.03 of the STANDARD SPECIFICATIONS.
- B. Compaction: Use 6 to 8-ton steel wheel rollers or smooth tread pneumatic tired rollers. Conform with procedure outlined in Section 401.03 of the STANDARD SPECIFICATIONS.

3.06 FIELD QUALITY CONTROL

- A. General: Test in-place bituminous concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:
 - 1. Base Course: one-half inch, plus or minus
 - 2. Surface Course: one-quarter inch, plus or minus
- C. Surface Smoothness: Test finished surface of each asphaltic concrete surface for smoothness, using 10-foot straightedge applied parallel with, and at right angles to centerline of paved area. Surfaces will not be acceptable in exceeding following tolerances for smoothness:
 - 1. Base Course Surfaces: 1/4"
 - 2. Surface Course Surface: 3/16"

3.07 PROTECTION

Protect pavement from damage and vehicular traffic until pavement has cooled and attained its maximum degree of hardness.

END OF SECTION 02500

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SECTION 02519

DISINFECTION OF WATER MAINS

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SECTION 02519

DISINFECTION WATER MAINS

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This Section identifies the requirements for furnishing all labor, materials, equipment and appurtenances necessary for the complete and satisfactory testing, disinfection, and flushing of the water main systems as specified herein and indicated on the Drawings. Disinfection is only required for the potable water mains. It is not required for the effluent force main piping, etc., however all other requirements of this Section, including testing and flushing requirements specified herein are applicable.
- B. All work, materials and incidentals necessary to the testing, disinfection, and flushing of the water main and other piping shall meet the requirements of Frederick County Standard Specifications and the applicable requirements of other Sections and as modified herein.
- C. The CONTRACTOR shall be responsible for filling, testing, flushing and disinfecting all water mains and other piping and as specified herein. The CONTRACTOR shall prepare a filling, testing, flushing and disinfection plan to be reviewed by the ENGINEER. The plan shall be submitted a minimum of 15 working days prior to the date of performing any proposed filling, testing, flushing and disinfection. The plan shall include dates when water is needed, dates of proposed flushing, discharge points, methods of disinfection and dechlorination, and sampling/testing methods, and testing laboratory. The CONTRACTOR shall obtain approval from and notify the Owner and ENGINEER a minimum of 5 working days in advance of the work. The CONTRACTOR shall implement the approved Plan at the convenience of the Owner and adjust or readjust the schedule as necessary to accommodate the OWNER.
- D. All water for filling, testing, disinfection and flushing of water mains and other piping shall be withdrawn from the existing potable water system at the treatment plant.

1.02 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Delaware Division of Public Health
 - 2. AWWA C600, Standard for Installation of Ductile Iron Water Mains and their Appurtenances.
 - 3. AWWA C651, Disinfecting Water Mains.
- B. Samples of the water after disinfection shall be tested in accordance with *Standard Methods for the Examination of Water and Wastewater*, by a certified laboratory for total coliforms.

1.03 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Water mains and other piping, valves, and appurtenances furnished and installed shall be hydrostatically tested to the specified pressure and duration of test. Water for testing shall be potable water. CONTRACTOR shall coordinate the use of potable water for the necessary testing with the OWNER.
 - 2. The CONTRACTOR shall furnish all supervision, labor, and materials, including but not limited to hose, piping, adapters, pumps, gauges, testing apparatus, and appurtenances required or necessary for performing the work and obtaining satisfactory results.
 - 3. Should the CONTRACTOR fail to obtain satisfactory results on either the pressure test or the bacteriological test, then the CONTRACTOR shall: repair any leaks or reinstall work necessary; or re-flush and re-disinfect as required; or provide work as specified herein to the satisfaction of the OWNER or ENGINEER, to obtain satisfactory test results at no additional cost to the OWNER.
 - 4. The CONTRACTOR shall be required to coordinate the work required under the Contract with the work by others or other CONTRACTORS.

1.04 SUBMITTALS

- A. The CONTRACTOR shall submit a Filling, Testing, Flushing and Disinfection Plan to identify the work to be performed, including the materials and methods to be implemented for the work as required herein.
- B. A minimum of 5 days prior to any filling, the CONTRACTOR shall submit to the OWNER, in writing, a request for water. The request shall include a description of the pipe segment to be filled, the distribution system withdrawal point(s), the time period for the withdrawal and the amount of water required.
- C. Results of testing. Submit in accordance with Section 01300.

PART 2 – PRODUCTS:

2.01 CHLORINE

Provide chlorine in accordance with requirements of AWWA C651 and C652.

PART 3 – EXECUTION

3.01 HYDROSTATIC TESTING

- A. Hydrostatic testing of the water mains shall be in accordance with section 02730.

3.02 PIPE CLEANING

- A. The CONTRACTOR shall clean each segment of pipe prior to placing the next segment of pipe. Any loose dirt or debris shall be removed prior to setting the next section of pipe.
- B. For each subsequent pipe segment installed, the CONTRACTOR shall clean a minimum of 5 feet of the previously installed pipe to remove dirt and debris while joining pipe segments.
- C. The CONTRACTOR shall install a mechanical seal to prevent dirt, debris and other contaminants from entering the cleaned portion of the pipe. The mechanical seal shall be a Foreman “Night Cap”, Type I or Type II by Advance Products and Systems, Inc. or an approved equal. The mechanical seal will be moved as required to seal off cleaned segments of

pipe. The CONTRACTOR shall maintain the cleanliness of the pipeline until acceptance by the OWNER.

- D. All equipment including spray equipment, mechanical seals, etc. shall be disinfected before they are used to clean the pipelines. CONTRACTOR shall use only potable water to clean and disinfect the equipment used to clean the pipelines.
- E. CONTRACTOR shall remove water, dirt, and foreign material and properly dispose of materials in accordance with local, state, and federal authorities.
- F. The CONTRACTOR shall maintain the cleanliness of the pipeline during installation or interconnection.
- G. Where possible, all pipelines shall be flushed at a rate of a minimum of 2.5 feet per second to remove any accumulated dirt or debris. Water for flushing shall be made available to the CONTRACTOR from the closest existing supply point. The CONTRACTOR shall provide all means of conveyance to include piping, valves, and fittings, ASSE approved Backflow Prevention Device double check valve assembly, and appurtenances required.
- H. The CONTRACTOR is responsible for proper disposal of the flushing water. The CONTRACTOR shall construct a suitable discharge basin comprised of straw bales, geotextile, stakes, and stone for dissipating the energy and concentrating the point of discharge for the flushing water. The basin shall be a minimum of 25 feet wide, 25 feet long and 4 feet total depth with one layer of straw bales.
- I. The CONTRACTOR shall notify the OWNER in advance of the need of any water to be provided.

3.03 PIPE DISINFECTION

- A. The raw and potable water pipelines and valves shall be disinfected by the CONTRACTOR in accordance with AWWA C651. The pipeline shall be disinfected with a chlorine concentration of at least 50-ppm for a minimum of 24 hours. After the chlorination procedure is completed and before the pipelines and facilities are placed into service, the OWNER will collect two samples, collected 24 hours apart, which shall indicate a negative result of coliform presence. Samples shall be taken by personnel qualified to perform bacteriological testing. Cleaning, flushing, disinfection, and testing shall be repeated by the CONTRACTOR at no

additional cost to the OWNER until satisfactory bacteriological results have been obtained and all piping is accepted by the OWNER. The piping system will not be accepted until satisfactory bacteriological results have been obtained.

- B. After the applicable retention period, heavily chlorinated water shall not remain in contact with the pipe for more than 48 hours without written permission of the ENGINEER. In order to prevent damage to the pipe lining or corrosion damage to the pipe, the heavily chlorinated water shall be flushed from the main until chlorine measurements show that chlorine level in water leaving the main is no higher than the level in the water obtained from the distribution system for flushing.

3.04 FLUSHING/DRAINING OF PIPE

- A. Following disinfection, all chlorinated water shall be thoroughly flushed from the raw or potable water main until the flushed water leaving the main shows a chlorine level that is no higher than the level in the water obtained from the distribution system for flushing.
- B. The CONTRACTOR shall be required to dechlorinate heavily chlorinated water (greater than 1.0-ppm residual) in a manner which conforms to all local, State and Federal regulations prior to discharge. The manner of dechlorination shall be the option of the CONTRACTOR, however the method shall be in accordance with Appendix C of AWWA C651. The maximum chlorine concentration for flushing water prior to discharging into a drainage ditch or storm drainage system shall be less than 0.1-ppm. The CONTRACTOR shall provide all tanks, basins, drains, piping, hoses, and chemical metering pumps and any other equipment necessary for dechlorination.
- C. Where possible, all pipelines shall be flushed at a rate of a minimum of 2.5 feet per second to remove any accumulated dirt or debris. Water for flushing shall be made available to the CONTRACTOR from the closest existing supply point. The CONTRACTOR shall provide all means of conveyance to include piping, valves, and fittings, ASSE approved Backflow Prevention Device double check valve assembly, and appurtenances required.
- D. The CONTRACTOR is responsible for proper disposal of the flushing water. The CONTRACTOR shall construct a suitable discharge basin comprised of straw bales, geotextile, stakes, and stone for dissipating the energy and concentrating the point of discharge for the flushing water. The

basin shall be a minimum of 25 feet wide, 25 feet long and 4 feet total depth with one layer of straw bales.

E. Flushing of Water Mains

1. Upon written acceptance of the Filling, Testing, Disinfection and Flushing Plan, the CONTRACTOR may proceed with the work. It is the responsibility of the CONTRACTOR to coordinate his work effort with the work of other projects. All work efforts, required in any one site, must be coordinated and sequenced to effect a successful and satisfactory project completion, particularly the operations described below.
2. The CONTRACTOR shall notify the OWNER 72 hours in advance of the need of any water to be provided.
3. The maximum withdrawal rate for flushing shall not exceed 300 gallons per minute, unless greater water is available and approved by the OWNER.
4. Disposal of flushing water into the sanitary sewer system will not be allowed.

3.05 FIELD QUALITY ASSURANCE

- A. No part of the work installed shall be made active with the existing system until all cleaning, flushing, disinfection, and testing have been completed and are satisfactory to the OWNER and ENGINEER.
- B. The OWNER will be responsible to take and pay for all bacteriological samples and for laboratory testing services. The OWNER will submit the collected samples to a laboratory for analysis and satisfactory results shall be obtained before pipelines are placed into service.

END OF SECTION

SECTION 02731

OUTSIDE PIPING

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SECTION 02731

OUTSIDE PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish all labor and provide all materials and equipment necessary for the complete and satisfactory installation of all pipe, fittings and appurtenances to the lines, grades and elevations shown on the Contract Drawings and as specified herein.

1.02 SUBMITTALS

Shop drawings, shall be submitted for items specified herein as specified under section 01300 SUBMITTALS. Shop drawings shall be submitted for, but not limited to, the following materials, and shall include the following information:

- A. All pipe and fittings: Product information and dimensions; DR, pressure class and operating pressure rating; storage, handling and installation recommendations, manufacturer's recommended testing procedures, and jointing methods and procedures.
- B. All isolation valves, valve boxes, air release valves.
- C. Other items to be used in the work that is not specifically identified above shall be subject to shop drawing review at the option of the Owner.

1.03 MANUFACTURER'S CERTIFICATES

Certificates of Compliance and certified test results shall be submitted for all pipe and fittings stating the item supplied is in accordance with the requirements specified herein.

1.04 QUALITY ASSURANCE

- A. The Engineer will inspect all materials before, during and after installation to ensure compliance with these Contract Documents. When specific material tests are called for in the referenced standards and specifications, the Owner shall have the option of requiring that any or all of these tests be performed on materials furnished for a specified project.
- B. The Contractor shall schedule all tests with the Engineer at least 48 hours in

advance, and shall conduct all acceptance testing in the presence of the Engineer.

C. Field Tests

1. After installation, the Engineer will initially inspect outside piping and shall be Contractor tested for compliance with these Specifications. The contractor shall furnish all labor, tools, materials, water, and equipment, including pumps, compressors, stopwatch, gauges, and meters, for testing in accordance with these specifications.
2. All defects revealed by the tests shall be corrected without cost to the Owner. Tests and repairs shall be continued until test requirements are met. Repairs to the various systems shall be made with new materials. No caulking of threaded joints, cracks, or holes will be acceptable. When it is necessary to replace any piece of pipe, fitting, valve, etc., the replacement shall be of the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good.
3. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage will result from the application of the test pressure. Relief devices in the various systems shall be capped or plugged during the tests.
4. All equipment used in testing shall be provided by the Contractor and subject to the approval of the Engineer, and shall be such as to properly develop, maintain and measure hydrostatic test pressures and leakage rates. Where devices such as meters, recorders, charts, plugs, caps, blind flanges, corporation stops or bulkheads are required to develop, maintain and measure test pressures these devices shall be furnished and installed by the Contractor.
5. All required testing will be witnessed by the Sussex County Engineering Department and the Engineer.

1.05 GENERAL NOTES - PIPING

- A. Miscellaneous piping systems which may not be described specifically by any section of these specifications shall be of the type of pipe and fittings as shown on the drawings.
- B. The Contractor shall verify all dimensions of valves, special castings and fittings, pipe equipment, etc., so that all of the pipe work performed will fit together properly and will conform to the arrangement as shown on the

drawings. In selecting laying lengths of fittings, the Contractor shall be guided by the indicated dimensions on the drawings. All pipe and specials shall be accurate to the dimensions shown.

1.06 GENERAL NOTES - FITTINGS

- A. All fittings shall be of the type indicated on the drawings unless otherwise specified. Ferrous piping shall be provided with ferrous fittings.
- B. All flanges shall come fairly (regularly and evenly) face to face with the pipe in perfect alignment. The pipes shall not be sprung to make a joint. Gaskets for flanged joints shall be as specified under "Joints." All joints shall be made neatly and with great care.

1.07 REFERENCES

- A. Ductile Iron Pipe
 - 1. ANSI/AWWA C104/A21.4 Standard for Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water.
 - 2. ANSI/AWWA C110/A21.10 Standard for Ductile Iron and Gray Iron Fittings, 3 through 48 inches, for Water and Other Liquids.
 - 3. ANSI/AWWA C111/A21.11 Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
 - 4. ANSI/AWWA C115/A21.15 Standard for Flanged Ductile Iron Pipe with Threaded Flanges.
 - 5. ANSI/AWWA C150/A21.50 Standard for the Thickness Design of Ductile Iron Pipe.
 - 6. ANSI/AWWA C151/A21.51 Standard for Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids.
 - 7. ANSI/AWWA C153/A21.53 Standard for Ductile Iron Compact Fittings, 3 Inches Through 12 Inches (75 MM through 300 MM), and 54-inches through 64-inches (1400 mm through 1600 mm) for Water Service
 - 8. ANSI/AWWA C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.
 - 9. AWWA C504 Standard for Rubber-Seated Butterfly Valves.

10. AWWA C507 Standard for ball valves 6-inch through 48-inch (150mm through 1200 mm).
 11. ANSI/AWWA C512, Standard for Air Release, Air Vacuum, and Combination Air Valves for Waterworks Service.
 12. ASTM A536-84 Standard Specification for Ductile Iron Castings
- B. Polyvinyl Chloride Pipe (PVC)
1. ANSI/AWWA C900 AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 through 12 inches for water.
 2. ANSI/AWWA C905 AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 through 48 inches for Water Transmission and Distribution.
 3. ANSI/AWWA C909 AWWA Standard for Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 through 24 inches for Water, Wastewater, and Reclaimed Water Service.
 4. AWWA Manual M23; PVC Pipe - Design and Installation.
 5. ASTM D1784 Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
 6. ASTM D2241 - Standard Specification for Polyvinyl Chloride (PVC) Pressure Rated Pipe (SDR Series).
 7. ASTM D2412 - Test Methods for Determination of External loading Characteristics of Plastic Pipe by Parallel Plate Loading.
 8. ASTM D2321 - Standard Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
 9. ASTM D2466 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
 10. ANSI/ASTM D2774 - Recommended Practice for Underground Installation of Thermoplastic Pressure Piping.
 11. ASTM D3139 Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

12. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes using flexible elastomeric seals.
13. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. Reinforce Concrete Pipe (RCP)

1. ANSI/ASTM C76 – Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
2. ANSI/ASTM C443 – Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
3. AWWA C302 – Reinforced Concrete Culvert, Storm Drain and Sewer Pipe with Steel Ring and Rubber Gasket Joint.

PART 2 - PRODUCTS

2.01 GENERAL

All pipe and fittings shall be new, of the sizes indicated on the drawings or specified.

2.02 PIPE SCHEDULE

Service	Pipe Material	Pipe Fittings
- Air Low Pressure Piping	Ductile Iron (Glass Lined) AWWA C150 AWWA C151 AWWA C111 Push-on/Restrained Joint Pressure Class 250	Ductile Iron (Glass Lined) AWWA C110 or AWWA C153, and AWWA C111 Pressure Rating 350 psi
- Screened Effluent - Grit Facility Effluent - Aerated Lagoon Effluent - Secondary Clarifier Effluent	Ductile Iron (Double Cement Lined) AWWA C150 AWWA C151 AWWA C111 Push-on/Restrained Joint Pressure Class 250	Ductile Iron (Double Cement Lined) AWWA C110 or AWWA C153, and AWWA C111 Pressure Rating 350 psi

Service	Pipe Material	Pipe Fittings
- 12" FM (To Spray rig) - Filtered Effluent - Raw Sewage Influent - Non-Potable Water Line (4-inches and greater) - Waste Activated Sludge - Return Activated Sludge - Scum - Drainage Pump Station Effluent	AWWA C-900 PVC DR 18	Ductile Iron (Double Cement Lined) AWWA C110 or AWWA C153, and AWWA C111 Pressure Rating 350 psi
- Sump Discharge Line (less than 4-inches) - Non-Potable Water Line (less than 4-inches)	Solvent Weld Schedule 80 PVC	Welded Socket
- Drainage Pump Station Influent	PVC ASTM D-3034 SDR 35	PVC ASTM D-3034 ASTM F-477 SDR 26

Note: Restrained Joint Pipe and Fittings are only required where indicated on the contract drawings.

2.03 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe for buried service shall be furnished in accordance with ANSI/AWWA C151/A21.51-96 or latest revision thereof. All ductile iron pipe shall be double cement mortar lined or glass lined as per the pipe schedule above, with a bituminous coated exterior.
- B. Joints for buried pipe, fittings and specials shall conform to ANSI/AWWA C-111/A21.11-95 or latest revision thereof and may be either a "Mechanical Joint" or a "Push-On Joint." Push-on joints shall be the "Tyton" joints of the U.S. Pipe and Foundry Company, the "Fastite" joint of American Cast Iron Pipe Company, the Tyton joint of Griffin Pipe Products Company, "or equal". All pipe furnished with push on joints shall be jointed in accordance with the manufacturer's recommendations.
- C. Joint restraints for gasketed push on joint shall be "TR-Flex" of U.S. Pipe and Foundry Company, "Flex-Ring" or "LOK RING" of American Cast Iron Pipe Company, "Snap-Lok" or "Bolt-Lok" by Griffin Pipe Products Company, "or

equal,” designed for a maximum water working pressure of 250 psi.

- D. Joint restraints for gasketed push on joint shall be "TR-Flex" of U.S. Pipe and Foundry Company, "Flex-Ring" or "LOK RING" of American Cast Iron Pipe Company, "Snap-Lok" or "Bolt-Lok" by Griffin Pipe Products Company, “or equal,” designed for a maximum water working pressure of 250 psi.
- E. Mechanical joint restraints for use with mechanical joint pipe and fittings shall be Ebba Iron Megalug 1100 Series, “or equal.” The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint and its wedging components shall be made of grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53. Torque limiting twist off nuts shall be provided to insure proper actuation of the restraining wedges. The mechanical joint restraint shall have a rated working pressure of 350 psi in sizes 16" and smaller and 250 psi in sizes 18" and larger. The device shall be listed by Underwriters Laboratory through the 24" size and approved by Factory Mutual up through the 12" size. All wedge assemblies shall be coated with a minimum of two coats of liquid Xylan flouropolymer coating with heat cure to follow each coat. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. All casting surfaces shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact an UV resistance. The coating system for all mechanical joint restraints shall be mega-bond by Ebba Iron “or equal”.
- F. Fittings and specials shall be manufactured in accordance with ANSI/AWWA C110/A21.10-98 or latest revision thereof and shall be pressure rated for 250 psi for ductile iron. The ductile iron used in the manufacture of ductile iron fittings and specials shall have a minimum tensile strength of 70,000 psi. Compact fittings manufactured in accordance with ANSI/AWWA C153/A21.53-94 or latest revision thereof will be permitted.
- G Unless otherwise specified, the inside of pipe and fittings shall be cement-lined in accordance with ANSI Specifications A21.4 (AWWA C-104). Thickness of cement lining shall be twice the standard thickness specified in the paragraph, "Thickness of Lining," in Section 4.8 of ANSI Specifications A21.4 (AWWA C104) and the curing shall be effected by means of a seal

coating. The outside of buried pipe and fittings shall be bituminous coated. All exposed ductile iron pipe and fittings shall be shop primed (with primer compatible with field painting) on exterior surfaces and given required finish coats in the field.

- H. The curing shall be effected by the application of a petroleum base bituminous seal coating which shall continuously cover and seal the cement mortar. After drying for 48 hours, such bituminous seal coating shall have no deleterious effect upon the quality, color, taste, or odor of potable water which has been standing for 48 hours in the pipe. The bituminous seal coating shall be applied to the lining as soon as it is sufficiently dry. No pipe or fittings shall be shipped in less than 12 hours after the lining is thoroughly set and hard
- I. Where required or shown, the Contractor shall provide ductile iron specials. Specials shall in general, consist of spool pieces, less than standard lengths of flanged, spigot end, or bell end pipe, or combination of ends, and non-standard fittings. The specials shall conform in material, thickness and finish to the pipe in which they are installed. Tapped reinforced bosses shall be provided as an integral part of fittings when shown or specified.
- J. Each piece of pressure ductile iron pipe shall have the weight and class designation conspicuously painted on it as near as possible to the flanged or bell end of the pipe and these designations shall be clearly legible.
- K. The Mechanical Joint shall consist of a rubber or composition tapered gasket, a cast iron gland ring and cast iron T- Head bolts. The joint shall be affected in accordance with AWWA C600-99 or latest revision thereof.
- L. Bell joint clamps shall be style 60 as manufactured by Dresser Industries, "or equal," for push on type joints.

2.04 PVC PRESSURE PIPE AND FITTINGS

- A. All PVC pressure pipe shall be unplasticized polyvinyl chloride normal impact type in conformance with ASTM D-1784. The 1 1/2" -3" diameter PVC pressure pipe shall conform to the requirements of ASTM D2241 and have a minimum SDR of 21. All 4-inch and greater PVC pressure pipe shall be a minimum of DR18 and conform to AWWA C-900. All pipe shall be rated for a working pressure of at least 150 psi plus a surge allowance of at least 35 psi and shall have a minimum hydrostatic strength of 600 psi when tested in accordance with AWWA C-900.
- B. All PVC pipe shall be manufactured with integral wall bell and spigot which shall utilize a flexible O-ring gasket conforming to ASTM F-477. All pipe

ends shall be beveled to accept the gasketed fittings. Gaskets for push on joints and compression type joints, and mechanical joints for joint connections between pipe and metal fittings, valves and other accessories shall be as specified in AWWA C111/A21.11 for push on joints and mechanical joints.

- C. All fittings for PVC pressure pipe 4-inches and greater shall be ductile iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall be rated for 250 psi working pressure. Fittings shall be provided with mechanical joint retainer glands in accordance with ANSI A 21.11, except where noted on the plans. All fittings shall have a double cement mortar lining conforming to AWWA C104/A21.4.
- D. All fittings for 1 1/2"-3" PVC pressure pipe shall be manufactured in one piece of injection molded PVC compound meeting ASTM 1784. Fittings shall be class 200 and have a minimum SDR of 21. Fittings shall be designed to withstand a minimum of 630 psi quick burst pressure at 73 degrees F., tested in accordance with ASTM D 1599. Bells shall be gasketed joint conforming to ASTM D 3139 with gaskets conforming to ASTM F477.
- E. Each pipe section including bell or coupling shall be subjected to a hydrostatic test of more than 500 psi for at least five seconds. Pipe shall be tested in accordance with conditions in ASTM D618. Any pipe that leaks or is unable to withstand the test pressure shall be rejected. The test shall be conducted at the factory and certification stating that the operation has been conducted as specified and the pipe meets all conditions of this specification shall be submitted to the Engineer.
- F. Pipe shall be manufactured in lengths not exceeding 20 feet.
- G. Mechanical joint restraint gland for use with PVC AWWA C900 pipe shall be EBAA Iron Sales, Inc., Series 2000 PV mechanical joint restraint, "or equal." The restraint mechanism shall consist of a plurality of individually activated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. The gland shall be such that it can replace the standard mechanical joint gland and be used with a standard mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53. Twist off nuts, sized same as t-head bolts, shall be used to insure proper actuating of the restraining device. The restraining gland shall be pressure rated equal to that of the pipe on which it is used. The restraining glands shall have been tested to and meet the requirements of ASTM F1674-96, be listed by Underwriters Laboratories, and be approved by Factory Mutual. All wedge assemblies shall be coated with a minimum of two coats of liquid Xylan fluoropolymer coating with heat cure to follow each coat. All wedge assemblies and related

parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. All casting surfaces shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance. The coating system for all mechanical joint restraints shall be mega-bond by Ebba Iron “or equal”.

- H. Restraint for PVC pipe bells (AWWA C900) for C900 pipe 4"-12" shall be EBAA Iron Sales, Inc., Series 1600, “or equal.” Restraint for PVC bells (AWWA C900) for C900 pipe 14" and greater shall be EBAA Iron Sales, Inc., Series 2800, “or equal.” All such restraints shall have the same coating system as the described for the mechanical joint restraint gland.

2.05 PVC PIPE, LATERALS AND FITTINGS FOR GRAVITY SEWER

- A. PVC used for sewer construction shall meet or exceed the requirements of ASTM D-3034 for all PVC pipe less than 18" and ASTM F-679 for pipe 18" and larger. Pipe shall be polyvinyl chloride gravity sewer pipe with integral wall bell and spigot rubber gasketed joints in standard lengths not exceeding 20'. All pipe for PVC gravity sewers and laterals shall be SDR 35 unless otherwise noted as requiring the installation of PVC meeting AWWA C-900. All gaskets shall conform to ASTM F 477.
- B. All bells shall consist of an integral wall section with a flexible elastomeric O-ring gasket joint assembled in accordance with the manufacturer's recommendations. All seals shall be securely locked in place to prevent displacement. Pipe length shall be either 12.5 or 20 feet.
- C. Pipe shall be designed to have a minimum pipe stiffness of 46 psi when measured under a 5% deflection at 73 degrees F, as tested in accordance with ASTM D-2412.
- D. PVC laterals shall be manufactured in accordance with the same specifications, and have the same thickness, depth of socket, and annular space as the pipe.
- E. Wye branches shall be complete pipe sections. Saddles will not be permitted for new construction. Gaskets for fittings shall conform to ASTM F-477. All PVC sewer fittings shall be SDR26 Heavy Duty fittings unless otherwise noted on the plans as requiring C-900 PVC fittings. All sewer fittings shall be as manufactured by Harco, Plastic Trends, or Multi Fittings.
- F. All PVC sewer pipe shall be J-M, Certain Teed PVC sewer pipe, “or equal”.

2.06 CONCRETE PIPE AND FITTINGS

- A. All Reinforced Concrete Pipe (RCP) shall be in conformance with ASTM C76, Class III with bell and spigot. Pipe joints shall be manufactured on machined equipment and joint surfaces shall be smooth and concentric with no diameter varying from the theoretical by more than 1/16 inch.
- B. Minimum laying length shall be 5 feet for sizes 12 inches and 15 inches, and 7.5 feet for sizes 18 inches and above.
- C. Concrete mix design, wall thickness, amount of reinforcing steel, and position of reinforcing cages shall be such that the pipe's crushing strength (3 edge bearing) equals or exceeds the pipe classes outlined herein. The bell and spigot areas shall contain not less than two layers (inner and outer) of longitudinal and circumferential steel designed to withstand the compression of the gasket as well as all other forces with steel area and sizes to be not less than for the pipe barrel reinforcement or for single reinforcing layer designs. The second layer to extend not less than 12 inches each side of joint. At least two lines of circumferential steel to be placed in bell area over gasket as part of bell reinforcing. All inner longitudinal steel to be welded to the steel ring joints. For concrete joints, the bell and spigot reinforcing to be welded to the pipe barrel reinforcing.
- D. Each section of pipe and fitting shall be steam cured in a moist atmosphere at uniform 110 degrees temperature for a minimum time period of 12 hours.
- E. Lifting holes, if used in the pipe, shall be permanently sealed with non-shrink grout.
- F. Fittings and special shapes shall be manufactured in accordance with the above requirements and the drawings.
- G. Fittings and specials shall match the size and class of pipe with which they are to be used.
- H. Fittings made for connection to catch basin laterals if not connected to manholes shall be wye or tee branch fittings, and shall be manufactured as follows. A scarified opening shall be made in the wall of the main pipe prior to curing. After curing is complete, the reinforcing steel in the opening shall be cut. A short section of bell end pipe of required size shall then be inserted into the opening and the annular space tightly packed with an epoxy mortar; the mortar being built up around the pipe to a point just behind the bell in a neat workmanlike manner. The mortar shall be made up using dry sand and "Armor-Weld No. 178" epoxy material, or "Embeco 536" non-shrink grout, or equal, following the manufacturer's directions.

- I. Joints for storm sewers shall be designed, manufactured and installed using O-ring rubber gasket joint conforming to ASTM C433. Steel spigot ring and steel bell ring with rubber O-ring gaskets of the "Snap-On" type (referred to as O-ring gaskets). Steel for joint rings shall conform to the requirements of AWWA Specification 302. The gasket shall be smooth, solid rubber of circular and uniform cross section conforming to Section 3.4 of AWWA Specification C302.
- J. Concrete pipe outlets shall be cast-in-place reinforced concrete head walls, with apron and tapered sides.

2.07 CLEANOUTS

- A. Cleanout frames and covers shall be constructed as indicated on the construction drawings. All cleanout frames and covers shall be cast iron. Cleanout frames and covers shall be watertight with recessed lifting holes.
- B. Sewer Lateral Cleanout Frames and Covers - Cleanout frames and covers shall be cast iron. Cleanout frames and covers shall be watertight with recessed lifting holes. Terminal Sewer cleanout frames and covers shall be East Jordan Iron Works Model MHR 1180, "or equal," for use with PVC pipe. House lateral cleanout frames and covers shall be East Jordan Iron Works Models 1565, or 1566, "or equal," for use with PVC pipe. Cleanout frames and cover shall be manufactured in the United States of America using American steel. See drawings for details.
- C. Each lot whether developed or undeveloped shall receive one sewer lateral and cleanout unless otherwise directed by the Engineer.

2.08 PIPELINE DETECTION SYSTEM

- A. Pipeline detectable tape shall be installed continuously along all Non-metallic utility lines. The tape shall be Lineguard type III Detectable Tape as manufactured by Lineguard, Inc., "or equal." The tape shall be a minimum of three (3) inches wide, yellow in color, imprinted with the words, "CAUTION – BURIED PIPELINE BELOW".
- B. Pipeline detectable wire shall be installed along the full length of all non-metallic pipe. The wire shall be insulated (green in color), solid copper, #14 AWG, 600 volt, of not less than 98% conductivity, conforming to ASTM Designation B.58. Splicing of wires shall be by a solderless, split bolt bug connector as Manufactured by ILSCO type DBK-1 connector "or equal". Removal of the insulation at the splice is required, so a metal connection is made. Placement of the wire shall be on top of the pipe. The wire shall be so

placed that it and the force main will not be separate by more than 3 inches. The wire shall be attached to the top of the pipe as indicated on the details prior to any backfilling. The wire shall be brought up to the surface of the ground at the beginning and termination of the pipe, at any in line valving (interior of the valve box) or any other appropriate location, or as directed by the Engineer.

2.09 GATE VALVES

- A. Gate valves shall be of the solid wedge, rubber encapsulated, resilient seat type. Valves shall be rated for 250 psi working pressure and hydrostatically tested to 500 psi in accordance with AWWA C-515. Valve bodies, bonnets and seal plates shall be ductile iron, with wedges totally encapsulated in rubber. Stems shall be manganese bronze. Bolts and hex heads shall be stainless steel.
- B. Resilient Seated Gate Valves shall be operated to open left of the non-rising stem type (NRS) in accordance with AWWA-C-515. NRS stem thrust collars shall be cast integral with the stem and machined to size. A stainless steel thrust bearing shall be incorporated, as required, to optimize operating torques. Operating stems for NRS Resilient Seat Gate Valves shall be equipped with O-Ring seals to prevent leakage past stem. All valves shall have two O-Rings above the stem thrust collar and one o-ring below.
- C. The internal and external iron surfaces of the valve body and bonnet shall be coated with fusion bonded epoxy to AWWA C-550 Standards. Gates for all valve sizes shall be completely encapsulated with elastomer including stem bore, and shall be field replaceable and provide a dual seal on the mating body seat. Valve shall be capable of installation in any position with rated sealing in both directions. Elastomer seats of specially compounded material shall be utilized and be capable of sealing under normal conditions. The valve body shall have integral guides engaging integral lugs in the gate in a tongue and groove manner, supporting the gate throughout the entire open/close travel. The inside and outside of valve body, bonnet and seal plate shall be coated with fusion bonded epoxy meeting AWWA-C-550 latest revision.
- D. Gate valves 18-inch and above shall be provided with spur gearing. All gate valves 18-inch and larger where the depth of cover prohibits installation of valve and valve box below grade shall be provided with bevel gearing.
- E. Buried valves shall be furnished with mechanical joint ends as indicated on the drawings. All tapping valves shall be supplied with flanged connection as required for connection to tapping sleeve.

- F. Marking shall be in accordance with AWWA-C-515 Standards, to include name of manufacturer, the year of manufacture, maximum working pressure and size of valve. Resilient seated gate valves shall be covered by a ten year limited warranty against defective materials or workmanship.
- G. Resilient seated gate valves shall be Mueller 2300 series, American flow control Series 2500 “or equal”.

2.10 VALVE BOXES

- A. Valve boxes for force main isolation valves 3” and smaller shall be three piece screw type with 5-1/4-inch shafts and N-6 round bases. Valve boxes shall be adjustable to the depth of the force main. Each valve shall have a two foot square concrete collar poured around it if not located within pavement. Lids shall be extra deep with two holes and the word “SEWER” cast in the upper surface.

2.11 POST HYDRANTS

- A. All Post Hydrants shall be self-draining, non-freezing, compression type with 2 1/8” opening. Inlets and outlets shall be 2-inches. Hydrants shall have ductile iron exterior casing pipe, a galvanized interior non-turning operating rod with heavy cast iron top stock. Principal interior operating parts shall be brass, bronze and aluminum and shall be removable for servicing without excavation. Hydrants shall have a 3.5’ bury depth and shall be set in 4 cubic yards of crushed stone to allow for proper drainage of the hydrant. Install the hydrant in accordance with AWWA recommendations. Hydrants shall be #2 Eclipse Post Hydrant as manufactured by John C. Kupferie Company or equal.

PART 3 - EXECUTION

3.01 PIPE INSTALLATION - GENERAL

- A. Contractor shall adhere to the manufacturer's recommended installation procedures.
- B. The pipe and accessories shall be inspected for defects prior to installation. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Owner.
- C. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipelines shall be covered to keep dirt and other substances from entering. The cover shall be kept in the end of the pipelines at all times when laying is

not in actual progress.

- D. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of debris into the line. If water enters the trench, the Contractor shall prevent the pipe from floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench conditions or the weather are unsuitable for proper installation as determined by the Owner.
- E. The pipe shall be cut in accordance with the manufacturer's recommended procedures. Cuts shall be completed in a neat and workmanlike manner without damage to the pipe so as to have a smooth end at right angles to the axis of the pipe.
- F. No pipe shall be laid upon the foundation into which frost has penetrated nor at any time when the Engineer shall deem that there is danger of formation of ice or the penetration of frost at the bottom of the excavation.
- G. Pipe bedding shall be in accordance with Section 02200, EARTHWORK, EXCAVATION, TRENCHING AND BACKFILLING.

3.02 DUCTILE IRON BURIED PIPE INSTALLATION

- A. Ductile iron pipe, fittings, valves and appurtenances shall be handled, stored and installed in accordance with AWWA C600-99 or the latest version thereof.
- B. All piping and restrained joints shall be joined in full conformance with the manufacturer's recommendations. The rubber gasket shall be the sole element depended upon to make the joint watertight.
- C. The maximum joint deflection allowed shall not exceed 70% of the values shown in Table 4, AWWA 600-99 for mechanical joint pipe and 70% of the manufacturer's maximum allowable deflection for restrained joint push on pipe.
- D. Before joints are made, such pipe shall be well bedded on a solid foundation in compliance with the trench details and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secure in place. Any defects due to settlement shall be made good by the Contractor at his own expense. Bell holes shall be dug large enough to insure the making of proper joints.
- E. Couplings or sleeves are to be placed as needed.

- F. Whenever ductile iron pipe requires cutting in the field, the work shall be done in a satisfactory manner which will leave a smooth end and not otherwise damage the pipe or lining.

3.03 PVC PIPE INSTALLATION

- A. PVC pipe shall be installed in accordance with the Standard Details and AWWA Manual M23: PVC Pipe-Design and Installation. All pipe, fittings, valves and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench.
- B. The pipe and accessories shall be inspected for defects prior to lowering into trench. Bowed sections of PVC pipe will not be acceptable. Any installation of pipe which has been bowed, whether or not the bow has been corrected, will not be allowed. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Engineer.
- C. The sealing surface of the pipe, the bell to be joined, and the elastomeric gaskets shall be cleaned immediately before assembly, and assembly shall be made as recommended by the manufacturer. When pipe laying is not in progress, the open ends of installed pipe shall be closed to prevent entrance of trench water into the line. Whenever water is excluded from the interior of the pipe, enough backfill shall be placed on the pipe to prevent floating. Any pipe that has floated shall be removed from the trench and the bedding restored. No pipe shall be laid when the trench conditions or the weather are unsuitable for proper installation as determined by the Engineer.
- D. The pipe shall be cut in a neat and workmanlike manner without damage to the pipe so as to have a smooth end at right angles to the axis of the pipe.
- E. The push on joint is assembled by positioning the elastomeric gasket(s) in the annular groove(s) of the bell or coupler and inserting the spigot end of the pipe into the bell compressing the gasket radially to form a positive seal. The gasket and annular groove are designed, sized and shaped so that the gasket will resist displacement. Care shall be taken so that only the correct elastomeric gasket compatible with the annular groove(s) of the bell or coupler is used. Insertion of the elastomeric gasket in the annular groove must be in accordance with the manufacturer's recommendations.
- F. PVC pipe shall be delivered and stockpiled in unit pallets. No stacking of pallets above 5' will be allowed. If pipe is stockpiled for more than 30 days prior to installation, it must be suitably covered with reflective material to protect the pipe from ultraviolet rays resulting from sunlight. Plastic sheets

shall not be used for protection. Air circulation shall be allowed under any covering.

3.04 RCP PIPE INSTALLATION

- A. The Contractor shall furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from storage areas to the trench shall be restricted to operations that can cause no damage to the pipe or lining or coatings.
- B. The pipe shall not be dropped from trucks onto the ground or into the trench.
- C. Pipe laying shall proceed upgrade with spigot ends pointing in the direction of flow.
- D. Each pipe section shall be placed into position in the trench on the pipe bedding in such manner and by such means required to cause no injury to the pipe, persons, or to any property.
- E. Pipe shall be installed so that a pipe joint occurs not more than 2 feet from the outside face of the wall manholes or structures to which the pipe connects.
- F. The pipe fittings and specials shall be firmly bedded in the pipe foundation so that the pipe barrel is uniformly supported and cradled throughout its length.
- G. Blocking will not be permitted under the pipe, except where the pipe is to be installed in concrete encasement or concrete cradle.
- H. Holes and depressions in the pipe foundation shall be provided to receive bells, couplings, or similar projections to assure proper bedding of the pipe barrel.
- I. When the pipe is in proper position it shall be joined or coupled to the mating end of the previously laid pipe, using the required joint and using the manufacturer's recommended assembly procedure. For reinforced concrete pipe with gasket-type joint, coat the rubber gasket with recommended lubricant and snap into place in the groove provided at the spigot end. Before the joint is shoved home, fill the outer joint space with a continuous loop of polyurethane foam and unhydrated Portland cement or Butyl mastic recommended by manufacturer. When the joint is shoved home, the material should be squeezed firmly against the shoulder of the spigot to completely fill and seal the outer joint space.
- J. After the pipe has been joined the pipe bedding material to be placed and

spread in maximum 8-inch layers to the midpoint of the pipe.

- K. Each layer compacted using mechanical compactors and hand tamping with T-Bars or shovel slicing so the pipe barrel is firmly embedded in the pipe bedding material.
- L. If inspection of the pipe indicates that the pipe has been properly installed as determined by the Engineer, the Contractor may then continue to spread the pipe foundation material to 12 inches over the top of pipe.
- M. The pipe foundation above the midpoint of the pipe shall be spread and compacted in 12-inch layers to 12 inches above the top of the pipe.
- N. After completing the pipe foundation to 12 inches above the top of the pipe the Contractor may then backfill the remainder of the trench in accordance with the earthwork specification and the typical trench details shown on the Drawings.
- O. The completed assembly of pipe sections shall form a storm sewer with uniform slope.
- P. Manufactured pipe plugs or temporary bulkheads shall be placed in the open ends of sewer lines whenever pipe laying is stopped overnight, over weekends, or whenever dirt or debris could enter the pipeline during construction.
- Q. At the end of each day's work or at intervals of length at the option of the Engineer, the Engineer, with the Contractor, will check the grade and inspect the pipe for alignment with lamps or mirrors. Defective work shall be dug up and reinstalled to the satisfaction of the Engineer.
- R. Where shown on the Drawings, the storm sewers shall be installed with a headwall at its discharge end. Headwall details are shown on the Drawings.

3.05 TESTING OF PIPE

- A. The Contractor shall schedule all tests with the Engineer at least 48 hours in advance, and shall conduct all acceptance testing in the presence of the Engineer.
- B. All testing shall be initiated within 45 days of initial utility installation and coordinated with final restoration time requirements.
- C. Generally, piping, fittings and appurtenances will be tested from end to end. Pressure and leakage tests shall be performed.

- D. The Contractor shall be responsible for the testing of all pipelines. The Contractor is responsible for supplying all labor and materials involved for all tests. All testing shall be performed at the expense of the contractor.
- E. If the piping or any section or component thereof fails the tests and/or inspection, the Contractor shall, at his own expense, repair and replace any defective component and retest until all requirements are met. The County will furnish personnel to witness tests, one time only. If additional tests are required, all costs of County personnel and equipment will be deducted from amounts to be paid the Contractor.

3.06 TESTING OF PRESSURE PVC/DIP PIPE

- A. Pressure Test - After backfilling has been completed, all newly laid pipe and any valved section thereof shall be subject to a hydrostatic pressure test of 150 psi for a duration of two hours with the pressure measured at the highest elevation on the line. The procedure for the pressure test shall be as follows:
 - 1. Each valved section of pipe 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 manner satisfactory to the Engineer.
 - 2. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation stops at such points so the air can be expelled.
- B. Leakage Test - After satisfactory completion of the pressure test, the Contractor shall conduct a leakage test. The Contractor shall furnish the gauge and measuring device for the leakage test. The Contractor shall furnish the pump, pipe connections, and other necessary apparatus. Leakage shall be defined as the quantity of water that must be supplied into a newly laid pipe or any valved section, to maintain the specified leakage test pressure. After the air in the pipeline has been expressed and the pipe has been filled with water, the allowable leakage shall be not more than 25 gallons of water per inch diameter of pipe per mile of pipe tested per 24 hours at a pressure of 100 psi, measured at the highest elevation. Leakage test shall be carried out for not less than a four hour duration and the allowable leakage prorated accordingly. Failure of the line to pass either the pressure or leakage test shall be cause for the test failure. The Contractor shall effect the necessary repairs and retest the line until it passes both tests. All tests shall be conducted in the presence of the Engineer.

3.07 TESTING OF SANITARY SEWERS

-
- A. Prior to the request for Substantial Completion, it shall be the Contractor's responsibility to examine all completed pipelines to insure that they are laid at the proper alignment and grade and free from foreign material. After this has been done to the satisfaction of the Engineer, he will order the tests on all sewers built under the contract. The Contractor shall cooperate and furnish all assistance and materials necessary to perform the tests specified herein and as directed by, and under the direction of the Engineer.
- B. All sanitary sewers installed shall be subject to Mirror Testing and Deflection testing as specified below. In addition, the Contractor shall provide either Air or Exfiltration / Infiltration testing as specified below.

1. Mirror Testing of Sanitary Sewers

Upon Completion of Pipe laying and backfilling, the Engineer will conduct a mirror test to check for defects, or leakage, and for horizontal or vertical misplacement. Mirror testing shall consist of reflecting sunlight or artificial light via mirrors through the completed section of pipeline, which, in order to be accepted, shall be true and straight in horizontal and vertical alignment to allow full passage for the reflected light.

2. Deflection Testing of Sanitary Sewers

a. Sanitary sewers shall be tested in the presence of the Engineer and the Contractor's representative to determine the amount of vertical deflection in the completed pipeline. Deflection testing as specified hereinafter shall be accomplished by the Contractor on all sanitary sewers installed. Should significant failures be detected, additional deflection testing shall be performed by the Contractor. Installation of Sanitary sewers shall be complete prior to the start of deflection testing. All sheeting shall be removed except where written approval by the Engineer has been obtained. All backfill shall be placed, consolidated and dewatering operations ceased 30 days prior to the start of deflection testing. The following method of testing shall be utilized.

b. A mandrel with a diameter equivalent to 95% of the inside diameter of the pipe to be tested shall be pulled through the pipeline, from manhole to manhole, by hand. If it is unable to pass through the pipe without applying excessive force (as judged by the Engineer), it will be considered as evidence that the pipe has deflected more than 5% of the inside pipe

diameter. A permanent record of all testing locations where excessive pipeline deflections occur shall be kept by the Contractor and forwarded to the Engineer after the completion of testing of each line. The mandrel shall be approved by the Engineer prior to use. Mandrels shall have an odd number of gaging plates. The minimum number of plates shall be nine (9) with a contact surface length equal to the inside diameter plus two (2) inches for pipelines 10 inches in diameter and smaller. On larger diameters, the contact surface length shall equal the inside pipe diameter. The Contractor shall immediately replace all sections of pipe which deflect more than 5% as measured by the foregoing method.

3. Air Testing

- a. All sanitary sewers shall be tested with air under low pressure in accordance with subsequent designated procedures, and will not be accepted by the Owner until the sewers meet with the specified criteria. Pressure gauges, stop watches, air compressor, hoses, plugs, and test supervision shall be furnished by the Contractor. All tests shall be conducted by the Contractor in the presence of the Engineer. The Contractor shall not be permitted to place air under pressure in any sewer under any circumstances except those explicitly mentioned herein.
- b. All sanitary sewers, including manholes, shall be inspected prior to air testing and any water leakage into the system sufficient to constitute any noticeable trickle or dribble shall be corrected and eliminated prior to undertaking the low pressure air test.
- c. Whenever it has been necessary to construct underdrains or place gravel under pipelines in order to dewater the trench during construction of the sewers, the air test shall not be made until any pumps which have been used in the dewatering process have been removed from the site.
- d. Before any air test is scheduled, the Contractor shall have completed all backfill operations including compaction testing.
- e. The Contractor shall schedule all air tests with the Engineer at least 48 hours in advance thereof. Each section of completed sewer shall be tested. Generally, the sewers will be tested

from manhole to manhole or from a manhole to the terminus of the sewer if there is no manhole at the other extremity.

- f. The test procedure shall be conducted in the following manner:
 - i. The Contractor shall thoroughly clean and remove all debris, silt, earth, or other material from the sewer prior to air testing. The pipe may be cleaned with water in a manner approved by the Engineer. None of this water or debris shall be allowed to enter the existing sewer.
 - ii. All branch fittings and end of laterals stubs shall be securely plugged to withstand the internal test pressures. The section of line being tested shall also be securely plugged at each manhole. All stoppers shall be adequately braced when required.
 - iii. If the pipe to be tested is expected to be below the groundwater table, the Contractor shall install either a small diameter perforated vertical pipe from the invert elevation of the sewer to the surface prior to backfilling or shall insert a pipe probe by boring or driving into the backfill material adjacent to the invert elevation of the pipe and shall determine the depth of the groundwater level above the pipe invert immediately prior to air testing the sewer. All gauge pressures in the test shall be increased by the amount of this back pressure due to groundwater submergence over the end of the probe.
 - iv. The Contractor shall add air slowly through a single control panel to the portion of the pipe under test until the internal air pressure is raised to 4.0 psi gauge greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of the test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the Contractor shall conduct only an infiltration test.
 - v. As a safety precaution, no one shall be allowed in a manhole after the air pressure is increased in the

sewer line. If the Engineer suspects that the test plug may be leaking, the pressure first shall be relieved before any adjustments are made to eliminate air leakage at the plug. The Contractor may precoat the plug with a soap solution to check the plug for leakage.

- vi. The Contractor shall allow the air temperature to stabilize for at least 2 minutes with the pipe subjected to an internal pressure of 4.0 psi by adding only the amount of air required to maintain this pressure.
- vii. After a 2-minute period, the Contractor shall completely disconnect the hose and compressor from the pipe being tested to assure that no additional air is added therein.
- viii. The rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease 1 lb/square inch.
- ix. The line shall be considered acceptable if the time, in seconds required for a 1 psi pressure drop is not less than the following:

$$T = 0.0850 DQ/K$$

Where;

K= 0.000419 DL, but not less than 1.0

Q= rate of loss of 0.0015 cu. ft/min/sq. Ft. of internal surface.

D= Pipe Diameter, in.

L = Length of line being tested, ft.

See the attached table 1 for specification time required for a 1 psig pressure drop for size and length of pipe indicated for Q=0.0015.

A sample air test data sheet is attached for Contractors use.

- x. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section.

- xi. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in the tables shall be deemed to have failed to pass the low pressure air test and is unsatisfactory for acceptance by the Owner. Any sewer that fails to pass this test shall be repaired by the Contractor at his own expense. Following repairs, the sanitary sewer shall be tested again in accordance with the designated procedures.

4. Infiltration and Exfiltration Tests

- a. Leakage, whether infiltration or exfiltration shall not exceed a rate of ten gallons per inch of diameter per mile of sewer per twenty-four hours in any section of piping between successive manholes.
- b. Infiltration testing shall take place when the natural ground water table is above the crown of the piping at the higher end of the TEST SECTION. The amount of leakage shall be measured by a suitable weir or other devices as directed. Exfiltration tests shall be made of each section as directed.
- c. A section of sewer line shall be prepared for testing by plugging the upper side of the downstream manhole and all openings in the next upstream manhole except the downstream opening. The maximum head on any section under test will not exceed thirty feet for PVC pipe. Branch sewers running from Y-branches on the MAINS shall be plugged at the upper end (C.O. location) if the test head would cause them to overflow.
- d. A section of sewer line prepared as above shall be tested by filling it with water to an elevation of one foot above the top of the pipe in the upstream manhole, in mains without laterals or the test head must exceed the highest house service elevation, whichever is greater. The water should be introduced into the test section at least four hours in advance of the official test period to allow the pipe and joint material to become saturated with water. All entrapped air shall be removed prior to performance of test.
- e. At the beginning of test the elevation of the water in the upper

manhole shall be carefully measured from a point near the water level such as a manhole rung. After a period of six hours or more, with the approval of the Engineer, the water elevation shall be measured from the same point on manhole rung and the LOSS of water during test period calculated. Sewer section showing leakage in excess of that allowed shall be repaired or reconstructed as necessary then retested.

3.08 TESTING OF UTILITY TONE WIRE

The Contractor shall coordinate with the Sussex County Engineering Department to tone all utility wires after final pressure testing has been completed. All inadequacies in the toning wire shall be immediately repaired by the Contractor at his expense to the complete satisfaction of the Engineer.

3.09 DEFECTS TO BE MADE GOOD

If at any time before the expiration of the guarantee period under this contract, any broken pipes or any other defects are found in any of the lines or in any of their appurtenances, the Contractor shall cause the same to be removed and replaced by proper material and workmanship, without extra compensation for the labor and material required, even though such injury or damage may not have been due to any act, default, or negligence on the part of the Contractor. All materials shall be carefully examined by the Contractor for defects just before placing and any found to be defective shall not be placed in the line.

3.10 EXISTING UTILITIES

- A. Existing utilities have been indicated on the drawings in accordance with the information shown on record drawings. The Owner expressly disclaims any responsibility for the accuracy or completeness of information shown. It shall be the Contractor's responsibility to verify the location and size of existing piping.
- B. Existing utilities and service shall be carefully protected; all damage to utilities by the work shall be immediately repaired by the Contractor to the satisfaction of the Engineer, using materials of the kinds damaged. No additional payment will be made for such repair work. The Owner assumes no responsibility for damages or downtime for the Contractor or their subcontractors resulting from the inadequate or negligent performance by utility locators.
- C. The Contractor shall bear the entire cost of all monetary penalties which may be assessed by utility companies whose facilities are damaged and/or put out of service by the Contractor during the prosecution of the work.

- D. Where new piping is to be connected to existing piping, the Contractor shall drain or purge the existing piping, cut, grind and prepare the existing piping in every respect in order that it be suitable for connecting to the new piping.
- E. Where existing piping is to be abandoned and removed, the Contractor shall not reuse the piping on the project. Abandoned piping remaining in place shall be plugged and capped using retainer glands. Piping that has been removed shall be hauled offsite and disposed by the Contractor.

3.11 LAYING FITTINGS, VALVES AND VALVE BOXES

- A. Fittings, valves, and valve boxes shall be placed along the sewer force mains where shown on the drawings or where designated by the Engineer.
- B. A valve box shall be carefully placed over the bonnet of each plug valve with the top at finished grade and it shall be set exactly plumb. In tamping and backfilling around the box, special care shall be taken to keep the box plumb and to have it firmly supported so as to avoid settlement. Any box which is found out of plumb, or which is not firmly supported, shall be dug up and reset in a satisfactory manner, at the Contractor's expense.

3.12 YARD HYDRANT INSTALLATION

- A. Hydrants shall be set so that the barrel is truly vertical, and shall be properly backfilled so that the barrel will remain truly vertical.
 - 1. They shall be placed with 3 cubic feet of crushed stone pocket to provide drainage for the hydrant.

END OF SECTION

SECTION 02930

FINE GRADING, SEEDING AND LANDSCAPING

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SECTION 02930

FINE GRADING, SEEDING AND LANDSCAPING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes seeding, sodding, and associated efforts as required for restoration and restabilization of disturbed areas and landscape plantings in accordance with the Contract Documents and other plantings as may be directed by the Engineer.

1.02 CONSTRUCTION CRITERIA

Provide seeding on all disturbed and filled areas. Landscaping shall be installed in locations as shown on the contract documents. Landscaping shall be installed in locations as shown on the contract documents.

1.03 REGULATIONS

- A. Delaware Erosion and Sediment Control Handbook shall govern material and construction methods, unless otherwise specified.
- B. Horticultural methods and standards as to size and quality shall conform to "USA Standard for Nursery Stock" of the American Association of Nurserymen, 1990 Edition.
- C. All materials installed within DelDOT rights of ways shall meet DelDOT standard specifications.

PART 2 - PRODUCTS

2.01 TOPSOIL

General Requirements

- A. Materials - Topsoil shall be a loam, sandy loam, clay loam, silt loam, sandy clay loam, loamy sand or other soil as approved by an agronomist or soil scientist. It shall contain no more than 5 percent by volume of cinders, stones, slag, coarse fragment, gravel, sticks, roots, trash or other extraneous materials larger than 1-1/2 inches in diameter. Topsoil must be free of plants or plant parts of bermudagrass, quackgrass, Johnsongrass, nutsedge, poison ivy, thistles, or others designated as noxious weeds by

the Delaware Department of Agriculture and contain no organic or inorganic substances deleterious to plant growth.

All topsoil shall be tested by a reputable laboratory for organic matter content, pH and soluble salts. A pH of 6.0 to 7.5 and an organic content of not less than 1.5 percent by weight is required. If the pH value is less than 6.0, lime shall be applied and incorporated with the topsoil to adjust the pH to 6.5 or higher. Topsoil containing soluble salts greater than 500 parts per million shall not be used.

No sod or seed shall be placed on soil which has not been treated with soil sterilants or chemicals used for weed control until sufficient time has elapsed to permit dissipation of toxic materials.

- B. Topsoil salvaged from the existing site may be used if it meets the standards as set forth in these Specifications. The depth of topsoil to be salvaged shall be no more than the depth described as a representative profile for that particular soil type as described in the soil survey published by the USDA-SCS in cooperation with the Delaware Agricultural Experimental Station.

2.02 TURF SEED

- A. For the periods March 1 thru April 30, and August 1 thru November 30, seed with 150 lbs. per acre (1.4 lbs. per 1,000 sq. ft.) of improved turf-type varieties of tall fescue. For the period May 1 thru July 31, seed with 150 lbs. of improved turf-type varieties of tall fescue per acre and 6 lbs. per acre (0.05 lbs. per 1,000 sq. ft.) of weeping lovegrass. During the period of December 1 thru February 28 protect site by the following options:
 - 1. Two tons per acre of well anchored straw mulch with seeding to be executed at the beginning of the next planting season.
 - 2. Sod.
 - 3. Seed with 60 lbs. per acre of improved turf-type varieties of tall fescue and mulch with 2 tons per acre of well-anchored straw.
- B. Seed purity and germination shall be in accordance with the Delaware Department of Agriculture Standards. Seed that has become wet, moldy or otherwise damaged prior to seeding will not be acceptable.

2.03 FERTILIZER

- A. The Contractor may submit soil samples to an approved soils testing laboratory for fertilizing recommendations.
- B. Fertilizer shall be uniform in composition, free flowing and delivered to the site fully labeled according to applicable State fertilizer laws and shall bear the name, trade name or trademark and warranty of the producer.
- C. Otherwise, provide fertilizer at the following rates:

- 1. Temporary Turf Seeding:

Supply N-P-K 10-10-10 fertilizer or approved equivalent at the rate of 600 pounds per acre or 14 pounds per 1,000 square feet.

- 2. Permanent Turf Seeding:

Apply fertilizer according to the recommendations of a soil test. When soil testing is not possible or impractical, apply fertilizer with a N-P-K ratio of 10-10-10 at the rate of 1,000 pounds per acre or 23 pounds per 1,000 square feet. Apply fertilizer uniformly and incorporate into the top 4 to 6 inches of soil.

- 3. Landscaping:

Utilize controlled release fertilizer granules or tablets with a N-P-K ratio of 10-18-10 or similar composition in accordance with manufacturer's instructions.

2.04 LIME

Apply pulverized dolomitic limestone materials for turf grass according to the recommendations of a soil test. When soil testing is not possible or impractical, apply dolomitic limestone at the rate of 100 pounds per 1000 square feet. Apply limestone uniformly and incorporate into the top 4 to 6 inches of soil.

The soil should be tested in areas receiving landscaping to determine if limestone is needed to maintain pH between 3.5. and 5.8.

2.05 MULCH

- A. Mulch for protection of permanent seeding shall conform to the following requirements:

1. Clean, weed free, unrotted straw (not less than 48 hours after mowing) shall be applied at a rate of not less than 70 pounds per 1,000 square feet (1 1/2 tons per acre) and shall be anchored with: mulch anchoring tool (flat slopes), mulch nettings, cut back and emulsified asphalt (five gallons per 1,000 square feet), Curasal (5 gallons per 1,000 square feet) Tera Tack II (20 gallons per 1,000 square feet), or Petroset (manufacturer's recommendations). On slopes 8 feet or more high, the rate of liquid binders shall be increased by 60%.
 2. Mulch nettings, jute or excelsior blanket.
- B. Mulch utilized as temporary protection and stabilization shall conform to the above materials requirements. Rate of application shall be as directed by the Engineer.
- C. Mulch for landscape plantings shall be fine ground pinebark or shreaded hardwood. It shall be composted, nitrogen stabilized, aged a minimum of 6 months and be free of noxious weed parts and substances deleterious to plant growth. It shall have uniform color and texture with pieces no larger than 2 1/2 inches in any direction.

2.06 PLANTS

Provide plant material as indicated on the Drawings. Plants shall be commercially grown and meet the standards set forth in the latest edition of the American Standards for Nursery Stock.

PART 3 - EXECUTION

3.01 TOPSOIL

- A. Grading - Grades in all areas temporarily disturbed by pipeline installation shall receive three inches of topsoil and be restored to preconstruction condition. Grades around pump stations and other structures shall be established in accordance with the plans and utilize 6 inches of topsoil.
- B. Liming - In areas where the need for liming has been indicated by soil testing, the recommended amounts shall be distributed uniformly over designated areas and worked into the soil in conjunction with tillage operations as described in the following procedures.
- C. Tilling - After the areas to be topsoiled have been brought to grade, and immediately prior to dumping and spreading the topsoil, the subgrade shall be loosened by discing or by scarifying to a depth as necessary to permit bonding of the topsoil to the subsoil.

3.02 PERMANENT SEEDING

- A. Harrow, disc, or otherwise loosen subsoil to a depth of four inches. Spread topsoil evenly over prepared subsoil to the following depths:

Slopes 3:1 or steeper, three inches after compaction.

Slopes flatter than 3:1, six inches after compaction.

- B. Apply lime and fertilizer at the rates specified in "PRODUCTS", and thoroughly mix into the top eight inches. Scarify the area and rake until the surface is leveled to provide a maximum of two inches in variation, and the soil is friable and of uniform fine texture.
- C. Remove objectionable material such as stones 1-1/2 inches or larger, clods, brush, roots, and trash from the top four inches of soil.
- D. Perform harrowing, discing, scarifying, and raking on the contour of slopes steeper than 3:1.
- E. Moisten seedbed during periods of high temperatures and when directed by the Engineer.
- F. Apply seed mixture uniformly with mechanical power driven seeders, mechanical cyclone hand seeders or hydroseeding equipment. Slurry for hydroseeder may contain seed and fertilizer only.
- G. Seed that has been broadcast must be covered by raking or dragging and then lightly tamped into place using a roller or cultipacker. Cultipack or roll one inch into soil in floodplain areas.
- H. If hydroseeding is used the seed and fertilizer will be mixed on site and the seeding operation shall be done immediately and without interruption.
- I. Apply mulch and anchor immediately after seeding as specified in "PRODUCTS".

3.03 TEMPORARY SEEDING

- A. Loosen top three inches of seedbed.
- B. Apply lime and fertilizer at the rates specified in "PRODUCTS".
- C. Moisten seedbed during period of high temperature and when directed by the Engineer.

- D. Apply seed mixture uniformly with mechanical power driven seeders, mechanical cyclone hand seeders or hydroseeding equipment. Slurry for hydroseeder may contain seed and fertilizer only.
- E. Seed that has been broadcast must be covered by raking or dragging and then lightly tamped into place using a roller or cultipacker.
- F. If hydroseeding is used, the seed and fertilizer will be mixed on site and the seeding operation shall be done immediately and without interruption.
- G. Apply mulch and anchor, immediately after seeding, as specified in "PRODUCTS".

3.04 MULCH ONLY

Perform grading as required. Place and anchor mulch only at the rates specified in "PRODUCTS" where indicated and where directed by the Engineer.

3.05 PLANTING

Plant material shall be installed in accordance with the details and planting design shown on the plans. Planting shall be performed within the period September 1 through April 30 but shall not occur during freezing temperatures. Plantings shall be maintained and their survival guaranteed for 1 year following installation. Replacements shall occur within the regular planting season.

3.06 TIME RESTRICTIONS

When permanent seeding or sodding is specified or directed, and seeding is not allowed because of time restrictions specified in "PRODUCTS", utilize one or more of the following methods to prevent erosion and sedimentation until such time as permanent seeding or sodding is allowed:

- A. Place and anchor straw mulch or wood chips.
- B. Apply temporary seeding.
- C. Prepare soil as for permanent seeding and then mulch as specified; overseed during next seasonal seeding period.
- D. Provide other erosion control measures acceptable to the Engineer and the sediment control inspector.

- E. Remove straw or wood chips used as temporary mulch or work into subsoil to a minimum depth of six inches prior to initiation of permanent seeding application.

3.07 MAINTENANCE OF SEEDED AREAS AND PLANTS

- A. Maintain seeded and sodded areas and landscape plants until receipt of final acceptance.
- B. Water seeded and sodded areas as necessary to maintain adequate moisture in the upper six inches of soil and maintain turf at a height of two to three inches; do not remove more than 1/3 of the grass blade during initial mowing. Do not mow sod until it is firmly rooted.
- C. Inspect seeded and sodded areas and perform any renovations or repairs necessary to attain 85% turf coverage.
- D. Provide replacements during the specified planting seasons.
- E. If turf grass stand is inadequate as determined by the Engineer, overseed and fertilize using half of the rates originally applied, or resod.
- F. If turf grass stand is over 60 percent damaged during a period of one year after final acceptance, as determined by the Engineer, re-establish following original seeding or sodding requirements.

END OF SECTION

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SECTION 03300

CAST-IN-PLACE CONCRETE

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE

Provide all labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, steel reinforcement installation, methods for achieving specified floor and slab flatness

and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture. Submit laboratory testing or strength test records in accordance with ACI 301. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.
- E. Hydrostatic Tightness Test:
 - 1. Procedure
 - 2. Data and Reports
- F. Certificates:
 - 1. In case the source, brand or characteristic properties of the ingredients need to be varied during the term of the Contract, submit revised design mix and manufacturer's certificates.
 - 2. Submit certificate stating that each admixture used is identical in composition to the sample used for acceptance testing and is compatible with all other materials in the design mix.
 - 3. Submit certificate stating that the concrete vibrator operators have the required experience in operating the equipment.
- G. All submittals shall state the location(s) and application(s) for each material.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and testing agency.
- B. Welding certificates.
- C. Manufacturer's Data: Submit manufacturer's data with installation instructions for all materials, including but not limited to, admixtures, curing compound and materials, coatings and joint materials.
- D. Batch Tickets: Submit a delivery ticket from the concrete supplier with each batch delivered to the site setting forth the following information:
 - 1. Name of supplier;
 - 2. Name of batching plant and location;
 - 3. Serial number of ticket;
 - 4. Date;
 - 5. Truck number and batch number;
 - 6. Specific job designation;
 - 7. Volume of concrete (cubic yards);
 - 8. Specific class of concrete;
 - 9. Time loaded and amount of water added;
 - 10. Type and brand of cement;
 - 11. Weight of cement;
 - 12. Maximum size of aggregates;
 - 13. Weights of coarse and fine aggregates, respectively;
 - 14. Type and amount of admixtures; and
 - 15. Mix design designation.
- E. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- F. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer licensed in the State of Delaware, detailing fabrication, assembly, and support of formwork.
 - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- G. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

- H. Contractor Quality Control (CQC) Plan: Detailing quality control procedures that the contractor will use to ensure the product meets all specified requirements.
- I. Field quality-control reports.
 - 1. Compressive strength tests, with date of test(s), at the following ages:
 - a. 7-day strength (psi).
 - b. 28-day strength (psi).
 - c. 56-day strength (psi), if 28-day strength does not meet the specified requirements.
- J. All submittals shall state the location(s) and application(s) for each material.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.07 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.09 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.01 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.02 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - 3. Overlaid Finnish birch plywood.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Concrete for Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box:
 - a. Plastic cone type, with threaded steel rod or wire, with waterstop, as approved. Rod type or wire type shall have no metal closer than 1-1/2" to finished surface.
 - b. Taper ties, with large end on soil or liquid side of the wall. Plug taper tie hole using Sure Plug, as manufactured by Dayton Superior, or approved equal. Install plug in accordance with manufacturer's written instructions.
 - c. She bolts with washer to provide liquid-tightness.

2. All other Concrete:

- a. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
- b. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

2.03 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A706, Grade 60, deformed.
- C. Deformed-Steel Wire: ASTM A 1064/A 1064M.

2.04 REINFORCEMENT ACCESSORIES

- A. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.
- B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.05 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 1. Portland Cement: ASTM C 150/C 150M, Type II.
 2. Fly Ash: ASTM C 618, Class F.
 3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

-
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 2. Alkali-Silica Reaction Testing: Comply with one of the three options indicated in ACI 301 for resistance to alkali-silica reaction.
- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 7. Crystalline waterproofing admixture: AQUAFIN-IC ADMIX as manufactured by Aquafin, Inc., XYPEX ADMIX C-500 as manufactured by Xypex Chemical Corporation, Penetron Admix as manufactured by ICS Penetron International LTD. or equivalent product as approved by the Engineer.
 8. The use of anti-freeze compounds, salts, chemicals or other foreign materials, for the purpose of lowering the freezing point of the concrete is prohibited. No calcium chloride or ingredients containing chloride shall be mixed in any concrete.

9. Admixtures used in concrete to receive surface hardener shall be compatible and approved for use by the surface hardener manufacturer.

F. Water: ASTM C 94/C 94M and potable.

2.06 WATERSTOPS

A. PVC Waterstops: Meeting the requirements of U.S. Corps of Engineers specification CRD-572 at construction joints. No reclaimed material shall be used in the manufacturing of waterstops.

1. Construction Joints (Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box): 6"x3/8", two-bulb type, unless otherwise noted on the Contract Drawings.

B. Swellable Type Waterstops, where indicated on Drawings: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.07 VAPOR RETARDERS

A. ASTM E1745, meeting or exceeding Class C, minimum thickness of barrier (plastic) shall be 10 mil. Permeance of less than 0.03 perms as tested in accordance with ASTM E1745. The seal tape for vapor barrier shall be minimum 3.75-inch wide high-density polyethylene tape with pressure-sensitive adhesive. Mastic for vapor barrier shall be a medium-viscosity, water-based, polymer-modified anionic bituminous/asphalt emulsion.

2.08 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Surfhard, as manufactured by The Euclid Chemical Company, or approved equal.

2.09 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
 - 1. Do not use on concrete surfaces which receive a penetrating liquid floor treatment.

2.10 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than **5000 psi** at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than **5000 psi** at 28 days when tested according to ASTM C 109/C 109M.

2.12 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Strength test records must not be more than 24 months old.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Provide concrete mixtures which can be placed without segregation into forms and around reinforcement under anticipate placement conditions.
- C. Submit data for each concrete mixture showing that the alkali-silica reaction requirements of ACI 301 are satisfied.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete and concrete with a w/c ratio below 0.50.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box Concrete, Not Indicated as Concrete Fill:
 1. Minimum Compressive Strength ($f'c$): 5000 psi at 28 days.
 2. Minimum Cementitious Material: 535 lbs/cubic yard.

3. Nominal Maximum Aggregate Size: 1-1/2 inch.
 4. Maximum W/C Ratio: 0.42.
 5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery, for 1-1/2" nominal maximum aggregate size.
 6. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture; plus or minus 1 inch.
 7. Water Soluble Chloride Ion Content: Determine the chloride ion content only for qualification of concrete mixtures. Determine water soluble chloride ion content in accordance with ASTM C1218 at concrete age between 28 and 42 days. The maximum water soluble chloride ion content in concrete, percent by weight of cement, shall be no more than 0.10%.
 8. Crystalline Waterproofing Admixture: Dosage rate as recommended by the manufacturer and approved by the Engineer.
- B. Slabs-on-Ground, Foundation Walls and Footings, Fastings, and Equipment Pads and Supports:
1. Minimum Compressive Strength ($f'c$): 4500 psi at 28 days.
 2. Nominal Maximum Aggregate Size: 1 inch.
 3. Maximum W/C Ratio: 0.45.
 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery, for concrete at or above frost depth, for 1 inch nominal maximum aggregate. Do not allow air content of trowel-finished floors to exceed 3 percent.
 5. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture; plus or minus 1 inch.
 6. Water Soluble Chloride Ion Content: Determine the chloride ion content only for qualification of concrete mixtures. Determine water soluble chloride ion content in accordance with ASTM C1218 at concrete age between 28 and 42 days. The maximum water soluble chloride ion content in concrete shall be no more than 0.30%.
- C. Concrete Fill, Ductbank Concrete, and Pipe Encasement Concrete:
1. Minimum Compressive Strength ($f'c$): 3000 psi at 28 days.
 2. Nominal Maximum Aggregate Size: 3/4 inch.
 3. Maximum W/C Ratio: 0.50.
 4. Slump Limit: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture; plus or minus 1 inch.

2.14 NON-SHRINK GROUT

- A. Non-shrink, non-metallic conforming to the requirements of U.S. Corps of Engineers specification CRD-C621. Mix and place according to the manufacturer's recommendations.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.01 FORMWORK INSTALLATION

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. **Class A, 1/8 inch** for smooth-formed finished surfaces.
 - 2. **Class B, 1/4 inch** for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. **Chamfer** exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.02 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.03 REMOVING AND REUSING FORMS

Unless otherwise authorized by the Engineer, forms shall not be removed before the expiration of the minimum number of days, or before the strength of concrete has reached the specified percentage of the minimum 28-day compressive strength (f'_c) as determined by testing of field-cured specimens, given in the following table. The times shown represent cumulative number of days, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above 50°F.

Sides of Beams and Girders, Walls, and Columns*: 1 day or 25% of f'_c

Elevated Slabs

Under 10 ft. clear span between Structural supports: 4 days** or 60% of f'_c
10 ft. to 20 ft. clear span between Structural supports: 7 days** or 75% of f'_c
Over 20 ft. clear span between Structural supports: 10 days** or 80% of f'_c

Joists, Beams, and Girder Soffits

Under 10 ft. clear span between Structural supports: 7 days** or 75% of f'_c
10 ft. to 20 ft. clear span between Structural supports: 14 days** or 90% of f'_c
Over 20 ft. clear span between Structural supports: 21 days** or 97% of f'_c

* Where such forms also support formwork for slab or beams, the removal times/strengths of the latter shall govern.

** Where forms can be removed without disturbing shores, use half of values in days or % of f'_c shown, but not less than 3 days or 50% of f'_c .

- A. Form removal shall be carried out in such a manner as to assure the complete safety and integrity of the formed surface of the structure. In no case shall any form or shoring be removed or disturbed until the concrete has thoroughly hardened and acquired sufficient strength to safely support its own weight and the live load upon it.
- B. Sufficient shoring and reshoring shall be kept in place to properly support the concrete structure after the forms have been removed and until such time as it is no longer necessary. All forms shall be so designed as to permit this

to be done. Reshoring of concrete beams and slabs shall take into account necessary spacing, dead and live loads, and the age and rate of gain of strength of concrete. Reshores shall remain in position at least 28 days. Reshoring shall be planned in advance and shall be subject to review by The Engineer.

3.04 SHORING AND RESHORING INSTALLATION

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
 - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 VAPOR-RETARDER INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.06 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.07 CONSTRUCTION JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 4. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Construction joints shall be as indicated on the Contract Drawings and the approved shop drawings. If not indicated, the locations of construction joints shall be determined by the Contractor to provide the quality of concrete required by this specification. In such instances, the maximum horizontal distance between joints shall be 50 feet for straight walls and elevated slabs, and 40 feet for circular walls. Maximum vertical distance between joints shall be 15 feet. Joints not indicated shall be made and located so as not to impair the strength of the structure, shall not impair appearance when subject to public view, and shall be approved in writing by the Engineer prior to their use.

- D. At all horizontal construction joints, and vertical construction joints as indicated on the Contract Drawings, provide a concrete surface clean and free of laitance and roughened to a full amplitude of at least 1/4", by one of the following methods:
1. Use an approved chemical retarder, which delays but does not prevent setting of the surface mortar. Remove retarded mortar within 24 hours after placing to produce a clean exposed coarse aggregate.
 2. Clean hardened concrete surfaces by abrasive blast method to expose clean coarse aggregate after the curing period or immediately before placing concrete.
 3. Surfaces of concrete which have been in place less than eight hours may be cleaned with air and water jets if surface laitance is removed and clean coarse aggregate is exposed to required depth.
- E. Before placement of fresh concrete, clean reinforcing steel and the surfaces of horizontal and vertical construction joints of surface laitance, curing compound, and other materials foreign to the concrete. Moisten surfaces on which concrete is to be placed with water immediately before placing concrete.
- F. Surfaces of horizontal construction joints, where expansion joint filler or bond breaking compound is to be placed as indicated, shall be cleaned of dirt, sawdust, and other loose material.
- G. When it is necessary to make a construction joint because of an emergency, furnish and place additional reinforcing steel across the joint as required at no additional expense to the Owner.
- H. Allow a minimum elapsed period of 48 hours between adjacent placements of concrete for the Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box.

3.08 CONTRACTION AND ISOLATION JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least **one-fourth** of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface

- finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.09 WATERSTOP INSTALLATION

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Swellable Type Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.10 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

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- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears

on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.11 FINISHING FORMED SURFACES

- A. As-Cast Finish (SF-2.0): As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel or broom finish.

- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
- D. Broom Finish: Apply a broom finish to all slabs-on-ground and top slabs of structures, unless indicated otherwise.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- E. Floor Flatness and Floor Levelness: Finish surfaces to the following tolerances, according to ASTM E 1155:
 - 1. For slabs-on-ground: Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

3.13 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

3.14 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to

manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces above 50°F and continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure above 50°F for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three

hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 HYDROSTATIC TIGHTNESS TESTS

- A. Hydrostatic tightness tests shall be in accordance with the requirements of ACI 350.1 Sections 1 and 2. The Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box shall be tested for hydrostatic tightness per the requirements of this specification.
- B. Provide all labor, materials, tools, equipment and devices for Hydrostatic Tightness Test for Open or Covered Containment Structures constructed under this contract at no additional cost to the Owner. Testing shall be performed prior to the installation of equipment and prior to acceptance or placing the structure in operation, but not before the upper bracing floors are at least seven (7) days old or have achieved at least 70% of f'c.
- C. Structures designed to contain or transport process liquid shall be thoroughly cleaned prior to the introduction of water for test purposes. Before testing a structure, all pipelines connecting to the structure shall have been tested and approved for leakage.
- D. The groundwater level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the tests. No backfill shall be placed against the walls or on the wall footings of the containment structures to be tested. No sheet waterproofing shall be installed on the containment structures until testing is complete and structures meet the test requirements.
- E. Testing shall include both the Part 1 qualitative (section 2.3.2) and Part 2 quantitative (section 2.3.3) criteria specified in ACI 350.1. The qualitative test shall be performed during the 3-day period before the quantitative test.

The drop in water level after adjustment for evaporation and rainfall shall not exceed 0.050% of volume per day for the quantitative test.

- F. Structures designed to be dry shall have their interior thoroughly cleaned below finished grade and pumped dry if necessary. Openings below grade shall be bulkheaded and made tight. After a period of five (5) days, interior surfaces will be inspected for accumulation of moisture. Any excess accumulation indicative of defects in the structure in the judgement of the Engineer, shall be repaired by the Contractor at no cost to the Owner and to the satisfaction of the Engineer.
- G. If any structure fails to meet the above requirements for hydrostatic tightness, then drain the structure, locate and repair all leaks, and retest the structure as many times as it is necessary to obtain a watertight structure as defined herein, all to the satisfaction of the Engineer and at no extra cost to the Owner.
- H. No separate payment will be made for testing structures for hydrostatic tightness or repairs. The cost thereof shall be considered as included in the lump sum and unit prices bid for this contract.
- I. All structures, both process liquid containing/transporting and dry, are meant to be watertight and free from discernible infiltration and exfiltration.

3.16 LIQUID FLOOR TREATMENT APPLICATION

- A. Slabs-on-ground must be given a liquid floor treatment.
- B. Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Ensure surfaces are clean, dry and free of standing water.
 - 2. Remove dirt, dust, oil, grease, sealers, and other materials that may prevent penetration of liquid floor treatment.
- C. Follow manufacturer's published recommendations for dilution ratio and mixing.
- D. Prior to full scale application perform sample application to determine required coverage and number of coats to eliminate dusting.
- E. Apply liquid densifier dustproofer to designated concrete areas in continuous manner following manufacturer's published recommendations regarding coverage and installation. Brush out all puddles and runs immediately. Do not allow excess material to dry on surface. Surfaces shall be allowed to dry thoroughly between coats but no less than 4 hours. Flush

floor with water after final coat and scrub thoroughly removing any residue after final coat.

3.17 JOINT FILLING

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

3.18 DEFECTIVE CONCRETE WORK

- A. Porous areas, open or porous construction joints and honeycombed concrete will be considered to indicate that the requirements for mixing, placing and handling have not been complied with and will be sufficient cause for rejection of the members of the structure thus affected.
- B. Defective work exposed upon removal of forms shall be entirely removed or repaired within 48 hours after forms have been removed.
- C. Defective concrete areas not repaired within 48 hours after removal of forms shall be patched with polymer-modified mortars and shall be completed by an approved applicator.
- D. Repaired areas will not be accepted if:
 - 1. The structural requirements have been impaired by reducing the net section of compression members;
 - 2. The bond between the steel and concrete has been reduced; or
 - 3. The area is not finished to conform to in every respect to the texture, contour and color of the surrounding concrete.
- E. If the above requirements are not satisfied, the Engineer may require that the members or unit involved be entirely removed and satisfactorily replaced at no additional expense to the Owner.

3.19 REPAIR OF DEFECTIVE CONCRETE

- A. General: The Engineer will determine the extent and manner of action to be taken for the correction of defective concrete as may be revealed by surface

defects or otherwise. Contractor shall submit the repair materials and methods, prepared by a Professional Engineer registered in the State of Delaware, for Engineer's review and approval.

B. Repair of Formed Surfaces:

1. As soon as possible after stripping forms, thoroughly clean and fill holes left by form ties, and other temporary inserts and perform corrective work.
2. Repair and patch defective areas with cement mortar of mix proportions and materials identical to those used in the surrounding concrete; and produce a finish on the patch that is indistinguishable from the finish of the surrounding concrete, immediately after removing forms, in a manner and by a method accepted by the Engineer in writing prior to start of repair operation.
3. Cut-out honeycomb, rock pockets and voids having a diameter more than 1/2 inch to solid concrete but not shallower than one inch. Make edges of cuts perpendicular to concrete surface. Before placing cement mortar, thoroughly clean, dampen and brush coat areas to be patched with neat cement grout. Proprietary patching compounds may be used if accepted by the Engineer in writing prior to start of repair operation.
4. Remove imperfect texture, laitance, fins and roughness by rubbing affected areas with concrete block or carborundum stone until smooth and uniform.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces for smoothness and to verify conformance of surface plans to tolerances specified. Correct low and high areas.
2. Test unformed sloped surfaces for trueness of slope and smoothness, using a template having required slope. Correct high and low areas as specified.
3. Repair finished unformed surfaces which contain defects which adversely affect durability of concrete.
4. Grind high areas in unformed surfaces after concrete has cured sufficiently to permit repairs without damaging adjacent areas.
5. Cut-out low areas in unformed surfaces after completion of surface finishing operations, and replace with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used if acceptable to the Engineer.
6. Cut-out defective areas, except random cracks and single holes not exceeding one inch diameter and replace with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and

- brush with neat cement grout coating or use concrete bonding agent. Place patching concrete before grout takes initial set. Mix patching concrete of same materials and in same proportions as adjacent concrete. Place, compact and finish as required to blend with adjacent concrete. Cure in same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over an inch in diameter by the dry-pack method. Groove tops of cracks, cut-out holes to sound concrete and remove dust, dirt and loose particles. Dampen cleaned concrete surfaces and brush with neat cement grout coating. Mix dry-pack, consisting of one part portland cement to 2-1/2 parts fine aggregate passing No. 16 sieve, using only enough water for handling and patching. Place dry-pack before grout takes initial set. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.
 8. Obtain approval of the Engineer before performing repair work other than the removal of imperfect texture, filling of pin holes, holes larger than 3/4 inch wide and insert holes. The Engineer will determine whether the defective area is sufficiently imperfect to warrant rejection of the structural unit.
 9. Repair methods not specified above may be used, subject to acceptance by the Engineer in writing.
- D. Repairs required to the structural components due to the failure of hydrostatic tightness tests may require specialized material and procedures. These repairs shall be performed by the personnel or contractor qualified in performing those repairs.

3.20 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.

- D. Concrete Sampling for Tests: Supply all concrete, compression test molds, tamping rods, trowel, metal or glass covers, slump cone, storage curing box and sand necessary for making compression test specimens outlined herein. Make and cure specified number of specimens for each sample in accordance with ASTM C31 and C172.
- E. Supervision of Tests: The making of all concrete specimens, slump, temperature, and air content tests shall be witnessed by the Owner's representative at the site.
- F. Testing Frequency: Composite samples for strength tests of each class of concrete placed each day, for laboratory and field-cured testing, shall be taken not less than: Once a day; once for each 50 yd³ of concrete at the Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box, and once for each 150 yd³ of concrete everywhere else; or once for each 1000 ft² of surface area for slabs or walls at the Aeration Distribution, Grit Facility, North Headworks, and Clarifier Distribution Box, and once for each 5000 ft² of surface area for slabs or walls everywhere else.
1. When the frequency of testing per the above requirements provides fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five batches are used.
- G. Slump: ASTM C143; one test at point of discharge for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
- H. Air Content: ASTM C231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
- I. Concrete Temperature: ASTM C1064; One test for each composite sample, and as specified for hot-weather and cold-weather concreting. Testing shall be performed at the same time that the compression test specimens are made, or as directed by the Engineer.
- J. Compression Test Specimens: ASTM C31.
1. Cast and laboratory cure three sets of at least six 6"x12" cylinders or at least eight 4"x8" cylinders for each composite sample.
 2. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.

- K. Compressive-Strength Tests: ASTM C39; test at specified age.
1. A compressive-strength test shall be the average compressive strength from a set of two 6"x12" cylinders or three 4"x8" cylinders, obtained from the same composite sample. Cylinders shall be tested at 7 days and 28 days. The remaining cylinders from each composite sample shall be held for backup purposes.
- L. Strength of each concrete mixture will be satisfactory if both of the following requirements are met:
1. Every arithmetic average of any three consecutive 28-day strength tests equals or exceeds $f'c$.
 2. No individual strength test at 28 days falls below $f'c$ by more than 500 psi.
- M. Test results shall be reported in writing to the Engineer and concrete manufacturer within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for 28-day tests.
- N. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- O. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
- P. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- Q. Deficiencies and Remedial Action: In the event that concrete strength test results do not meet the acceptance criteria specified above, additional tests of concrete in place as specified in ACI 301 shall be performed at the sole expense of the Contractor. In the event that tests of concrete in place do not meet the acceptance criteria specified in ACI 301, those portions of the structure affected, as determined by the Engineer, shall be removed and replaced or otherwise remediated in a manner acceptable to the Engineer and at no additional expense to the Owner.

R. Field-Cured Concrete Tests

1. Field-cured cylinders shall be used to determine the strength of concrete for stripping of forms and backfilling against structure. Strength requirements shall be as indicated in the Contract Documents.
 2. Field-cured cylinders shall be cured under field conditions in accordance with ASTM C31.
 3. Cast and field cure one set of at least two 6"x12" cylinders or three 4"x8" cylinders for each composite sample.
 4. Field-cured test cylinders shall be molded at the same time and from the same samples as laboratory-cured test cylinders.
 5. Compressive-Strength Tests: ASTM C39.
 6. A compressive-strength test shall be the average compressive strength from a set of specimens obtained from the same composite sample.
- S. Measure floor and slab flatness and levelness according to ASTM E 1155 within 72 hours of finishing.

3.21 GROUTING

- A. Proportion mixing water in accordance with grout manufacturer's recommendations for shrinkage compensating grout.
- B. Clean off all loose and foreign material, which would prevent bond between the grout and the concrete surfaces contacting the grout.
- C. Thoroughly moisten concrete surfaces to be grouted or dry-packed prior to starting work.
- D. Completely fill all recesses and assure that the grout material is in complete contact with all steel and concrete surfaces.
- E. Cure all exposed grout.

3.22 PROTECTION FROM AND REMOVAL OF STAINS

- A. Protect the concrete structure from rust staining by structural steel members and from other substances during the work.
- B. If staining does occur, remove stains and restore the concrete to its original color.

3.23 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03300

SECTION 03410

PRECAST CONCRETE STRUCTURES

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SECTION 03410

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 SCOPE

Provide all labor, materials, tools and equipment necessary for the furnishing and installing of all precast concrete units as shown on the drawings and herein specified. This specification is not applicable to underground precast concrete structures which retain or transport process liquid.

1.02 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Precast concrete work shall be supplied by a firm with a minimum of three years of continuous operations and which has performed at least three representative jobs, three years or older, comparable to precast work to be provided for this project.
 - 2. Manufacturer of precast concrete products shall be certified per NPCA, and shall have their own batching plant at site of manufacturing certified per NPCA.
 - 3. A company specializing in providing precast and/or precast prestressed concrete products and services and with at least 80 percent of its production staff having at least three years full time experience with precast concrete products. Written evidence shall be submitted to show experience, qualifications and adequacy of plant capability and facilities for performance of Contract requirements.
 - 4. Plant QC Inspectors and assigned backup inspectors shall complete the following minimum training requirements:
 - a. NPCA Production and Quality School (PQS).

- b. American Concrete Institute (ACI) Concrete Field Testing Technician - Grade I.
 - c. Training records, including course outline, syllabus, test results and instructor qualifications shall be maintained on file at the plant for five years.
- B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
- C. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with "NPCA Quality Control Manual for Precast and Prestressed Concrete Plants" (NPCA).
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.04 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
- C. Store units with dunnage across full width of each bearing point unless otherwise indicated.
- D. Place adequate dunnage of even thickness between each unit.
- E. Place stored units so identification marks are clearly visible, and units can be inspected.

- F. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- G. Lift and support units only at designated points indicated on Shop Drawings.

1.06 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a Professional Engineer registered in the State of Delaware to design precast structural concrete civil utility structures.
- B. Design Standards and Structural Performance: Comply with ACI 318, ASTM C478, ASTM C857, and ASTM C858, except as modified below. Provide precast structural concrete civil utility structure units and connections capable of withstanding the design loads per the above referenced standards, except as modified below, within limits and under conditions indicated:
 - 1. Vehicle Load: AASHTO HS-20
 - 2. Soil Parameters and Surcharge: Per geotechnical report.
 - 3. Hydrostatic Load:
 - a. Groundwater Elevation: Finished Grade
 - b. Factor of Safety for Buoyancy Uplift: 1.10

1.07 ACTION SUBMITTALS

- A. Product Data: For each type of product listed below.
- B. Concrete Mixtures
- C. Shop Drawings
 - 1. Plans and/or elevations of precast items, locating and defining all material furnished by manufacturer.
 - 2. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 - 3. Sections and details showing connections, cast-in items and their relation to the structure.
 - 4. Indicate type, size, and length of welded connections by AWS standard symbols.
 - 5. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 - 6. Lifting and erection inserts.
 - 7. Dimensions and finishes.

8. Stamped and signed by a Professional Engineer registered in the State of Delaware.
- D. Design Calculations: Stamped and signed by a Professional Engineer registered in the State of Delaware.
 - E. Test Reports
 1. Reports of trial design mixes and tests on concrete shall be prepared by the manufacturer or his suppliers and approved by the Engineer, in advance of production.
 2. Reports on material tests, field samples of components, and concrete cylinder strengths shall be made available for review by the Owner.

1.08 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator and testing agency.
- B. Welding Certificates
- C. Material Certificates: For the following:
 1. Cementitious materials.
 2. Reinforcing materials.
 3. Admixtures.
- D. Material Test Reports: For aggregates, by a qualified testing agency.
- E. Source quality-control reports.

1.09 INSPECTION AND CERTIFICATION

- A. Prior to the delivery of a structure, the manufacturer shall provide a statement giving the source and type of cement, the source and specific gravities of the aggregates, the concrete mix proportions, strength, type, amount, and name of admixtures and mill certificates for the reinforcement steel used. Copies of all certificates shall be available to the Engineer upon request.
- B. The Engineer and Owner shall be allowed into the casting plant at any time to inspect the fabrication of units for this project.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials shall be in accordance with ASTM C913 with Type I/II cement.
- B. Joint sealing material shall be preformed, flexible joint sealing compound conforming to ASTM C990.

2.02 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C150, Type I/II or Type II
 - 2. Fly Ash: ASTM C618, Class F.
 - 3. Slag Cement: ASTM C989, Grade 100 or 120.
- C. Aggregates:
 - 1. Concrete Aggregate: ASTM C33. Aggregate may be crushed stone, natural or manufactured sand. Uniformity of grading and moisture content shall be obtained by methods recommended in ACI 304R.
 - a. Coarse Aggregate: Class 4S
 - b. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement
 - 2. Alkali-Silica Reaction Testing: Comply with one of the three options indicated in ACI 301 for resistance to alkali-silica reaction.
- D. Admixtures and Additives:
 - 1. Air Entraining Admixtures: ASTM C260.
 - 2. Water Reducing and Retarding Admixtures: ASTM C494, Type D.
 - 3. Water reducing admixture shall be per ASTM C494, Type A when casting at temperatures below 75 deg. F; and be per ASTM C494, Type D when casting at temperatures above 75 deg. F.
 - 4. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
 - 5. The use of anti-freeze compounds, salts, chemicals or other foreign materials, for the purpose of lowering the freezing point of the

concrete is prohibited. No calcium chloride or ingredients containing chloride shall be mixed in any concrete.

- E. Water: ASTM C94 and potable.
- F. Reinforcing steel shall be per ASTM A615, Grade 60, deformed bar.

2.03 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.
- C. Surface Retarder: Chemical set retarder, capable of temporarily delaying setting of newly placed concrete mixture to depth of reveal specified.

2.04 CONCRETE MIXTURES

- A. Water Soluble Chloride Ion Content: Determine the chloride ion content only for qualification of concrete mixtures. Determine water soluble chloride ion content in accordance with ASTM C1218 at concrete age between 28 and 42 days. The maximum water soluble chloride ion content, percent by weight of cement, in concrete shall be no more than 0.30%.
- B. Concrete shall be as specified in NPCA Quality Control Manual, Chapters 2 and 3, with the following modifications:
- C. Minimum Compressive Strength (f'_c): 4500 psi at 28 days.
- D. Maximum W/C Ratio: 0.45.
- E. Air Content: Per ACI 318.

- F. Chloride accelerators are prohibited.

2.05 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.06 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
 - 1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.
 - 2. Edge and Corner Treatment: Uniformly chamfered.

2.07 FABRICATION

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with NPCA product dimension tolerances as well as position tolerances for cast-in items.
- B. See Section 05500 “Metal Fabrications” for requirements for related items used in precast concrete products.
- C. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate

anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- D. Furnish loose hardware items including steel plates, seat angles, channels, anchors, dowels, lifting hooks, access hatches, inspection portals, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- E. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- F. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings without Engineer's approval.
- G. Reinforcement: Comply with recommendations in NPCA for fabricating, placing, and supporting reinforcement.
1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcing steel to maintain 2 inch concrete cover, or as indicated on the Contract Drawings. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- H. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- I. Comply with requirements in NPCA and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
- K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with NPCA.
 - 1. Place self-consolidating concrete (SCC) without vibration according to NPCA.
- L. Comply with NPCA procedures for hot- and cold-weather concrete placement.
- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- N. Cure concrete, according to requirements in NPCA, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in NPCA and meet Engineer's approval.

2.08 FINISHES

- A. Sides and Underside of Elements: As-cast finish as specified in NPCA.
- B. Top of Elements: Non-slip finish as specified in ACI 301, Section 5.

2.09 PATCHING

- A. Patching will be acceptable provided the manufacturer certifies the structural adequacy of the product, and the appearance is not impaired.

2.10 PRODUCT MARKING

- A. Each precast unit shall be legibly marked with the following information:

1. Specification's designation.
2. Date of manufacture.
3. Manufacturer's name or trademark.
4. Manufacturer's order number or, where applicable, Owner' project to receive unit.
5. Above information shall be indented in unit's surface or painted onto surface with a waterproof paint or indelible ink.

2.11 MANUFACTURING PLANT STORAGE

- A. All units shall be stored off ground.
- B. Stored units shall be placed so that identification marks are discernible.
- C. Stacked members shall be separated by battens across full width of each bearing point.
- D. Units shall be stacked so that lifting devices are accessible and undamaged.
- E. The upper member of stacked tier shall not be used as storage area for shorter member or heavy equipment.

2.12 GROUT MATERIALS

- A. Nonmetallic, Nonshrink Grout: In accordance with Section 03300 – Cast-in-Place Concrete.

2.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling
 1. Precast concrete members shall be lifted and supported during manufacturing, stockpiling and transporting operations only at the lifting or supporting points, or both, as shown on the Contract and shop drawings, and with approved lifting devices. All lifting devices shall have a minimum safety factor of three per ANSI B30.20.
 2. Transportation and delivery site handling shall be performed with acceptable equipment and methods, and by qualified personnel.

2.14 SOURCE QUALITY CONTROL

- A. Proper ACI Field Technician Grade 1 test techniques and procedures shall be demonstrated for slump, temperature, unit weight, air content, and

fabrication of compressive strength cylinders during the NCPA inspection. If testing is performed by an outside testing agency, maintain documented qualifications that the personnel performing the tests have been properly trained.

- B. Slump: A slump test shall be performed for each 100 cubic yards of concrete, or once a day, whichever comes first. Slump tests shall be performed in accordance with ASTM C143. SCC, no-slump, or dry-cast concrete does not need to be tested for slump.
- C. Slump Flow and Visual Stability Index: For SCC mixtures, slump flow and Visual Stability Index (VSI) tests shall be performed each day by testing the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification, as defined by the initial mix qualification process. Slump flow and VSI tests shall be performed in accordance with ASTM C1611. Concrete that does not meet specifications will be discarded. Thereafter, slump flow and VSI testing shall be performed as follows:
 - 1. Every 50 yards or 25 batches, whichever comes first
 - 2. When changing mix designs
 - 3. When changing raw materials
 - 4. When a mixture becomes suspect or a problem occurs,
 - 5. As required in NPCA.
- D. Temperature: The temperature of fresh concrete shall be measured when slump or air content tests are made and when compressive test specimens are made. The measured concrete temperature shall be recorded together with other fresh concrete test data. Concrete temperature testing shall be performed in accordance with ASTM C1064.
- E. Compressive Strength:
 - 1. Wet-Cast: For wet-cast concrete, specimens shall be a 6-inch diameter by 12-inch high cylinders unless the nominal maximum aggregate size is 3/4 inch or smaller, in which case 4-inch diameter by 8-inch high cylinders may be used. Compressive strength cylinders shall be made in accordance with ASTM C31. Specimens shall be cured in a manner similar to the curing of the concrete products represented by the specimens.
 - 2. Machine-Cast or Dry-Cast: For machine-cast and/or dry-cast concrete products, test cylinders can be vibrated or cores cut from the product. Test cylinders shall be vibrated in the same method as the product they represent or fabricated according to the applicable section of ASTM C497.

3. At least four compressive strength specimens shall be made for each 150 cubic yards of concrete of each mix or once per day, whichever occurs first. Two specimens shall be tested at or before 7 days and the other two shall be tested at 28 days. Specimens made in cylinder molds shall be tested in accordance with ASTM C39. Cubes or cores cut from products shall be tested in accordance with ASTM C42.
- F. Air Content: Tests for air content shall be made on air-entrained, wet-cast concrete for each 150 cubic yards of concrete, but not less often than once each day when air-entrained concrete is used. Air content shall be determined by either ASTM C231 or ASTM C173. A unit weight test, performed in accordance with ASTM C138, may be substituted for ASTM C231 or ASTM C173 after a correlation between air content and unit weight has been established.
- G. Unit Weight: Tests for unit weight of fresh concrete shall be performed a minimum of once per week or every 150 cubic yards, whichever occurs first, to verify the yield of batch mixes. Tests shall be performed in accordance with ASTM C138.
- H. Defective Concrete: If cylinder tests fall below the specified value, three cores may be used to determine concrete strength. Cores shall be obtained and tested in accordance with ASTM C42.

PART 3 - EXECUTION

3.01 PRODUCT HANDLING

- A. Precast sections shall be transported and handled with proper equipment to protect the elements from damage. Sections shall be handled by means of lifting inserts embedded in the concrete. Damaged sections that cannot be satisfactorily repaired shall be replaced by new sections at no additional cost to the Owner.

3.02 INSTALLATION

- A. Install all accessories required for connecting precast structural concrete units to supporting members and backup materials.
- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.

1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Connect precast structural concrete units in position by grouting or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Field cutting of precast units is not permitted without approval of the Engineer.
- E. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 5. Keep grouted joints damp for not less than 24 hours after initial set.

3.03 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of NPCA.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by the Engineer.

3.04 REPAIRS

- A. Repair precast structural concrete units if permitted by the Engineer.
 - 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- B. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by the Engineer.

3.05 CLEANING

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

END OF SECTION 03410

SECTION 03480

PRECAST POST-TENSIONED CIRCULAR TANK (AWWA D115)

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SECTION 03480

PRECAST POST-TENSIONED CIRCULAR TANK (AWWA D115)

PART 1 - GENERAL

1.01 DESCRIPTION

- A. In lieu of utilizing regularly reinforced cast in place concrete clarifiers, Contractor may choose to use internal tendon precast concrete as an alternate material. Bidders must select an approved manufacturer named herein, or an alternate manufacturer who has been suitably pre-approved prior to bid in accordance with these specifications. Bidders shall be required to name their selected manufacturer in the bid form. Alternative tank manufacturers will not be considered post-bid. Any and all design/redesign associated with the use of the alternate material and the cost for review of the design/redesign with the use of the alternate material, and the cost for review of the design/redesign by the Engineer, will be the responsibility of the Contractor. All “tank manufacturers” must be approved as detailed herein. Bidders shall indicate their intention to utilize this alternative design and name a preapproved tank manufacturer team in the bid form.
- B. Related Work: Work Specified Under Other Sections: Items to be embedded in concrete are as specified in the various sections of these specifications. The responsibility for coordinating concrete pours and tank wall fabrication with embedded items rests solely with the Contractor.
- C. Related Documents Drawings and General Provisions of Contract including Division/Specification Sections, apply to this Section.

1.02 REFERENCES

- A. General: The work shall comply with the most recent standards or tentative standards as published at the date of the contract and as listed in this specification using the abbreviation shown.
- B. American Concrete Institute (ACI):
 - 1. ACI 301 Specifications for Structural Concrete for Buildings
 - 2. ACI 302 Recommended Practice for Concrete Floor and Slab Construction
 - 3. ACI 304 Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
 - 4. ACI 305R Hot Weather Concreting
 - 5. ACI 306R Cold Weather Concreting
 - 6. ACI 308 Recommended Practice for Curing Concrete (Reaffirmed 1978)
 - 7. ACI 309 Recommended Practice for Consolidation of Concrete (Reaffirmed 1978)
 - 8. ACI 311 Recommended Practice for Concrete Inspection
 - 9. ACI 318 Building Code Requirements for Reinforced Concrete

10. ACI 318-08 Appendix B Alternate Design Method
 11. ACI 344R Design and Construction of Circular Pre-stressed Concrete Structures (Reported by ACI Committee 344)
 12. ACI 347 Recommended Practice for Concrete Formwork
 13. ACI 350R Concrete Sanitary Engineering Structures
 14. ACI SP-2 ACI Manual of Concrete Inspection
 15. ACI 533-3R Fabrication, Handling and Erection of Precast Concrete Wall Panels
- C. American Waterworks Association (AWWA) Publications
1. AWWA D115-06 AWWA Standard for Circular Pre-stressed Concrete Water Tanks with Circumferential Tendons
- D. American Society for Testing and Materials (ASTM):
1. ASTM A416 Steel Strand, Uncoated Seven-Wire Stress Relieved for Pre-stressed Concrete
 2. ASTM A615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
 3. ASTM C150 Specification for Portland Cement
 4. Air Entraining Admixtures: ASTM C260.
 5. Water Reducing and Retarding Admixtures: ASTM C494, Type D.
 6. Water reducing admixture shall be per ASTM C494, Type A when casting at temperatures below 75 deg. F; and be per ASTM C494, Type D when casting at temperatures above 75 deg. F.
 7. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
 8. ASTM D566 Standard Test Method for Dropping Point of Lubricating Grease
 9. ASTM D1743 Corrosion Inhibitor
 10. ASTM D2000 Standard Classification System for Rubber Products in Automotive Applications
 11. ASTM D30331 Specification for Standard Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 12. ASTM D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

1.03 MANUFACTURER'S QUALIFICATIONS

- A. The tankage shall be manufactured, installed and assembled by one manufacturer. The structure shall be precast, post-tensioned concrete as manufactured by Dutchland Inc. or pre-approved equal. The Contractor shall prepare a bid based on the specific design and materials specified for purposes of determining the low bid. The Contractor shall be responsible for any incidental cost incurred for installation of structures of a size or type other than indicated on the Contract Drawings, including but not limited to engineering, piping, excavation and backfill, concrete anti-flotation or base slabs, electrical work, etc., and shall include all such incidental costs in this bid.
- B. Tank designers/builders seeking to be pre-approved must submit all required information no less than four (4) weeks prior to bid. Firms seeking pre-approval must submit to the engineer stamped preliminary plans prior to the bid as well as document all experience qualifications at this time. Additional pre-qualified

companies will be released via addendum no less than one week prior to the bid date. Alternate tank manufacturers will not be considered post-bid. All manufacturers submitting must include a reference sheet demonstrating that they are prequalified for AWWA D115 precast post-tensioned concrete tank construction.

- C. The precast post-tensioned tank shall be designed, fabricated and erected by a firm having a minimum of 15 years experience in designing and constructing tanks of similar size and configuration in accordance with AWWA D115. The tank manufacturer shall participate in PCI's Certification program at the time of bidding and must have three years of successful experience designated as PCI-certified plant in Group C, Category C3-Prestressed Straight Strand Structural Members. The manufacturer shall document the installation of a minimum of ten (10) such functioning facilities and provide documentation in a qualification statement. At least 5 of the above tanks shall have been in successful service for a minimum of 5 years.
- D. Prior to project closeout, the tank designer shall provide documentation certifying that the tank has been designed and constructed in full conformance with ACI 318 and ACI 350. This certification shall be signed and sealed by a licensed professional engineer in the State of Delaware.
- E. All post-tensioning must be performed by technicians certified by the Post-Tensioning Institute (PTI). Documentation illustrating such certification shall be submitted with the bid. The tank builder must have a PTI certified inspector on staff. Evidence of certification shall be submitted with the bid.
- F. Wire-wound shotcrete tank designs (AWWA D110 standard) will not be accepted.

1.04 SUBMITTALS

- A. Shop Drawings and Product Data:
 - 1. Submit shop drawings in accordance with:
 - a. Provide detailed construction drawings for pre-stressed concrete tank, complete with design calculations. Provide details of all pipe openings on the shop drawings.
 - b. Calculations to include stresses in the tank at all stages including post-tensioning, tank empty and tank full.
 - c. Drawings shall include details of tendon profile, anchorage details, tensioning procedures, and tensioning sequence.
 - d. Design drawings and calculations shall be sealed by a Registered Professional Engineer licensed to practice in Delaware. The owner's approval does not relieve the Contractor, and his design engineer of his design responsibility.

2. Product Data:

- a. Provide mill certificates of post-tensioning wire.
- b. Provide submittals for concrete admixtures.
- c. Provide submittals for all tank materials.

1.05 SYSTEM DESCRIPTION

- A. This section consists of designing and furnishing of all materials, equipment and labor, for performing all operations for the construction of precast post-tensioned concrete tanks, as indicated on the drawings.

1.06 STRUCTURAL WARRANTY, 10-YEAR

- A. The Manufacturer shall provide a 10-year structural non-prorated warranty to the Owner. The warranty shall be provided without additional cost to the owner. The warranty shall include all necessary labor and materials to repair all material defects subject to this warranty after notification from the Owner to the Manufacturer. The warranty shall not create any obligation upon the Manufacturer to discover or inspect the Structure for possible defects subject to this warranty.

1. Exclusions from Warranty:

- a. All items within the Tank Structure and plumbing connections to the Tank Structure.
- b. All equipment. The Manufacturer shall pass on the warranty of equipment suppliers to the owner.
- c. Sealants are not included, unless the condition of the sealant allows for leakage or passing of water exceeding ACI 350.06 standards.
- d. Items not required for structural soundness and all non-structural items.
- e. Emptying of tanks, inspection of tanks, processing of the water/wastewater, filling of tanks, etc. complete in preparation for the Manufacturer to make repairs, and after completion of repairs by the Manufacturer.

2. Terms and Conditions:

- a. The Manufacturer shall warrant to the Owner that the Tank Structure shall be free from material defect due to faulty design, workmanship, or materials which appear, are discovered, and are reported in writing (notice) to the Manufacturer within ten (10) years of the Project Acceptance Date is defined as the date of substantial completion or the date of the final successful leak test; whichever comes first. Timely notice shall be provided to the Manufacturer (30 days' notice) prior to commencement of

- any warranty related work. This warranty shall not extend to any Exclusion's identified above.
- b. The maximum cost of warranty repair by The Manufacturer shall be the Manufacturer contract value of the tank in question.
 - c. The Warranty coverage is only for repair of items provided and installed by The Manufacturer and shall in no event cover items such as bodily injury or death or damage to personal property.
 - d. This Limited Express Warranty is exclusive and shall be in lieu of all other warranties of any nature whatsoever, except title, whether oral, written, express implied or by operation of law, except non-waivable warranties. This warranty is not assignable. This warranty shall not apply to defects caused by accident, abuse, misuse, mishandling, negligence, improper or defective application, force majeure or other acts of God, or any party other than The Manufacturer, its subcontractors and suppliers.
 - e. The Manufacturer's liability shall be limited to the cost of repair and the Manufacturer shall not be liable for any consequential damages or any of Owner's incidental costs associated with repair work under this warranty.
 - f. This warranty is a corporate guarantee by the Manufacturer and is not covered by any other form of insurance or bond.
3. Warranty Shall not be included to the extent:
- a. That the Owner fails to take timely action to minimize losses.
 - b. That those defects are, in, caused by, or resulting from materials or work supplied by anyone other than the Manufacturer, its employees, agents or subcontractors.
 - c. That a loss or defect is covered by insurance.
 - d. That damage is caused by unstable or improperly constructed water and/or soil conditions.
 - e. That the damage is normal wear and tear.
 - f. That the owner failed to properly maintain the tank structure.

1.07 DESIGN CRITERIA

- A. The post-tensioning concrete tank shall be designed and constructed in accordance with the AWWA D115 specifications for Precast Post-Tensioned Tanks with Internal Tendons.

1.08 DESIGN METHOD

- A. Base tank design on elastic analysis methods and take into account effects of all loads and pre-stressing forces during and after tensioning, and conditions of edge restraint at wall junctions with floor.
- B. Consideration shall be given to the effects of all loads and load combinations.
- C. The design must meet the most current AWWA D115 requirements, for the prospective design loads, design method, and allowable stresses.

1.09 DESIGN LOADS

- A. Loads indicated in this section shall be included in the design. Post-tensioning forces shall follow governing codes.
- B. Design Loads:
 - 1. Tank Contents: Shall be the fluid load water to the overflow elevation; unit weight of the water shall be 62.4 pounds per cubic foot, or 65 pounds per cubic foot for wastewater,
 - 2. Wind load: Shall be as required by the most recent version ASCE 7.
 - 3. Seismic Loads: Shall be as required by the most recent version ASCE 7.
 - 4. Backfill equivalent fluid pressure.

1.10 DESIGN CONSIDERATIONS FOR FOUNDATION/BASE DESIGN

- A. Dead Load from tank walls, supported equipment and structures.
- B. Live loads from supported walking surface structures.
- C. Fluid Loads.
- D. Uplift hydrostatic due to ground water, (including when the tank is empty).
- E. Radial forces from base to tank wall.
- F. Tank foundations shall be designed for the SPECIFIED soil bearing capacity and the general contractor shall provide and verify the specified bearing capacity before base installation.
- G. Tanks shall be supported on suitable natural soils, and/or on new compacted structural fill according to the geotechnical report recommendations.
- H. Subgrade: In accordance with geotechnical report.
- I. When tanks are to be installed in locations susceptible to frost, the foundations shall extend below grade to the maximum frost depth for the area.
- J. Floor shall be membrane type or a rigid mat, cast-in-place slab or, as shown on the drawings.
- K. Loads are assumed to be transmitted to the sub-base directly through the membrane or rigid base slab. Minimum thickness of the membrane slab shall meet all the requirements of ACI 318 and 350. Floors shall be placed continuously in sections as large as practicable to decrease number of construction joints.
- L. Where penetrations and joints are provided, suitable methods and/or devices shall be employed to prevent leakage. The minimum reinforcement for shrinkage cracks shall be according to ACI 350 recent revisions.

- M. Post-stressed floors shall also be designed to produce a minimum residual compressive stress of 200 psi after allowance for slab-sub-grade friction and tensile forces resulting from the wall base reaction. Slab sub-grade friction and the friction coefficient shall be in accordance with "Post-Tensioned Commercial and Industrial Floors" of the Post Tensioning Institute for Type II slabs. The post-stressed floor tendons shall be stressed in two stages: one half stress in each tendon within three days after placement or earlier, if the strength of the concrete has reached 2,500 psi, and full stress in each tendon within 10 days if the strength of the concrete has reached 4,000 psi (21 MPa).
- N. The sub-grade for membrane floors shall have adequate bearing capacity to sustain the fluid contents. The floor slab shall not be constructed directly on the natural sub-grade soil or rock unless it is uniform and compact. Differential settlement must not exceed 1/500th of the longest dimension of the base slab or 1" inch whichever is less.

1.11 FOOTING

A. Wall Footings:

- 1. A continuously reinforced concrete footing, as a thickened floor edge region shall be provided to distribute the vertical loads at the base of the wall to the underlying foundation material. Foundation for membrane floors and footings shall be of uniform compaction and bearing value to support the structure without differential settlement that can damage the structure. Foundation for footings shall likewise provide uniform support to limit differential settlement.

B. Column Footings:

- 1. Column footings shall be provided to support both vertical live and dead loads and shall be an integral part of the base. Separation of the column footing from the floor requires the use of submerged joints that increase the potential for leakage. Where footings are placed below the floor slab, and integral with it, additional reinforcing shall be required to control cracking due to restriction of slab movement during curing and temperature or moisture changes. However, inverted footings above the slab avoid this condition but can entrap sediment and impede normal wash down and cleaning maintenance. Transitions in floor thickness shall be gradual, and additionally reinforced to prevent shrinkage cracking and leakage.

1.12 COLUMNS AND BEAMS (IF REQUIRED)

- A. Columns and beams shall conform to the requirements of ACI 350, including supplements thereto. Minimum concrete cover over principal reinforcement shall be as allowed by ACI 350.

1.13 WALL DESIGN LOADS

- A. Internal Pressure: The pressure from maximum water level to the top of overflow elevation.

- B. Backfill Loading: The lateral pressure from earth backfill, symmetrical or asymmetrical. Net lateral loads, including those due to unequal backfill, shall be determined by rational methods of soil mechanics based on foundation and soils investigations. Surcharge loads on backfill surfaces shall be considered. Backfill pressure shall not be used to reduce the amount of post-tensioning force required for resisting internal water pressure. Hydrostatic pressure shall be considered unless the design ground water elevation is below the bottom of the tank foundation.
- C. Compressive stresses and bending moments in the wall due to application and post-tensioning forces.
- D. Seismic loads - shall be as required by ACI 350.3-06.
- E. Wind loads - shall be as required by ASCE 07.
- F. The minimum final circumferential post stressing force is to contain the water load at any point on the wall, and the allowance for a minimum residual compression of 200 psi for a covered tank and 200 psi to 400 psi for an open top tank per AWWA D-115.

1.14 VERTICAL STRESSES AND REINFORCEMENT

- A. Maximum tensile stress for regular mild steel reinforcement used to resist vertical bending stresses shall be in accordance with ACI 350-06 section 9.2.6.

1.15 POST-TENSIONING STEEL

- A. Allowable stress in post-tensioned reinforcement shall comply with AWWA D115 section 3.4.2.

1.16 MILD REINFORCEMENT

- A. Reinforcing steel shall be designed in accordance with the requirements of ACI 350.
- B. Reinforcing shall consist of rebar or welded wire fabric to effectively control cracking due to bending moments in the wall.
- C. Reinforcing steel shall not be credited with resisting any portion of primary circumferential tension resulting from radial design pressure.
- D. Mild steel reinforcement shall not be used to resist any portion of circumferential tension.

1.17 ALLOWABLE STRESSES IN CONCRETE

- A. The allowable stresses for concrete must not exceed those values given in ACI 318 and ACI 350 and AWWA D115.

1.18 WALL THICKNESS

- A. The thickness of the concrete wall shall be such that membrane shell stresses are within the allowable stresses and that the minimum thickness shall be not less than 7 inches.

1.19 WALL JOINT DETAILS

- A. The designer shall consider wall boundary conditions resulting from the construction joint details to be used at the top and bottom of the wall.
- B. The restraint of the wall at the base shall be assumed as a hinged condition for the vertical bending stress analysis after completion of the post-tensioning.

1.20 WALL DESIGN

- A. Design Method: Wall design shall be based on elastic finite elements analysis or elastic cylindrical shell analysis for stresses and deformations due to the loads outlined herein. Provide record calculations. Effects of shrinkage, temperature change, temperature gradient, and creep shall be considered. The designer shall consider all wall boundary conditions resulting from the construction joint details to be used at the top and bottom of the wall.
- B. Circumferential Post-Tensioning Force: Circumferential post-tensioning steel shall be furnished to resist all forces due to internal loads, after accounting for all stress losses and for residual compression.
- C. Tensioning Force: Tensioning steel shall be furnished to resist forces due to internal loads, after accounting for all stress losses.
- D. Watertightness: Where penetrations and joints are required, suitable methods and/or devices shall be employed to prevent leakage.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete
 - 1. Conforming to recommendations of ACI 350, as modified herein. Submit mix proportions for approval by the Engineer meeting the following strength requirements:
 - a. Strength: 5,000 PSI minimum 28 days compressive strength.
 - b. Slump: 4 inches, or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture; plus or minus 1 inch.
 - c. Cement: Type I/II or Type II conforming to ASTM C 150.
 - d. Mixing Water: Conforming to ACI 318.
 - e. Admixtures: Comply with requirements of ACI 301.

- f. Admixtures containing chlorides, fluorides, or sulfides are not permitted.
- B. Perform compression tests in accordance with ACI 301.
- C. Non-stresses reinforcement shall conform to requirements of ACI 318 or ASTM A 615, Grade 60. Steel reinforcement shall be placed in conformance with ACI 301 and Section 03300 of these Specifications. The minimum cover over bar and welded wire fabric reinforcement shall be as specified in ACI 318 and 350.

2.02 POST TENSIONED TENDONS

- A. Post-tensioned tank walls and floors shall be designed in accordance with ACI 318 and the Post-Tensioning Institute.
- B. Post-tensioning shall be as follows:
 - 1. Horizontal post-tensioning reinforcement shall be a bonded seven-wire tendon system.
 - 2. Vertical wall tendons, floor tendons, and roof tendons shall be either bonded or un-bonded, encapsulated seven wire tendons.
 - 3. Tendons shall be seven wire, stress relieved low relaxation strand conforming to ASTM-416-A, "Specifications for uncoated seven-wire stress relieved low relaxation strand for pre-stressed Concrete." Mill test reports for each pack of strand shall be furnished to the Engineer upon request.
- C. Corrosion Protection of Bonded Tendons:
 - 1. Plastic ducts for horizontal circumferential tendons shall be either corrugated or smooth, minimum 36 mil thickness. The horizontal ducts shall be made continuous in the vertical joint between wall panels. Plastic ducts shall be chemically inert.
 - 2. Tendons are grouted in the ducts with Portland cement grout, in accordance with Chapter 18 of ACI 318.
- D. Corrosion Protection of Un-bonded Tendons:
 - 1. Corrosion protection of un-bonded tendons shall consist of two layers with one layer of corrosion inhibitor on the steel strand, then a seamless layer of polypropylene. Polypropylene shall be hot melt extruded over the corrosion inhibitor with a thickness averaging 0.020-inch with no areas of coating less than 0.018-inch thick. Corrosion inhibitor shall provide a thickness over the bare strand of at least 0.003-inch.
 - 2. Un-bonded strands shall be in conformance with PTI "Specifications for Un-bonded Single Strand Tendons" for a corrosive environment.

2.03 WATERSTOPS

- A. Water stops shall be in accordance with section 03300.

PART 3 - EXECUTION

3.01 FORMING

- A. Form work shall meet the requirements of ACI 347 and ACI 301.
- B. Floor Slab:
 - 1. Joints shall be placed in accordance with Section 03300.
 - 2. The floor finish shall be mechanical float.
- C. Precast Concrete Wall Panel:
 - 1. Concrete for each precast panel shall be placed in one continuous operation.
 - 2. Panel finish:
 - a. Smooth form finish on exterior
 - b. Steel trowel on interior.

3.02 CONCRETE PLACEMENT

- A. Unless specifically authorized in writing, concrete shall not be placed during cold weather when the ambient temperature is below 35 degrees F and rising, or below 40 degrees F and falling, when the concrete is likely to be subjected to freezing temperature before final set has occurred and the concrete strength has reached 500 psi.
- B. For concrete placed during extremely hot weather, temperatures greater than 92°F which, the placement schedule shall be arranged, as approved, in such manner as to provide time for the temperature of the previously placed course to recede. The mixing water shall be the coolest available at the site, insofar as is practicable and shall conform to ACI 305.
- C. Placement of concrete during periods of low humidity shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing and shall be water cured continuously from the time the concrete has taken initial set. Curing compounds shall be used in conjunction with water curing.
- D. Site cast concrete shall be placed in accordance with Section 03300 of these specifications.

3.03 ERECTION

- A. Threading the tendons through the wall panels should begin after all panels are erected and plumbed.
- B. The vertical slots between panels shall be filled with cast-in-place concrete grout, compatible with the details of the joint. The strength of the concrete grout shall be per AWWA D-115 Section 5.3.3.6.

- C. Tendons shall be stressed as required by the design and in accordance with the referenced standards of ACI and PTI.
- D. After post-tensioning is complete and the elongations are checked by the Engineer the excess strand length shall be removed and the anchorage hardware and exposed wire strands shall be completely coated with epoxy or encapsulated in plastic. The anchorage-coupler area shall then be covered with the required concrete cover (as per manufacturer's design) and the void inside the cover shall be coated with an epoxy bonding agent filled solid with a non-shrink concrete grout.
- E. Grouting of tendon ducts shall be carried out as promptly as possible after tensioning. The total time the pre-stressing steel is exposed to other than a controlled environment prior to grouting shall not exceed 10 days, nor 7 days after tensioning, whichever is less, unless special precautions, such as use of a vapor phase corrosive inhibitor, are taken to protect the pre-stressing steel. The methods or products used shall not jeopardize the effectiveness of the grout as a corrosion inhibitor, nor the bond between the pre-stressed reinforcement and grout. Vapor phase corrosion inhibitors shall be used in strict accordance with the manufacturer's recommendations. Additional restrictions can be appropriate for potentially corrosive environments.
- F. Grouting equipment shall be capable of grouting at a pressure of 200 psi (1.4 MPa). However, the tendon ducts shall not be over pressurized during injection if blockage exists. Instead the grout shall be washed out and the blockage removed. Ducts shall be flushed with clean water (not air) prior to grouting to assure there are no blockages.
- G. Horizontal grouted tendons shall have air release valves which shall also act as standpipes at intentionally high points and drains at intentionally low points such as when tendons are deflected around penetrations. These vents and drains, and a vent at the opposite end of the tendon from the point of injection, shall be closed when a steady stream of pure grout is ejecting. After all vents and drains are closed, the pressure in the duct can be increased to 100 psi (0.7 MPa) and a valve at the injection end closed to lock off the grout under pressure. After grout has set, but not less than 24 h after grouting, cut off any vents or stand pipes and seal.
- H. Grout injections in vertical tendons shall always be from the lowest point in the tendon to avoid entrapping air.
- I. All cement grout shall pass through a screen with 0.125 in. (3 mm) maximum clear openings prior to being introduced into the grout pump.
- J. When quick setting can occur due to hot weather, the grout shall be cooled by acceptable methods such as cooling the mixing water to prevent blockages during pumping operations. When freezing weather conditions prevail during and following the placement of grout, adequate means, such as keeping the wall temperature up by heaters or blankets, shall be provided to protect the grout in the ducts from freezing until the grout attains a minimum strength of 1,000 psi (6.9 MPa).

- K. The concrete must be dry for seal installation. Temperature must be 50 degrees F (min.). After the seal is installed and cured, the tank shall be hydrotested.
- 3.04 TOLERANCES
- A. Manufacturing tolerances shall be per PCI MNL-135-00 and ACI 117-10.
- 3.05 HYDROSTATIC TIGHTNESS TESTS
- A. All concrete tanks designed to contain liquid shall be tested for water tightness as outlined in Section 03300.
- 3.06 TANK BACKFILL
- A. After successful testing, backfill shall be replaced, as required, and compacted with static compaction equipment around the tank in uniform layers in such a manner as to not cause damage to the tank.
- 3.07 CLEAN UP
- A. The premises shall be kept clean and orderly at all times during the work, and upon completion of construction, the Contractor shall remove or otherwise dispose of all rubbish and other unsightly material caused by the construction operations. The Contractor shall leave the premises in good a condition and clean.

END OF SECTION 03480

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SECTION 04810

UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Concrete building brick.
 - 3. Mortar and grout.
 - 4. Steel reinforcing bars.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Embedded flashing.
 - 8. Miscellaneous masonry accessories.

1.03 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.05 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Contractor will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 - 1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 - 2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
 - 4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Control Joint Locations: Indicate locations on both plan and elevation views for all CMU walls.
 - 3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 - 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 - 1. Exposed CMUs.
 - 2. Concrete facing brick.
 - 3. Weep holes and vents.
 - 4. Accessories embedded in masonry.

1.07 INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Qualification Data: For testing agency.
- C. Material Certificates: For each type and size of the following:
1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.
 5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01400 "Quality Requirements" for mockups.
 - 1. Build sample panels for typical exterior wall in sizes approximately 64 inches long by 48 inches high by full thickness.
 - 2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
 - 3. Clean exposed faces of panels with masonry cleaner indicated.
 - 4. Protect approved sample panels from the elements with weather-resistant membrane.
 - 5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
 - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01310 "Project Management and Coordination."

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.010 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
 2. Density Classification: Lightweight unless otherwise indicated.
 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 4. Exposed Faces: Provide color and texture matching the manufacturer's standard grey block.
- C. Decorative CMUs: ASTM C 90.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fizzano Brothers Concrete Products

- b. York Building Products Company
 - 2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
 - 3. Density Classification: Lightweight.
 - 4. Size (Width): Manufactured to dimensions specified in "CMU's" paragraph.
 - 5. Pattern and Texture:
 - a. Standard pattern, split face finish, scored vertically so units laid in running bond appear as square units laid in stack bond.
- D. Concrete Building Brick: ASTM C 55.
- 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
 - 2. Density Classification: Lightweight.
 - 3. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

2.03 CONCRETE AND MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 03300 "Cast-in-Place Concrete," and with reinforcing bars indicated.
- C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.04 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Mortar Cement: ASTM C 1329.
 - 1. Products: Subject to compliance with requirements, provide the following:

- a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
 - b. Cemex: Cemex Mortar Cement.
- E. Aggregate for Mortar: ASTM C 144.
- 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- F. Aggregate for Grout: ASTM C 404.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.
 - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- H. Water: Potable.

2.05 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
- 1. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 2. Wire Size for Side Rods: 0.148-inch diameter.
 - 3. Wire Size for Cross Rods: 0.148-inch diameter.
 - 4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
 - 5. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.06 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
- B. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick, steel sheet, galvanized after fabrication.
 2. Tie Section: Triangular-shaped wire tie, sized to extend 1 inch into masonry, made from 0.187-inch-diameter, hot-dip galvanized steel wire.
 3. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick, steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to a minimum of 2 inches into masonry.

2.07 MISCELLANEOUS ANCHORS

- A. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.
- B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- C. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.
1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 2. Material for All Locations: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.08 EMBEDDED FLASHING MATERIALS

- A. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep

spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. Products: Subject to compliance with requirements, provide the following:

a. Mortar Net USA, Ltd.; Blok-Flash.

B. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.09 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will

E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.

b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.

c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.

d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.010 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.011 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270 Type M or N, Proportion Specification.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.03 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.04 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.05 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
1. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch-thick joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.06 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
1. Space reinforcement not more than 16 inches o.c.
 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.07 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 16 inches o.c..

3.08 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
- C. Fill the vertical cell on each side of the control joint with grout. Provide a joint stabilizing anchor at 16 inches vertically on center.
- D. Provide control joints, in both exterior and interior CMU walls, at locations which satisfy the following conditions. Submit proposed locations for approval.
 1. Spacing not to exceed the lesser of 25 feet or 1.5 times the wall height
 2. Control joints must not pass through pilasters, piers, or lintels
 3. Locate at intersections of interior and exterior walls; and intersections of interior and interior walls
 4. From wall corners, locate not more than half the maximum control joint spacing, but not less than 2 feet
 5. For walls which bear on slabs-on-ground, locate wall control joints at location of slabs-on-ground control and construction joints.

3.09 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete or masonry lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.

- C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.010 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.011 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.012 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.013 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.014 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 04810

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SECTION 05120
STRUCTURAL STEEL FRAMING
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SECTION 05120

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Shear stud connectors.
 - 3. Shrinkage-resistant grout.

1.02 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Shear stud connectors.
 - 4. Anchor rods.
 - 5. Shop primer.
 - 6. Galvanized-steel primer.
 - 7. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Mill test reports for structural-steel materials, including chemical and physical properties.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant,

Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. ANSI/AISC 303.
 - 2. ANSI/AISC 360.
 - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 - 1. Connection designs have been completed and connections indicated on the Drawings.

2.02 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.
- B. Channels, Angles, S-Shapes: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.
- E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts;

ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating finish.

C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.04 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.05 PRIMER

A. Steel Primer:

1. Comply with Section 099600 "High-Performance Coatings."

2.06 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.07 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

2.08 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.09 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 6 (WAB)/NACE WAB-3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 2.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.10 SOURCE QUALITY CONTROL

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

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. [**Comply with manufacturer's written installation instructions for grouting.**]
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.03 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.04 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.

- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05120

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STEEL JOIST FRAMING
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SECTION 05210

STEEL JOIST FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Non-Standard gabled joist.
 - 2. Joist accessories.
- B. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
 - 2. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.03 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
 - 1. Include layout, designation, number, type, location, and spacing of joists.
 - 2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
 - 3. Indicate locations and details of bearing plates to be embedded in other construction.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and professional engineer.
- B. Welding certificates.
- C. Manufacturer certificates.
- D. Mill Certificates: For each type of bolt.
- E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.
- F. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.08 SEQUENCING

- A. Deliver steel bearing plates to be built into masonry construction.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide non-standard gabled joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/360 of the span.

2.02 NON-STANDARD GABLED STEEL JOISTS.

- A. Manufacture non-standard gabled steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated.
 - 1. Joist Type: Non-standard gabled.
 - 2. End Arrangement: Bottom chord bearing with top chord extension to support decking.
 - 3. Top-Chord Arrangement: Gabled, pitched as indicated.
- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Camber non-standard gabled steel joists for the design loads specified. Do not camber joists adjacent and parallel to the masonry bearing walls (i.e. two gabled end walls) that support the metal deck.
- D. Design steel joist for the design loads indicated. Provide additional web diagonal members to support the concentrated loads where required.

2.03 PRIMERS

- A. Primer: Provide shop primer that complies with Section 099600 "High-Performance Coatings."

2.04 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- D. Fabricate steel bearing plates from ASTM A36/A36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- E. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- F. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.
- G. Welding Electrodes: Comply with AWS standards.
- H. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.05 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
 1. Before installation, splice joists delivered to Project site in more than one piece.
 2. Space, adjust, and align joists accurately in location before permanently fastening.
 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.

- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709.
 - c. Ultrasonic Testing: ASTM E164.
 - d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

3.04 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2 or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 05210

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SECTION 05310

STEEL DECKING

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SECTION 05310

STEEL DECKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Roof deck.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
 - 2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
 - 3. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
 - 4. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
 - 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.

2. Acoustical roof deck.
 - D. Evaluation Reports: For steel deck, from ICC-ES.
 - E. Field quality-control reports.
- 1.05 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.
 - B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 - C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

- 2.01 PERFORMANCE REQUIREMENTS
- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- 2.02 ROOF DECK
- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), **[Grade 33] [Grade 40] [Grade 80]**, **[G60] [G90]** zinc coating.
 3. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), **[Grade 33] [Grade 40] [Grade 80]**, G60 zinc

coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

- a. Color: [**Manufacturer's standard**] [**Gray**] [**White**] [**Gray top surface with white underside**].
4. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A792/A792M, Structural Steel (SS), Grade 33 minimum, AZ50 aluminum-zinc-alloy coating.
5. Deck Profile: **As indicated**
6. Profile Depth: As indicated.
7. Design Uncoated-Steel Thickness: As indicated.
8. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
9. Span Condition: As indicated.
10. Side Laps: Overlapped.

2.03 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- H. Galvanizing Repair Paint: ASTM A780/A780M.
- I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: 5/8 inch, nominal.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.
 - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum or butted at Contractor's option.
- D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

3.05 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 053100

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SECTION 05500
METAL FABRICATIONS

PART 1 – GENERAL

1.01 SCOPE

Provide all labor materials equipment and services necessary for and incidental to, the complete and satisfactory installation of metal fabrications included in this section.

1.02 SUMMARY

A. Section Includes:

1. Aluminum Framing
2. Metal ladders.
3. Metal bollards.

B. Related Requirements:

1. Section 05120 “Structural Steel Framing.”

1.03 COORDINATION

- A. 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.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Grout.
2. Bollard cover.

- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Aluminum Framing
2. Metal ladders.
3. Metal bollards.

- C. Delegated-Design Submittal: For ladders including analysis data signed and sealed by a professional engineer registered in the State of Delaware responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design ladders.

- B. Structural Performance of Metal Ladders: Metal ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3 and OSHA.

2.02 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.
- F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6

2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125 M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 2.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Post-Installed Anchors: Comply with Section 05510.

2.04 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- D. Concrete: Comply with requirements in Section 03300 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) for bollard fill.

2.05 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 (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. 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 or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.06 METAL LADDERS

A. General:

1. Comply with ANSI A14.3 and OSHA requirements.

Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, not less than 3/8-by-2-1/2 steel flat bars, with eased edges.
3. Rungs: Not less than 3/4-inch-diameter steel bars and spaced at 12" o.c. Provide rung centerline 7" from face of wall. Coordinate final ladder geometry and locations with OSHA clearance requirements.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.

7. Hot-dip galvanize steel ladders, including brackets and fasteners.

B. Aluminum Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches (64 mm) deep, 3/4 inch (19 mm) wide, and 1/8 inch (3.2 mm) thick.
3. Rungs: Extruded-aluminum tubes, not less than 3/4 inch (19 mm) deep and not less than 1/8 inch (3.2 mm) thick, with ribbed tread surfaces and spaced at 12" o.c. Provide rung centerline 7" from face of wall. Coordinate final ladder geometry and locations with access hatch above and OSHA clearance requirements.
4. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.
5. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted aluminum brackets.
6. Provide aluminum Ladder UP safety post, as manufactured by the Bilco Company, or approved equal.

2.07 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe.
 1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
 2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.
- B. Fabricate bollards, where indicated on Drawings, with steel baseplates for bolting to concrete.
 1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
- C. Hot-dip galvanize bollards.
- D. Provide 1/4" thick safety yellow plastic cover at all bollards.

2.08 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.

2.09 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.

2.10 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 - F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.
- 3.02 INSTALLING METAL BOLLARDS
- A. Anchor bollards per the Drawings.
 - B. Fill bollards solidly with concrete, mounding top surface to shed water.
- 3.03 ADJUSTING AND CLEANING
- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05500

SECTION 05510

POST-INSTALLED ANCHORS

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SECTION 05510

POST-INSTALLED ANCHORS

PART 1 – GENERAL

1.01 SCOPE

- A. Provide all labor, materials, equipment, and services necessary for and incidental to, the complete and satisfactory installation of post-installed anchors for concrete and masonry used as structural connections, earthquake bracing, guard rails, mechanical and electrical equipment support, piping and ductwork support and bracing, cladding and façade connections, or rebar doweling.

1.02 SUMMARY

- A. Related work not included in this section specified elsewhere:
 - 1. Section 03300 “Cast-in-Place Concrete”
 - 2. Section 03410 “Precast Concrete Structures”
 - 3. Section 04810 “Concrete Unit Masonry”
- B. Design Requirements
 - 1. If anchor is part of a delegated design system, design shall be in accordance with ACI 318 (2011) and manufacturer’s published data.

1.03 ACTION SUBMITTALS

- A. Shop Drawings: Indicate anchor type, size, embedment depth, spacing, and edge distance for all anchors which are part of a delegated design system.
- B. Design Calculations: Stamped and signed by a Professional Engineer registered in the State of Delaware for all anchors which are part of a delegated design system.
- C. Product Data: For all anchors.
- D. Test Reports: Certified test reports showing compliance with the specified performance characteristics and physical properties.

- E. ICC ES Evaluation Reports indicating conformance with the current applicable ICC ES Acceptance Criteria.
- F. Installer Qualifications.
- G. Installer Training: Submit a letter of procedure stating method of drilling, the product proposed for use, the complete installation procedure, manufacturer training date, and a list of the personnel to be trained on anchor installation.

1.04 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Printed Installation Instructions (MPII).

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Post-installed anchors shall be installed by an installer with at least three years of experience performing similar installations.
 - 2. Installation of adhesive anchors horizontally or overhead shall be performed by personnel certified by an applicable certification program. Certification program shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent.
- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the installer on the project. Training shall consist of a review of the complete installation process for post-installed anchors, to include but not limited to:
 - 1. Hole drilling procedure.
 - 2. Hole preparation & cleaning technique.
 - 3. Adhesive injection technique & dispenser training / maintenance.
 - 4. Rebar dowel preparation and installation.
 - 5. Proof loading/torqueing.
- C. Substitution Requirements
 - 1. Submit for Engineer's review, calculations that are stamped and signed by a registered Professional Engineer licensed in the State of Delaware demonstrating that the substituted product is capable of achieving the pertinent equivalent performance values of the specified product using the appropriate design procedure and/or standard(s) as required by the Building Code. In addition, the calculations shall specify the diameter and embedment depth of the

substituted product. Any increase in material costs for such submittal shall be the responsibility of the Contractor.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's packaging undamaged, complete with installation procedures. Protect and handle materials in accordance with MPII to prevent damage or deterioration. Store anchors in accordance with MPII.
- B. Any component material or anchor that has been damaged, has deteriorated, or has been contaminated shall not be used. Material deemed not useable shall be disposed of in a manner specified by the manufacturer and acceptable to federal, state, and local environmental control regulation.
- C. Material Safety Data Sheet (MSDS) for all anchors and components must be obtained from the manufacturer and must be accessible at the job site. Contractor shall be responsible to confirm that all materials used in accordance with MPII and worker's safety laws and regulation.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Fasteners and Anchors:
 - 1. Stainless Steel Threaded Rods and Anchors: AISI Type 316.
 - 2. Stainless Steel Nuts: ASTM F594, Type 316.
 - 3. Stainless Steel Washers: ASTM A240, Type 316.
 - 4. Reinforcing Steel Dowels: In accordance with Section 03300.

2.02 MANUFACTURED UNITS

- A. CMU Adhesive Anchors
 - 1. Adhesive and anchors other than reinforcing dowels shall be from the same manufacturer. Adhesive anchors shall have current ICC Evaluation Service Report that demonstrates compliance with ACI 355.4, which is supplemented by ICC-ES AC308 for concrete and ICC-ES AC58 for masonry.
 - 2. Adhesive, for use in masonry: Hilti HIT-HY 70 as manufactured by Hilti Corporation, or approved equal.
 - 3. Anchors, for use in masonry: Hilti HAS-R threaded rod, as manufactured by Hilti Corporation, or approved equal. Provide mesh sleeve at hollow masonry locations.

4. All anchors shall be Type 316 stainless steel.

B. Concrete Mechanical Anchors

1. Mechanical anchors shall have current ICC Evaluation Service Report that demonstrates compliance with ACI 355.2, which is supplemented by ICC-ES AC193 for concrete.
2. Mechanical anchors, for use in cast-in-place: Hilti KWIK Bolt TZ, as manufactured by Hilti Corporation, or approved equal.
3. All anchors shall be Type 316 stainless steel.

2.03 EQUIPMENT

- A. Drilling and setting equipment used to install anchors shall be in accordance with MPII.

2.04 ACCESSORIES

- A. Provide all accessories required by manufacturer for proper installation of anchor including but not limited to nozzles, brushes, mesh screen tubes, dispensers, and tools.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Concrete at the time of anchor installation shall have a minimum age of 21 days.
- B. Drilled-in Anchors
1. Drill holes with rotary impact hammer drills using carbide-tipped bits, hollow drill bit system, and core drills using diamond core bits. Drill bits shall be of diameters as specified by the anchor manufacturer. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 2. Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer. Adhesive anchors shall not be installed in core drilled holes.
 3. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items.

Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines. Coordinate allowable connection zones in precast hollow-core planks with Contract Drawings.

4. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
5. Perform anchor installation in accordance with MPII.

C. Cartridge Injection Adhesive Anchors

1. Clean all holes per MPII to remove loose material and drilling dust prior to installation of adhesive. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive. MPII to ensure proper mixing of adhesive components. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface. Remove excess adhesive from the surface. Shim anchors with suitable device to center the anchor in the hole. Do not disturb or load anchors before manufacturer specified cure time has elapsed. Follow MPII with respect to installation temperatures and concrete moisture condition for cartridge injection adhesive anchors.

D. Corrosion Protection: Coat surfaces of post-installed anchors that come in contact with dissimilar metals with a coat of bituminous paint.

E. Repair of defective work

1. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

END OF SECTION 05510

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SECTION 05511
METAL GRATING STAIRS
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SECTION 05511

METAL GRATING STAIRS

PART 1 - GENERAL

1.01 SCOPE

- A. Provide all labor, materials, equipment and services necessary for and incidental to, the complete satisfactory installation of metal grating stairs.

1.02 COORDINATION

- A. 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.
- B. 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.
- C. 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.

1.03 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. Retain subparagraph below if railings are specified in this Section.
5. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

- C. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by a professional engineer registered in the State of Delaware responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification.
1. Keep aluminum members off ground and spaced by using pallets, dunnage, or other supports and spacers.
 2. Protect aluminum 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

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, to design stairs, including attachment to building construction.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity, wind, and seismic loads and the following loads and stresses within limits and under conditions indicated:

1. First three subparagraphs below are based on the International Building Code (IBC); revise to suit Project and to comply with requirements of authorities having jurisdiction.
2. Uniform Load: 100 lbf/sq. ft.
3. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
4. Uniform and concentrated loads need not be assumed to act concurrently.
5. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
6. Retain option in subparagraph below or insert another requirement. The IBC limits deflection of floor members to $L/360$.
7. Limit deflection of treads, platforms, and framing members to $L/360$.
8. Reaction from railing connected to stairs.
9. Exterior stairs must be designed to resist wind loading per the Drawings.
10. Comply with applicable OSHA requirements.

C. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: 1.5.

2.02 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. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
- D. Steel Wire Rod for Grating Crossbars: ASTM A 510/A 510M.
- E. Provide hot-dip galvanized finish for steel.
- F. 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.
- G. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

- H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6

2.03 FASTENERS

- A. General: Provide zinc-plated fasteners, when connecting to steel, with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5; and Type 316 stainless-steel fasteners for connecting to aluminum.
 - 1. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Post-Installed Anchors: In accordance with Section 05510.

2.04 MISCELLANEOUS MATERIALS

- A. Welding Electrodes: Comply with AWS requirements.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with ASTM A 780/A 780M and compatible with paints specified to be used over it.
- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for exterior use; noncorrosive and non-staining; mixed with water to consistency suitable for application and a 30-minute working time.

2.05 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 and railings 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. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.
- 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.

2.06 FABRICATION OF ALUMINUM-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 required to comply with "Performance Requirements" Article.
 - b. Provide closures for exposed ends of channel stringers.
 - c. Finish: As-Fabricated Finish: AA-M12.
 2. Construct platforms and tread supports of aluminum plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.

- a. Provide closures for exposed ends of channel framing.
 - b. Finish: As-Fabricated Finish: AA-M12.
 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, rectangular-bar aluminum grating with openings in gratings no more than 1 inch in least dimension.
 - a. Surface: Serrated.
 - b. Finish: As-Fabricated Finish: AA-M12.
 2. Fabricate grating treads with slip-resistant 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 or grating clamps.
- 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 items.
 2. Fabricate to dimensions and details indicated.

2.07 FABRICATION OF STAIR RAILINGS

- A. Comply with applicable requirements in Section 05521 "Pipe and Tube Railings."

2.08 FINISHES

- A. Finish metal stairs after assembly.

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLING METAL STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
 - 1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing 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 welding stair framing to structure or to weld plates cast into concrete unless otherwise indicated.
 - 1. Grouted Baseplates: Clean concrete and masonry 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.
 - 2. Neatly finish exposed surfaces; protect grout and allow to cure.
 - 3. 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, masonry, or similar construction.

- 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.
 - 2. 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.
 - 3. Comply with requirements for welding in "Fabrication, General" Article.

3.03 INSTALLING RAILINGS

- A. Comply with Section 05521.

END OF SECTION 05511

SECTION 05521

PIPE AND TUBE RAILINGS

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SECTION 05521

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.01 SCOPE

- A. Provide all labor, materials equipment and services necessary for and incidental to, the complete and satisfactory installation of pipe and tube railings.

1.02 SUMMARY

- A. Related Requirements:
 - 1. Section 05511 "Metal Grating Stairs".

1.03 COORDINATION

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.08 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

2.01 MANUFACTURERS

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer, registered in the State of Delaware to design railings, including attachment to building construction and stairs.

-
- B. Structural Performance: 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. Intermediate Rails of Guards
 - a. Concentrated load of 50 lbf applied horizontally.
 - b. Intermediate rail and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Deflection: Span/360.
- 2.03 METALS, GENERAL
- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.
- 2.04 STEEL AND IRON
- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
1. Provide galvanized finish.

- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Railing Dimensions.
 - 1. Height of top rail in guard rail: 42" above stair nosing or walking surface.
 - 2. Height of intermediate rail in guard rail: 21" above stair nosing or walking surface.
 - 3. Height of hand rail above stair nosing: 34"
 - 4. Maximum post spacing: 8" - 0".
 - 5. Rail and post outside diameter: 1-1/2".
 - 6. Comply with applicable OSHA requirements.

2.05 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

2.06 FASTENERS

- A. General: Provide the following:
 - 1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 2. Aluminum Railings: Type 316 stainless-steel fasteners.
 - 3. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- 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. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

D. Post-installed Anchors: Comply with Section 05510.

2.07 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. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.08 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 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 flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form Changes in Direction as Follows:
 - 1. By bending or by inserting prefabricated elbow fittings.
- L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

- M. Close exposed ends of railing members with prefabricated end fittings.
- N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- Q. For removable railing posts, fabricate slip-fit sockets from aluminum tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
- S. Toe Boards: Provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to 4 inch height.

2.09 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
 - 4. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

2.10 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are

acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- B. Mill Finish: AA-M12, nonspecular as fabricated.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.02 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of

exposed locking screws using plastic cement filler colored to match finish of railings.

- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.03 ANCHORING POSTS

- A. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
 - 2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.
- B. Install removable railing sections, where indicated, surface-mounted sockets.

3.04 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.05 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.06 PROTECTION

- A. 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 05521

SECTION 05531

BAR GRATINGS

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SECTION 05531

BAR GRATINGS

PART 1 – GENERAL

1.01 SCOPE

- A. Provide all labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of bar gratings.

1.02 SUMMARY

- A. Related Requirements:
 - 1. Section 05120 "Structural Steel Framing" for structural-steel framing system components.
 - 2. Section 05511 "Metal Grating Stairs" for grating treads and landings of steel-framed stairs.
 - 3. Section 05521 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.03 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 gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Clips and anchorage devices for gratings.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.

- C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables or analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.05 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.
- B. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: For grating which is part of a delegated design system, engage a professional engineer, registered in the State of Delaware to design gratings.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Stairs: Uniform load of 100 lbf/sq. ft. or concentrated load of 300 lbs, whichever produces the greater stress.
 - 2. Limit deflection to $L/360$ or 1/4 inch, whichever is less.
- C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.5.

2.02 METAL BAR GRATINGS

- A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual.

- B. Pressure-Locked Steel Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.
 - 1. Bearing Bar Spacing: 1-3/16 inches o.c.
 - 2. Bearing Bar Depth: As required to comply with structural performance requirements.
 - 3. Bearing Bar Thickness: 3/16 inch.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Serrated.
 - 6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

- C. Pressure-Locked, Rectangular-Bar Aluminum Grating: Fabricated by pressing rectangular flush-top crossbars into slotted bearing bars or swaging crossbars between bearing bars.
 - 1. Bearing Bar Spacing: 1-3/16 inches o.c.
 - 2. Bearing Bar Depth: As indicated on the Drawings.
 - 3. Bearing Bar Thickness: 3/16 inch.
 - 4. Crossbar Spacing: 4 inches o.c.
 - 5. Traffic Surface: Serrated.
 - 6. Aluminum Finish: Mill finish.

2.03 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

- B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

- C. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).

- D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205).

2.04 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 (ASTM B 221M), alloys as follows:
 - 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 - 2. 6061-T1, for grating crossbars.
- C. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 5052-H32.

2.05 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 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M,) and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 2 (A4).

2.06 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.07 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 (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Welding: Comply with AWS recommendations and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
- F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
 - 2. Fabricate toeplates for attaching in the field.
 - 3. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.
- 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.
 - 2. Provide no fewer than four saddle clips for each grating section containing rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced 15/16 inch (24 mm) or more o.c., 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.
 - 1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

- I. Do not notch bearing bars at supports to maintain elevation.

2.08 STEEL FINISHES

- A. Finish gratings, frames, and supports after assembly.
- B. 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.
 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.09 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- 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.

3.02 INSTALLING METAL BAR GRATINGS

- A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.
- B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.03 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05531

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SECTION 05532

PLANK GRATINGS

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SECTION 05532

PLANK GRATINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes extruded-aluminum plank gratings and metal frames and supports for gratings.
- B. Related Requirements:
 - 1. Section 05120 "Structural Steel Framing" for structural-steel framing system components.
 - 2. Section 05531 "Bar Gratings" for aluminum bar gratings and components.

1.03 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 anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Extruded-aluminum plank gratings.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For gratings, including manufacturers' published load tables.

1.05 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.
- B. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.07 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: For grating which is part of a delegated design system, engage a professional engineer, registered in the State of Delaware to design gratings.
- B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Concentrated load of 1000 pounds.
 - 2. Uniform loads indicated on the contract drawings.
 - 3. Limit deflection to $L/360$ or 1/4 inch, whichever is less
- C. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 .
 - 1. Component Importance Factor: 1.5.

2.02 EXTRUDED-ALUMINUM PLANK GRATINGS

- A. Provide extruded-aluminum plank gratings in type, size, and finish indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.
 - 1. Type: Extruded-aluminum planks approximately 6 inches wide with multiple flanges approximately 1.2 inches o.c., acting as bearing bars connected by a web that serves as a walking surface. Top surface has raised ribs to increase slip resistance.
 - 2. Depth: As indicated.
 - 3. Perforations: None.

4. Finish: Mill finish, as fabricated.

2.03 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use indicated, and 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 B221, alloys as follows:
 1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
 2. 6061-T1, for grating crossbars.
- C. Aluminum Sheet: ASTM B209, Alloy 5052-H32.

2.04 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 1. Provide stainless-steel fasteners for fastening aluminum.
- B. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group 1.
- C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

2.05 MISCELLANEOUS MATERIALS

- A. 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.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.06 FABRICATION

- A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- B. Fit exposed connections accurately together to form hairline joints.
- C. 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.
- D. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
 - 1. Fabricate toeplates for attaching in the field.
 - 2. Toeplate Height: 4 inches unless otherwise indicated.
- E. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.
 - 1. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
- F. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.07 GRATING FRAMES AND SUPPORTS

- A. Frames and Supports: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, fabricate from same basic metal as gratings.
 - 2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

2.08 ALUMINUM FINISHES

- A. Class I, Clear Anodic Finish: AA-M12C22A41 complying with AAMA 611.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.
- D. Fit exposed connections accurately together to form hairline joints.
 - 1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Attach toeplates to gratings by welding at locations indicated.
- 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 come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.02 INSTALLING METAL PLANK GRATINGS

- A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.
- B. Attach removable units to supporting members by bolting at every point of contact.

- C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.
- D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

3.03 ADJUSTING AND CLEANING

- 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 requirements for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05532

SECTION 06100

ROUGH CARPENTRY

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SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood furring.
3. Plywood backing panels.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.03 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
1. Fire-retardant-treated wood.
 2. Power-driven fasteners.
 3. Post-installed anchors.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.02 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 **for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.**
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Plywood backing panels.

2.04 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
 1. Application: All interior partitions.
 2. Species:
 - a. Southern pine or mixed southern pine; SPIB.
 - b. Northern species; NLGA.
 - c. Eastern softwoods; NeLMA.
 - d. Western woods; WCLIB or WWPA.
- B. Framing Other Than Non-Load-Bearing Partitions: Construction or No. 2 grade.
 1. Application: Framing other than **interior partitions**.
 2. Species:

- a. Hem-fir (north); NLGA.
- b. Southern pine; SPIB.
- c. Southern pine or mixed southern pine; SPIB.
- d. Spruce-pine-fir; NLGA.

2.05 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 2. Eastern softwoods; No. 2 Common grade; NeLMA.
 3. Northern species; No. 2 Common grade; NLGA.

2.06 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.07 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

2.08 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install shear wall panels to comply with manufacturer's written instructions.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 - 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 - 3. ICC-ES evaluation report for fastener.

3.02 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

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FRP FABRICATIONS
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SECTION 06740

FRP FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1, Specifications Sections, apply to this section.

1.02 SUMMARY

- A. This section includes the following:
 - 1. Grating
 - 2. Accessories and Hardware

1.03 REFERENCES

- A. The latest editions of the publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
 - 1. ASTM D 570-98(2010) Standard Test Method for Water Absorption of Plastics
 - 2. ASTM D 638-14 Standard Test Method for Tensile Properties of Plastics
 - 3. ASTM D 695-15 Standard Test Method for Compressive Properties of Rigid Plastics
 - 4. ASTM D 696-16 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer
 - 5. ASTM D 790-15e2 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 6. ASTM D 792-13 Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 - 7. ASTM E 84-16 Standard Test Method for Surface Burning Characteristics of Building Materials
- C. CODE OF FEDERAL REGULATIONS (CFR)
 - 1. Occupational Safety and Health Standards (OSHA)

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. Structural Performance of Grating Panels: Engineer, fabricate, and install grating panels and stair treads for the Design Loads indicated without exceeding the allowable design working stress of the materials for the grating panels and stair treads, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising grating panels and stair treads.

1.05 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings
 - a. Grating
 - 1) Indicate joints, shapes, dimensions, accessories and installation details for the plastic fabrications complete.
- B. Product Data
 - 1. Grating
- C. Test Reports
 - 1. Mechanical Properties for gratings, treads and structural framing members.

1.06 QUALITY ASSURANCE

- A. Appearance
 - 1. Do not change source of supply for materials after work has started. Variation in component size and location shall be limited to plus or minus 1/8 inch.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver until areas are ready for installation. Deliver components and materials to the site undamaged.
- B. All systems, sub-systems and structures shall be shop fabricated and assembled into the largest practical size suitable for transporting.
- C. All materials and equipment necessary for the fabrication and installation of grating shall be stored before, during and after shipment in a manner to prevent cracking, twisting, bending, breaking, chipping or damage of any kind to the materials or equipment, including damage due to over exposure to the sun. Any material, which in the opinion of the Owner, has been damaged as to be unfit for use, shall be promptly removed from the site, and the Contractor shall receive no compensation for the damaged material or its removal. Undamaged material shall be supplied by the Contractor at no additional cost to the Owner.

- D. Identify and match-mark all materials, items and fabrications for installation and field assembly.

1.08 COORDINATION

- A. Provide imbedded curb angles in concrete where indicated. Deliver to the job site so as to be built into other work and not delay project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Available manufacturers subject to compliance with the requirements are
 - 1. Strongwell Corporation, Bristol, VA
 - 2. Fibergrate Composite Structures, Dallas, TX
 - 3. AMICO/Seasafe Inc., Lafayette, LA.

2.02 GLASS-FIBER-REINFORCED-PLASTIC GRATINGS

- A. Pultruded Glass-Fiber-Reinforced Gratings: Bar gratings assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.
 - 1. Configuration: I4015; 1.5-inch I-bars spaced 1 inch o.c. (40 percent open)
 - 2. Weight: 4.6 lb/sq. ft.
 - 3. Resin Type: Vinylester.
 - 4. Flame-Spread Index: 25 or less when tested according to ASTM E 84.
 - 5. Color: Gray or Yellow Manufacturer's standard.
 - 6. Traffic Surface: Applied abrasive finish.

2.03 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use
- B. 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.

2.04 FABRICATION

- A. Shop Assembly: Shop fabricate grating sections 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 (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form gratings 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. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.05 MISCELLANEOUS ACCESSORIES

- A. Provide miscellaneous accessories such as curb angles, flat plates, bolts, grating hold down clips and other hardware for the complete installation of the plastic fabrications.
- B. Bolts and other hardware shall be ANSI Type 316 stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Coordinate and furnish all fasteners, setting drawings, diagrams and instructions for installation.
- B.
- C. Perform cutting, drilling, and fitting required for installation of FRP fabrications. Set FRP fabrications accurately in location, alignment and elevation with edges and surfaces level, plumb, true, and free of rack.
- D. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer.
- E. Install items as indicated and in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 07131

SELF-ADHERING SHEET WATERPROOFING

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SECTION 07131

SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes self-adhering modified bituminous sheet waterproofing and blindside sheet waterproofing.

1.02 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.04 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.06 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MODIFIED BITUMINOUS SHEET WATERPROOFING (VSW-1)

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
 - b. Grace, W. R., & Co. - Conn.; Bituthene 3000/Low Temperature or Bituthene 4000.
 - c. Henry Company; Blueskin WP 100/200.
 - d. Meadows, W. R., Inc.; SealTight Mel-Rol.
 2. Physical Properties:
 - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
 - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
 - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
 - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
 - e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
 - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
 - g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
 - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.
 3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.02 BLINDSIDE SHEET WATERPROOFING (HSW-1)

- A. Bonded HDPE or Polyethylene Sheet of Blindside Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane consisting of either, total 46-mil thickness, or a cross-laminated film of low- and medium-density polyethylene, coated with a modified asphalt layer and a nonwoven geotextile-fabric final layer, total 95-mil thickness; with the following physical properties:
1. Products: Subject to compliance with requirements, available products that may be incorporated into Work include, but are not limited to, the following:
 - a. Grace Construction Products; W.R. Grace & Co. – Conn; Preprufe 300R
 2. Tensile Strength, Film: 2000 psi minimum; ASTM D 412.
 3. Low-Temperature Flexibility: Pass at minus 10 deg F; ASTM D 1970.
 4. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D 903, modified.
 5. Lap Adhesion: 2.5 lbf/in. minimum; ASTM D 1876, modified.
 6. Hydrostatic-Head Resistance: 231 feet; ASTM D 5385, modified.
 7. Puncture Resistance: 200 lbf minimum; ASTM E 154
 8. Vapor Permeance: 0.01 perms maximum; ASTM E 96/E 96M, Water Method.
 9. Water Absorption: 0.5 percent; ASTM D 570.

2.03 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.
- G. Protection Course: ASTM D 6506, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners and as follows:
 - 1. Thickness: 1/8 inch, nominal, for vertical applications; 1/4 inch, nominal, elsewhere.
 - 2. Adhesive: Rubber-based solvent type recommended by waterproofing manufacturer for protection course type.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 3. Verify that compacted subgrade is dry, smooth, and sound; and ready to receive adhesive-coated HDPE sheet.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Bridge and cover isolation joints and expansion joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay flat sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap substrate.
- G. Corners: Prepare, prime and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install $\frac{3}{4}$ inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.03 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Prepare surfaces and install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- E. Seal edges of sheet-waterproofing terminations with mastic.

- F. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- H. Immediately install protection course with butted joints over waterproofing membrane.
 - 1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.04 BLINDSIDE SHEET-WATERPROOFING APPLICATION

- A. Install bonded blindside sheet waterproofing according to manufacturer's written instructions.
- B. Horizontal Applications: Install sheet with face against substrate. Accurately align sheet and maintain uniform side and end laps of minimum dimension required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- C. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
- D. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane trowelings.
- E. Install sheet-waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
- F. Repair tears, voids and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

3.05 MOLDED-SHEET DRAINAGE-PANEL INSTALLATION

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install protection course before installing drainage panels.

3.06 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07131

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SECTION 07210

BUILDING INSULATION

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SECTION 07210
BUILDING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass reinforced mat faced polyisocyanurate insulation.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research/evaluation reports.

PART 2 - PRODUCTS

2.01 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company (The).
 - c. Owens Corning.
 2. Type IV, 25 psi.

2.02 POLYISOCYANURATE INSULATION BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville.
 - 3. Knauf Insulation.
 - 4. Owens Corning.
- B. Polyisocyanurate Board Insulation: Closed cell polyisocyanurate foam core bonded to fiberglass-reinforced facers, conforming to ASTM Type II, Class 1, Grade 2, with a maximum flame spread and smoke-developed indexes of 75 and 450 respectively, per ASTM E-84.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.02 INSTALLATION OF INSULATION FOR FRAMED OR FURRED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill

voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

- C. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

END OF SECTION 07210

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SECTION 07272

FLUID-APPLIED MEMBRANE AIR BARRIERS

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SECTION 07272

FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes fluid-applied, vapor-permeable membrane air barriers.

1.03 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, at least 64 square feet in area, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.09 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect air-barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.
- B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

2.02 PERFORMANCE REQUIREMENTS

- A. General: Air barrier shall be capable of performing as a continuous vapor-**permeable** air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.03 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, synthetic polymer membrane.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Synthetic Polymer Membrane:
 - 1) Carlisle Coatings & Waterproofing Inc.; Barritech VP.
 - 2) Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.
 - 3) Henry Company; Air-Bloc 31 or Air-Bloc 33.
2. Physical and Performance Properties:
 - a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
 - b. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M.
 - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.

2.04 ACCESSORY MATERIALS

- A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Counterflashing Strip: Modified bituminous, 40-mil-thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil-thick, cross-laminated polyethylene film with release liner backing.
- D. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- E. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.
- F. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- G. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.
- I. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil-thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance value of 37 perms.
- J. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 07920 "Joint Sealants."

- K. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
 - 2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
 - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.03 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
 - 1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

3.04 TRANSITION STRIP INSTALLATION

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
 - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 - 2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 - 1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply adhesive-coated transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- I. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, counterflashing strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.05 FLUID AIR-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
 1. Apply primer to substrates at required rate and allow it to dry.
 2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
 3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
 1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in one or more equal coats.
- C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.
- D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.
- E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. **Inspections may include the following:**
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 4. Site conditions for application temperature and dryness of substrates have been maintained.
 - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 6. Surfaces have been primed, if applicable.
 - 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
 - 8. Termination mastic has been applied on cut edges.
 - 9. Strips and transition strips have been firmly adhered to substrate.
 - 10. Compatible materials have been used.
 - 11. Transitions at changes in direction and structural support at gaps have been provided.
 - 12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 13. All penetrations have been sealed.
- C. Tests: As determined by Owner's testing agency from among the following tests:
 - 1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization or ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
 - 2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
 - 3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- D. Air barriers will be considered defective if they do not pass tests and inspections.
 - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.

2. Remove and replace deficient air-barrier components for retesting as specified above.
- E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.07 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 60 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.
- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION 07272

SECTION 07412

STANDING-SEAM METAL ROOF PANELS

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SECTION 07412

STANDING SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes standing-seam metal roof panels.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Sample of special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. **UL-Certified, Portable Roll-Forming Equipment:** UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.07 WARRANTY

- A. **Special Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. **Warranty Period:** Five years from date of Substantial Completion.
- B. **Special Warranty on Panel Finishes:** Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. **Finish Warranty Period:** 20 years from date of Substantial Completion.
- C. **Special Weathertightness Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 - 1. **Warranty Period:** 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. **Recycled Content of Steel Products:** Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. **Solar Reflectance Index:** Not less than 78 when calculated according to ASTM E 1980.
- C. **Energy Performance:** Provide roof panels with an aged Solar Reflectance Index of not less than 0.64 when tested according to CRRC-1.
- D. **Structural Performance:** Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. **Wind Loads:** As indicated on Drawings.
 - 2. **Other Design Loads:** As indicated on Drawings.

- E. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 1680 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- F. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- G. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- H. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 - 1. Uplift Rating: UL 90.
- I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
 - 1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
 - 2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fabral - Slim Seam
 - b. Merchant & Evans.
 - c. Morin; a Kingspan Group company.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.028 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: Mission Red.
3. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.032 inch.
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer finish.
 - d. Color: Mission Red.
4. Clips: Two-piece floating to accommodate thermal movement.
 - a. Material: 0.062-inch-thick, stainless-steel sheet.
5. Joint Type: Single folded.
6. Panel Coverage: 16 inches.
7. Panel Height: 2.0 inches.

2.03 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.
 1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.

3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT or Ultra.
 - c. Henry Company; Blueskin PE200 HT.
- B. Felt Underlayment: ASTM D 226/D 22M, Type II (No. 30), asphalt-saturated organic felts.
- C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.04 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match metal roof panels and roof fascia and rake trim.

- E. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.05 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.06 FINISHES

- A. Panels and Accessories:
 - 1. Two-Coat Fluoropolymer: AAMA 621 or AAMA 620, based on material provided. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.02 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the roof area indicated below:

- a. Roof perimeter for a distance up from eaves of 24 inches beyond interior wall line.
- b. Rake edges for a distance of 18 inches.
- c. Hips and ridges for a distance on each side of 18 inches.
- d. Over entire surface of plywood sheathing where there is no roof insulation.
- e. Around dormers, chimneys, skylights, pipes, and other penetrating elements for a distance from element of 18 inches.

- B. Felt Underlayment: Apply at locations indicated below, in shingle fashion to shed water, and with lapped joints of not less than 2 inches.

1. Apply on roof not covered by self-adhering sheet underlayment. Lap over edges of self-adhering sheet underlayment not less than 3 inches, in shingle fashion to shed water.

- C. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

- D. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07620 "Sheet Metal Flashing and Trim."

3.03 METAL PANEL INSTALLATION

- A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 - c. At panel splices, nest panels with minimum **6-inch** end lap, sealed with sealant and fastened together by interlocking clamping plates.
- B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.04 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 07412

SECTION 07415

FORMED METAL WALL PANELS

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FORMED METAL WALL PANELS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Concealed-fastener, lap-seam metal wall panels.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
- 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- 3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
- 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
- 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
- 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
- 7. Review temporary protection requirements for metal panel assembly during and after installation.
- 8. Review of procedures for repair of metal panels damaged after installation.
- 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.04 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 each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
 - 1. Include Samples of trim and accessories involving color selection.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical metal panel assembly, including corner, supports, attachments, and accessories.
 - 2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration according to AAMA 501.2.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect 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.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.09 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.010 COORDINATION

- A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.011 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..

- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fabral Décor-Flush, or comparable product by one of the following:
 - a. Berridge Manufacturing Company.
 - b. Morin; a Kingspan Group company.
 - 2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.028 inch.
 - b. Exterior Finish: Two-coat fluoropolymer.
 - c. Color: Match existing Pump and Blower Building on site..

3. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.032 inch .
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer.
 - d. Color: Match existing Pump and Blower Building on site.

2.03 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 1. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels

and remain weathertight; and as recommended in writing by metal panel manufacturer.

2. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.04 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.05 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Steel Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- D. Aluminum Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.

2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.03 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 1. Shim or otherwise plumb substrates receiving metal panels.
 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 3. Install screw fasteners in predrilled holes.
 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 5. Install flashing and trim as metal panel work proceeds.
 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- D. Watertight Installation:
1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.
- F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Water-Spray Test: After installation, test area of assembly for water penetration according to AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.
- D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.05 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07415

SECTION 07419
METAL SOFFIT PANELS
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SECTION 07419

METAL SOFFIT PANELS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes metal soffit panels.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings.
 - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.02 METAL SOFFIT PANELS

- A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

- B. Metal Soffit Panels: Match profile and material of metal [**wall**] [**roof**] panels.
1. Finish: [**Match finish and color of metal wall panels**] [**Match finish and color of metal roof panels**] [**As indicated on Drawings**].
 2. Sealant: Factory applied within interlocking joint.
- C. V-Groove-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a V-groove centered between panel edges; with a V-groove joint between panels.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. ATAS International, Inc.
 - b. Berridge Manufacturing Company.
 - c. Englert, Inc.
 - d. Fabral.
 - e. McElroy Metal, Inc.
 - f. Petersen Aluminum Corporation.
 2. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
 - a. Thickness: 0.032 inch.
 - b. Surface: Smooth, flat finish.
 - c. Exterior Finish: Two-coat fluoropolymer.
 - d. Color: Bone White.
 3. Panel Coverage: 12 inches.
 4. Panel Height: 0.375 inch.

2.03 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, **G90** coating designation or ASTM A 792/A 792M, **Class AZ50** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum **1-inch**-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch thick.
 - 2. Joint Sealant: ASTM C 920; as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.04 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.05 FINISHES

- A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.
 1. Soffit Framing: Wire tie **or clip** furring channels to supports, as required to comply with requirements for assemblies indicated.

3.02 METAL PANEL INSTALLATION

- A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
 1. Apply panels and associated items true to line for neat and weathertight enclosure.
 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
 4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- B. Watertight Installation:
 1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
 2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
 3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.03 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 07419

SECTION 07620

SHEET METAL FLASHING AND TRIM

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SECTION 07620
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed steep-slope roof sheet metal fabrications.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include identification of finish for each item.
4. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

- C. Samples: For each exposed product and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

- A. Product certificates.

- B. Product test reports.

- C. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof eave, including gutter, fascia, and fascia trim, approximately 10 feet long.

1.07 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.02 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Exposed Coil-Coated Finish:
 - a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color: As selected by Architect from manufacturer's full range.

2.03 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT or Ultra.
 - c. Henry Company; Blueskin PE200 HT.
 - 2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
 - 3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.
- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.04 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim

installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Aluminum Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.05 MANUFACTURED REGLETS

- A. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Heckmann Building Products, Inc.

- b. Hickman, W. P. Company.
 - c. Keystone Flashing Company, Inc.
 - d. National Sheet Metal Systems, Inc.
 - e. Sandell Manufacturing.
2. Material: Galvanized steel, 0.022 inch thick.
 3. Finish: With manufacturer's standard color coating.

2.06 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Obtain field measurements for accurate fit before shop fabrication.
 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.
- C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.07 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch-long sections. Furnish flat-stock gutter brackets and gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
 - 1. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.
- B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
 - 1. Hanger Style: SMACNA Figure B.
 - 2. Fabricate from the following materials:
 - a. Aluminum: 0.024 inch thick.

2.08 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Eave, Rake, and Ridge, and Hip Flashing: Fabricate from the following materials:
 - 1. Aluminum: 0.032 inch thick.

PART 3 - EXECUTION

3.01 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.02 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 - 3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 - 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 - 5. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
 - 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 07920 "Joint Sealants."

- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.03 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
 - 1. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
 - 2. Install continuous gutter screens on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.
- C. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.

3.04 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches.
- E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.05 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07620

SECTION 07841

THROUGH-PENETRATION FIRESTOP SYSTEMS

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SECTION 07841

THROUGH-PENETRATION FIRESTOP SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.03 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

B. Product test reports.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by UL or a qualified testing agency acceptable to authorities having jurisdiction.
 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems bearing marking of qualified testing and inspection agency.
- C. Pre-installation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grace Construction Products.
 2. Hilti, Inc.
 3. 3M Fire Protection Products.

2.02 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
 2. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.
- C. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Sealants: 250 g/L.

2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- E. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the State of Delaware.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- D. Install fill materials for firestopping by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.02 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.03 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.04 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping for Metallic Pipes, Conduit, or Tubing:
 - 1. UL-Classified Systems: C-AJ - 1001-1999.
- C. Firestopping for Nonmetallic Pipe, Conduit, or Tubing
 - 1. UL-Classified Systems: C-AJ- 2001-2999.
- D. Firestopping for Electrical Cables:
 - 1. UL-Classified Systems: C-AJ-3001-3999.

- E. Firestopping for Cable Trays with Electric Cables:
 - 1. UL-Classified Systems: C-AJ - 4001-4999.
- F. Firestopping for Insulated Pipes:
 - 1. UL-Classified Systems: C-AJ -5001-5999.
- G. Firestopping for Miscellaneous Electrical Penetrants:
 - 1. UL-Classified Systems: C-AJ- 6001-6999.
- H. Firestopping for Miscellaneous Mechanical Penetrants:
 - 1. UL-Classified Systems: C-AJ -7001-7999.
- I. Firestopping for Groupings of Penetrants:
 - 1. UL-Classified Systems: C-AJ - 8001-8999.

END OF SECTION 07841

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SECTION 07920

JOINT SEALANTS

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SECTION 07920

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Urethane joint sealants.

1.03 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each application indicated below:
 - a. Each kind of sealant and joint substrate indicated.
 - 3. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 4. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.04 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion Test Reports: For each sealant application tested.
- G. Warranties: Sample of special warranties.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Pre-installation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.08 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. **Compatibility:** Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. **VOC Content of Interior Sealants:** Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural Sealants: 250 g/L.
 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. **Liquid-Applied Joint Sealants:** Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. **Suitability for Immersion in Liquids.** Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
- D. **Stain-Test-Response Characteristics:** Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- F. Colors of Exposed Joint Sealants: Match color of field.

2.02 URETHANE JOINT SEALANTS

- A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP1 or Sonolastic Ultra.
 - b. Bostik, Inc.; Chem-Calk 900.
 - c. Pecora Corporation; Dynatrol I-XL.
 - d. Sika Corporation, Construction Products Division; Sikaflex - 1a.
- B. Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP1 or Sonolastic Ultra.
 - b. Sika Corporation, Construction Products Division; Sikaflex - 1a.
- C. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic SL 1.
 - b. Bostik, Inc.; Chem-Calk 950.
 - c. Pecora Corporation; Urexpan NR-201.
 - d. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
- D. Immersible, Single-Component, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses T and I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Building Systems; Sonolastic NP1.
 - b. Sika Corporation, Construction Products Division; Sikaflex - 1a.

2.03 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.04 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. **Surface Cleaning of Joints:** Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
- B. **Joint Priming:** Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

- A. **General:** Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:

- a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
- a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.05 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.06 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces[<JS-#>].
 - 1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between plant-precast architectural concrete paving units.
 - d. Joints in stone paving units, including steps.
 - e. Tile control and expansion joints.
 - f. Joints between different materials listed above.
 - 2. Urethane Joint Sealant: Single component, nonsag, traffic grade or Single component, pourable, traffic grade.
 - 3. Joint-Sealant Color: Grey.
- B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
 - 1. Joint Locations:
 - a. Joints in concrete tanks.
 - b. Other joints as indicated.
 - 2. Urethane Joint Sealant: **Immersible, single component, nonsag, traffic grade.**
 - 3. Joint-Sealant Color: Grey.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.

- c. Control and expansion joints in unit masonry.
 - d. Joints between metal panels.
 - e. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors and louvers.
 - g. Control and expansion joints in ceilings.
 - h. Other joints as indicated.
2. Urethane Joint Sealant: Single component, nonsag, Class 25.
 3. Joint-Sealant Color: Match field color.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
 2. Urethane Joint Sealant: Single component, nonsag, traffic grade or single component, pourable, traffic grade.
 3. Joint-Sealant Color: Grey.

END OF SECTION 07920

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SECTION 08120

FIBERGLASS DOORS AND FRAMES

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SECTION 08120

FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes requirements for providing all new fiberglass faced doors and aluminum frames as indicated in accordance with the Contract Documents.

1.02 SUBMITTALS

- A. General: Submit each item in this Article according to GR-16 of the General Requirements and the conditions of the Contract and Division 01 Specification Sections.
 - 1. Manufacturer's descriptive literature for doors and frames. Include data and details for door construction, panel (internal) reinforcement, insulation, and door edge construction.
 - 2. Shop drawings for doors and frames showing elevations, construction details, hardware provisions, method of glazing, and installation details. Include a schedule showing doors and frames location.
- B. Submit two color samples of each color for prefinished doors in accordance with Division 1.
- C. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 8 Section "Door Hardware" for door hardware.

1.03 QUALITY ASSURANCE

- A. Single- Source Responsibility: Obtain doors from one source and by a single manufacturer.
- B. Manufacturer shall have a minimum of 5 years experience in the production of pre-assembled door systems with factory installed hardware, using the types of materials specified for this project.

1.04 DELIVERY AND STORAGE

- A. All materials shall be delivered to the site in sealed, undamaged containers fully identified with the manufacturer's name, project number, the tag location, the door type, color and weight. Store doors and frames under cover in clean, dry, ventilated, and accessible location, with 1/4 inch air space between door. Replace damaged materials with new.

1.05 PERFORMANCE REQUIREMENTS

- A. Thermal Transmittance of Assembly: $R = 1.39$.
- B. Structural Performance of Assembly:
 - 1. Air Infiltration: ASTM E283 at 1.57 psf (25 mph) – 0.31 cfm/ft.
Air Infiltration: ASTM W182 at 6.24 psf (50 mph) – 0.97 cfm/ft.
 - 2. Water Penetration: ASTM E-331 – 15 min. cycle – No Entry
 - 3. Uniform Load: ASTM E330 – (+/-) 40 lbs./sq. ft.
- C. Structural Integrity Tests:
 - 1. Exit Bar Pull-off Test: 7,975 lbs. minimum load resistance before exit bar disengages from door.
 - 2. Closer Pull-off Test: 8,000 lbs. minimum load resistance before closer disengages from door.
- D. Windborne Debris Resistance Tests:
 - 1. Missile Impact Test: PA201 – 94 – Passed
 - 2. Cyclic Wind Pressure Test: PA203 – 94 – 60 lbs./sq. ft.
 - 3. Forced Entry Test: SFBC 3603.2 – 300 lbs. – Passed.
- E. Hinge Reinforcement Attachment:
 - 1. Internal reinforcement shall be continuous within the structure.
 - 2. Frame Screw Holding Value to Accommodate Screw: 1,000 lbs. per screw.

1.06 DOOR LEAF REQUIREMENT TESTS:

- A. Door leaf without frame or hardware and with a minimum lite cut-out of 12" x 24" shall meet the following requirements:
 - 1. Concentrated Load Bow Test: 5,000 lbs. minimum load with no permanent deflection to door leaf.
 - 2. Torsion Twist Test: at 300 lbs. minimum load with no permanent set to door leaf.

1.07 FACE SHEET REQUIREMENTS TESTS:

- A. FRP material and FRP face sheets with core materials are to meet the following criteria:
 - 1. Center Door Section (face sheet / core / face sheet)
 - a. Gardner Impact Test – ASTM D5420 – 413.7 in.-lbs.
 - 2. FRP Material (MR84)

- a. Flexural Strength Test – ASTM D790 – 13.3 x 103.
- b. Izod Impact Strength Test – ASTM D256 – 15 ft-lb / in. thickness.
- c. Barcol Hardness – ASTM D5420 – 50.

1.08 WARRANTY

- A. Door and frame manufacturer shall provide unconditional ten year warranty against failure due to corrosion of doors and frames from specified environment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide the Vale Door Solutions Model V-600, as manufactured by the following:
 1. Vale Doors, Collingdale, PA. (610)-586-6500.
 2. Special Lite, Inc., Decatur, Michigan Series SL-17 (215) 345-6601
 3. Commercial Door Systems, Bensalem, PA Model CDS-F500 HDU (215) 244-9080.
 4. Or an acceptable equivalent project.

2.02 EXTRA HEAVY DUTY FIBERGLASS WIDE STILE DOORS

- A. Doors shall be fabricated from a structural aluminum main frame faced with Fiberglass Reinforced Polymer (FRP) panels, filled with polystyrene core, and trimmed with removable aluminum edge pieces.
- B. Doors panels shall be made of fiberglass reinforced polyester, using resins tailored to the specific corrosive environment and have a fiberglass content of 25% by weight. Panels shall be not less than 0.120 inches thick, and have a pebble-like embossed finish. The doors shall be flush construction, having no seams or cracks.
- C. Structural main frame shall be constructed from extruded aluminum 6063-T6 alloy rectangular tube. Tubes forming the stiles shall be 1 ½ inch x 5 ¾ inch; tubes forming the rails shall be 1 ½ inch x 6 inches. Minimum thickness shall be 3/16 inch for the hinge side stile; all other members shall be a minimum of 1/8 inch.
- D. Main Frame Joinery: Assembly for the four meeting joints of the stiles and rail shall be mortise and tenon, with the mortise being cut into the stile, and the rail seated in the recess. Assembly shall be secured by 3/8 inch diameter stainless steel rods, with two tie rods in the head rail, and 1 tie rod in the bottom rail.
- E. Core material will be 25 psi compressive strength polystyrene foam, with a flame spread rating of no greater than 25.
- F. Aluminum edge trim shall be completely removable with interlocking edge. No exposed fastening devices are to be used.

- G. Weather-stripping shall be pile, with .50 inch backing strip width, 0.5 inch pile height. Provide at center stile of door pairs.
- H. Adequate reinforcing and compression members shall be used to accommodate surface hinges, closers, locksets, and push or pull plates. In no case shall screws be used into fiberglass matrix to provide holding for hinges, locks or closers or any structured attachment. Provide ¼" aluminum plate for closer reinforcement at head rail
- I. All reinforcing resins shall contain a halogenated additive or co-reactant plus Antimony Trioxide to achieve a flame spread of 25 or less per ASTM B-84 and shall be self-extinguishing per ASTM D-735.
- J. The color of the doors shall be integrally molded as the part is made. The color of the doors shall be selected by the Owner from manufacturer's full range of color samples.

2.03 FRAME

- A. Frames shall be aluminum standard closed back extruded aluminum rectangular tubes of 6063-T6 alloy. Tube size shall be 2 inches by 8 inches by 0.125 inch wall thickness for jambs, heads and mullions. The color of the frames shall be dark bronze.
- B. Vertical frame jambs and mullions shall be the full height of the opening. Head rails shall be attached to the jambs and mullions by slipping over an extruded aluminum U-channel, attached to the jambs with stainless steel machine screws. Rails shall be attached to the reinforcing channel with stainless steel flat headed machine screws.

2.04 ANCHORS

- A. Frame anchors shall be stainless steel expansion type bolts for securing frame to masonry or concrete opening.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation of doors and frames shall be in strict compliance with the manufacturer's written instructions using non-corrosive materials and methods.
- B. Installation of door hardware is specified in Section 08710.

3.02 ADJUSTING & CLEANING

- A. Adjust door hardware to operate correctly in accordance with hardware manufacturer's maintenance instructions.
- B. Clean surfaces of door opening assemblies and sight-exposed door hardware in accordance with manufacturer's maintenance instructions.

END OF SECTION

SECTION 08331

OVERHEAD COILING DOORS

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SECTION 08331

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

- 1. Insulated service doors.

- B. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- C. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

- 1. Wind Loads: As indicated on Drawings.

- a. Basic Wind Speed: 130 mph.
 - b. Importance Factor: III.
 - c. Exposure Category: C.

- 2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

- D. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 30 lbf/sq. ft. wind load, acting inward and outward.

- E. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996.

- 1. Large Missile Test: For overhead coiling doors located within 30 feet of grade.

- F. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - 2. Seismic Component Importance Factor: 1.5.
- G. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
 - 1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Show locations of replaceable fusible links.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.
- D. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of seismic restraints.
 - 2. Summary of forces and loads on walls and jambs.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- C. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.

PART 2 - PRODUCTS

2.01 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch and as required to meet requirements.
 - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
 - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

4. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
- B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.02 HOOD

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
 1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.03 LOCKING DEVICES

- A. Chain Lock Keeper: Suitable for padlock.

2.04 CURTAIN ACCESSORIES

- A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
 1. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of hood.
 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.05 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.06 MANUAL DOOR OPERATORS

- A. Equip door with manufacturers recommended manual door operator unless another type of door operator is indicated.
- B. Chain Hoist Operator: Consisting of endless steel hand chain, chain pocket wheel and guard, and gear-reduction unit with a maximum 25 lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.07 DOOR ASSEMBLY – DOOR 902.1

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cornell Iron Works, Inc.
 - b. McKeon Rolling Steel Door Company, Inc.
 - c. Overhead Door Corporation.
- B. Operation Cycles: Not less than 50,000.

1. Include tamperproof cycle counter.
- C. Curtain R-Value: 7.7 deg F x h x sq. ft./Btu.
- D. Door Curtain Material: Galvanized steel.
- E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
 1. Insulated-Slat Interior Facing: Metal.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.
 1. Shape: Round.
 2. Mounting: Face of wall.
- H. Locking Devices: Equip door with slide bolt for padlock or chain lock keeper.
- I. Door Finish:
 1. Powder-Coated Finish: Color as selected by Owner from manufacturer's full range.
 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.08 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.09 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.03 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.04 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter.

3.05 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08348

ACCESS HATCHES

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SECTION 08348

ACCESS HATCHES

PART 1 – GENERAL

1.01 SCOPE

- A. Provide all labor, materials, equipment, and services necessary for and incidental to, the complete and satisfactory installation of aluminum access hatches.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: Indicate location of each submitted hatch

PART 2 – PRODUCTS

2.01 ALUMINUM ACCESS HATCHES

- A. Aluminum Trough Frame Access Hatch:
 - 1. Provide Type TPS for single leaf doors, Type TPD for double leaf doors, and Type THS for single leaf H-20 rated doors, as manufactured by USF Fabrication, or approved equal.
 - 2. Door: Single or Double leaf as shown on Drawings.
 - 3. Performance characteristics:
 - a. Cover: Unless indicated otherwise on drawings, hatch must be reinforced to support a minimum live load of 300 PSF with a maximum deflection of 1/150th of the span. At locations indicated on Drawings to support an H-20 load, hatch must be reinforced to support AASHTO H-20 wheel load with a maximum deflection of 1/150th of the span
 - 4. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing, through the use of stainless steel horizontal springs or gas shocks.
 - a. Operation of the cover shall not be affected by temperature.

- b. Entire door, including all hardware components, shall be highly corrosion resistant.
 5. Cover: Shall be 1/4" aluminum diamond pattern, with slip-resistant surface.
 6. Frame: Extruded aluminum trough section with an integral anchor flange on all four sides.
 7. Hinges: Type 316 stainless steel with type 316 stainless steel tamper-resistant bolts/locknuts.
 8. Drain Coupling: Provide a 1-1/2" drain coupling located adjacent to a concrete wall. Coordinate drainage piping with coupling location.
 9. Lifting mechanisms: Manufacturer shall provide the required number and size of springs or gas shocks to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the covers when closing.
 10. Flush exterior lifting handle, type 316 stainless steel.
 11. Hardware:
 - a. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 1/4" (6mm) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the covers do not protrude into the channel frame.
 - b. Cover shall be equipped with a hold open arm which automatically locks each cover in the open position.
 - c. Cover shall be fitted with the required number and size of compression spring operators. Springs and spring tubes shall be Type 316 stainless steel.
 - d. A Type 316 stainless steel slam lock with fixed handle shall be mounted on the underside of one cover.
 - e. Hardware: Shall be Type 316 stainless steel throughout.
 12. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.
 13. Provide handrails on access hatch leafs located above stairs. Coordinate handrail geometry with stair handrail fabricator.
- B. Fall Protection: At locations indicated on the Drawings. Permanently installed fall-through protection aluminum single grate system, designed to withstand a minimum pedestrian load of 300 PSF. Grate shall operate independent of the cover's reinforcing and have an attached aluminum pull rod. Powder-coat with OSHA safety orange.
- C. Provide bituminous coating on the access hatch frame surfaces which will be in contact with concrete.

2.02 MATERIALS

- A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666. Remove tool and die marks and stretch lines, or blend into finish.
- B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- D. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- E. Frame Anchors: Same material as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Type 316 stainless steel.

2.03 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.
 - 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 08710 "Door Hardware." If cylinder not specified, coordinate with the Owner.
- E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.04 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Stainless-Steel Finish: Bright, cold-rolled, unpolished No. 2B finish.

PART 3 – EXECUTION

3.01 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
 - 1. Test units for proper function and adjust until proper operation is achieved.
 - 2. Repair finishes damaged during installation.
 - 3. Restore finishes so no evidence remains of corrective work.

3.03 ADJUSTING

- A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION 08348

SECTION 08710

DOOR HARDWARE

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SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For plastic protective trim units in each finish, color, and texture required for each type of trim unit indicated.
- C. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 5) Fastenings and other pertinent information.
 - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for door hardware.
 - 8) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For door hardware, from the manufacturer.
 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Warranty: Special warranty specified in this Section.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.06 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. Door Hardware:
 - a. Three pair of butt hinges.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Pre-installation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.09 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.010 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

1.011 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum

requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.02 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
 - c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.03 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 2. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- D. Lock Trim:
 1. Description: Provide handed, quick reversible locks.
 2. Levers: Cast.
 - a. Newport.
 3. Escutcheons (Roses): Forged.
 4. Dummy Trim: Match lever lock trim and escutcheons.
 5. Operating Device: Lever with escutcheons (roses).
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Arrow USA; an ASSA ABLOY Group company.
 - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - c. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - d. Schlage Commercial Lock Division; an Ingersoll-Rand company.
 - e. Yale Security Inc.; an ASSA ABLOY Group company.

2.04 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. Hiawatha, Inc.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. Trimco.

2.05 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. Von Duprin; an Ingersoll-Rand company.

B. Provide listed Panic Devices at Electrical Rooms as noted.

2.06 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: Same manufacturer as for locking devices.
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
 - b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
 - c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
 - d. Schlage Commercial Lock Division; an Ingersoll-Rand company.
 - e. Yale Security Inc.; an ASSA ABLOY Group company.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.

2.07 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 2. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver or Brass.
1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.
 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.

2.08 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hiawatha, Inc.
 - b. IVES Hardware; an Ingersoll-Rand company.
 - c. Rockwood Manufacturing Company.
 - d. Trimco.

2.09 ACCESSORIES FOR PAIRS OF DOORS

- A. Astragals: BHMA A156.22.

2.010 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. LCN Closers; an Ingersoll-Rand company.
 - b. Norton Door Controls; an ASSA ABLOY Group company.
 - c. Yale Security Inc.; an ASSA ABLOY Group company.

2.011 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. Cal-Royal Products, Inc.
 - c. Hiawatha, Inc.
 - d. Rockwood Manufacturing Company.
 - e. Trimco.

2.012 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Architectural Builders Hardware Mfg., Inc.
 - b. Glynn-Johnson; an Ingersoll-Rand company.
 - c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

2.013 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. National Guard Products.
 - b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
 - c. Reese Enterprises, Inc.

2.014 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Baldwin Hardware Corporation.
 - b. Hiawatha, Inc.
 - c. IVES Hardware; an Ingersoll-Rand company.
 - d. Trimco.

2.015 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where

through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

2.016 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.03 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying schedule.
 - 2. Furnish permanent cores to Owner for installation.
- E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07920 "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

3.04 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final

operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.05 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 01820 "Demonstration and Training."

3.07 DOOR HARDWARE SCHEDULE

HW-1 Door 802.1 (Removable Head Bar)

5 Pair	Butt Hinges	Stanley FBB 199, 4 1/2" x 4 1/2", NRP, US 32D
1 Each	Mortise Lock	Corbin Russwin ML2051, Newport, US32D
1 Each	Cylinder	6 pin cylinder
3 Pair	Flush Bolts	Ives FB257N, US26D
2 Each	Stop and Holder	Glynn Johnson 90H, US32D
1 Each	Threshold	Reese FBR 555
2 Each	Kickplate	4" x 34", US32D
1 Set	Weatherstripping	Reese DS 78C

HW-2	Door 801.1, 901.1	
3 Pair	Butt Hinges	Stanley FBB 199, 4 1/2" x 4 1/2", NRP, US 32D
1 Each	Exit Device	Corbin Russwin ED5600T, ANSI 5, US 32D
1 Each	Cylinder	6 pin cylinder
1 Pair	Flush Bolts	Ives FB257N, US26D
1 Each	Closer	LCN P4040, Parallel Arm,
1 Each	Stop and Holder	Glynn Johnson 90H, US32D
1 Each	Threshold	Reese FBR 555
2 Each	Kickplate	4" x 34", US32D
1 Set	Weatherstripping	Reese DS 78C
HW-3	Door 801.3, 802.2, 802.3, 902.2, 902.3	
1 1/2 Pair	Butt Hinges	Stanley FBB 199, 4 1/2" x 4 1/2", NRP, US 32D
1 Each	Mortise Lock	Corbin Russwin ML2051, Newport, US32D
1 Each	Cylinder	6 pin cylinder
1 Each	Stop and Holder	Glynn Johnson 90H, US32D
1 Each	Threshold	Reese FBR 555
1 Each	Kickplate	4" x 34", US32D
1 Set	Weatherstripping	Reese DS 78C
HW-4	Door 801.2, 901.2, 901.3	
1 1/2 Pair	Butt Hinges	Stanley FBB 199, 4 1/2" x 4 1/2", NRP, US 32D
1 Each	Mortise Lock	Corbin Russwin ML2051, Newport, US32D
1 Each	Cylinder	6 pin cylinder
2 Each	Stop and Holder	Glynn Johnson 90H, US32D
1 Each	Threshold	Reese FBR 555
2 Each	Kickplate	4" x 34", US32D

END OF SECTION 08710

SECTION 09900

HIGH PERFORMANCE COATINGS

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**SECTION 09900
HIGH-PERFORMANCE COATINGS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Exterior Substrates:
 - a. Steel.
 - b. Process piping - do not coat bolts or factory finished items.
 - 2. Interior Substrates:
 - a. Concrete masonry unit walls.
 - b. Exposed pre-engineered steel structures.
 - c. Process piping - do not coat flanges, bolts or factory finished items.
 - d. Conduit, junction boxes, pull boxes, etc.

1.03 ACTION SUBMITTALS

- A. Provide all submittals in accordance with Section 01900, SPECIAL CONDITIONS.
- B. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- C. Samples for Initial Selection: For each type of topcoat product indicated.
- D. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.04 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. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.06 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated in painting schedule found in Part 3.

2.02 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Material Compatibility:
 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
 3. Provide products of same manufacturer for each coat in a coating system.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.
 1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.

3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pre-Treatment Wash Primers: 420 g/L.
7. Floor Coatings: 100 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

2.03 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates 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 coatings, 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 coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
- E. Masonry Substrates: Remove existing paint from interior brick walls of Pump Station with chemical remover. Wash and neutralize surface after paint has been removed. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 - 2. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 - 3. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 - 5. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."

- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and 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 coatings.

3.03 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.04 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.05 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.06 HIGH-PERFORMANCE COATING SCHEDULE

	Item to be Painted	Coat	Tnemec	Carboline	Axalta	Dry Film Mills per Coat	Total Item Dry Film Thickness
1.	Ductile Iron and Steel – Structural Steel, Pipes, Equipment and Bollards	Surface Prep	SSPC-SP6				
		Prime Coat	Series 1 Omnithane	Carbozinc 859	Ganicin 2.8 ZR-U	2.5 to 3.5	
		2 nd Coat	Epoxoline II Series 69	Carboguard 691	Corlar 2.8 HG	4.0 to 6.0	
	Exterior Exposure (Non-immersion)	3 rd Coat	Series 1075 Color Endura-Shield	Carbothane 133 HB	Imron 2.8 HG	3.0 to 4.0	9.5 to 13.5
2.	Structural Steel Joists, Purlins, Pipes, Pipe Supports and Equipment	Surface Prep	SSPC-SP6				
		Prime Coat	Series 1 Omnithane	Carbozinc 859	Ganicin 2.8 ZR-U	3.0 to 5.0 for N140; 2.5 to 3.5 for Omnithane	
		2 nd Coat	Epoxoline II Series 69	Carboguard 691	Corlar 2.8 HG	4.0 to 5.0	
	Interior Exposure (Non-immersion)	3 rd Coat	Epoxoline II Series 69	Carboguard 691	Imron 2.8 HG	4.0 to 5.0	10.5 to 13.5
3.	Concrete masonry units and gypsum board finishes.	Surface Prep (CMU only)	Wash CMU walls with hot water and detergent solution with scrub brush. Rinse thoroughly and let dry. Mechanically remove existing loose or flaking paint				
		1 st Coat	Series FC 151-1051 Elasto-grip	Carbocrylic / Santile 120	Tufcoat 72P	2.0 to 3.0	
	Interior Exposure (Non-Immersion)	2 nd Coat	Series 156 Envirocrete	Carbocrylic / Santile 120	Tufcoat 72P	2.0 to 3.0	4.0 to 6.0

END OF SECTION 09900

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SECTION 10213

FIXED LOUVERS

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SECTION 10213 FIXED LOUVERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes fixed, extruded-aluminum louvers.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on tests performed according to AMCA 500-L.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

2.02 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

- a. American Warming and Ventilating; a Mestek company.
- b. Construction Specialties, Inc.
- c. Greenheck Fan Corporation.
- d. Ruskin Company; Tomkins PLC.

2. Louver Depth: 4 inches.

3. Frame and Blade Nominal Thickness: Not less than 0.080 inch for blades and 0.080 inch for frames.

4. Mullion Type: Exposed.

5. Louver Performance Ratings:

- a. Free Area: Not less than 8.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
- b. Point of Beginning Water Penetration: Not less than 1075 fpm at 0.01 oz. / sq. ft..
- c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area intake velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.03 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: Bird screening.
- B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.
- C. Louver Screening for Aluminum Louvers:
1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.04 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.05 FABRICATION

- A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.06 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than **70** percent PVDF resin by weight in color

coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- D. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.02 ADJUSTING

- A. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

END OF SECTION 10213

SECTION 11211

HORIZONTAL SPLIT CASE CENTRIFUGAL PUMPS

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SECTION 11211

HORIZONTAL SPLIT CASE CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all coordination, labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the equipment as shown or specified and in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Furnish detailed shop drawings for all items specified herein in accordance with Division 1.
- B. Furnish detailed Operation and Maintenance manual for all items specified herein in accordance with Division 1.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.
- B. Electrical and Instrumentation equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Division 16 and 17.

1.04 QUALITY CONTROL

- A. The equipment manufacturer shall have a minimum of 10 years experience in manufacturing equipment similar, equal or larger size, to that specified.
- B. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience requirements. Installation information shall include, but not be limited to, the following:
 - 1. Name and location of the installation.
 - 2. Name of person in direct responsible charge for the equipment.

3. Address and phone number of person in direct responsible charge.
4. Month and year the equipment was placed in operation.
5. Capacity of Equipment

C. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.06 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, supervise all initial start-up operations, as required to determine satisfactory operation of all the equipment provided. Services shall be provided for a minimum of two 8-hour days as specified under Division 1.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.07 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, in accordance with Division 1, certifying that the equipment is installed in a complete and satisfactory manner ready for operation.

1.08 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be in accordance with Division 1.

1.09 WARRANTY AND GUARANTEE

The Contractor shall provide warrants and guarantees to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective. Contractor shall make the necessary repairs and replacements any defective equipment at the convenience of the Owner for a Period of one year after the completion of the Contract. Warrants and Guarantees shall be in accordance with the provisions in Division 0 and 1.

PART 2 - MATERIALS

2.01 PUMPING UNIT DESIGN AND DESIGN CRITERIA

- A. The amplitude of vibration of the pumping unit, when operating at its rated speed shall not, when measured in the field, exceed the values allowed by the latest edition of the Hydraulic Institute for the type of pump furnished. Measurements shall be made both in a horizontal and vertical plane. Measurements shall be taken at the locations prescribed by the Hydraulic Institute.
- B. All bearings for pumps and motors specified herein shall be designed and constructed for L-10 life of not less than 100,000 operating hours.
- C. The Contractor shall provide for the pumping unit a foundation suitable for the pumping unit furnished, providing adequate support and sufficient mass to permit satisfactory operation with minimum vibration not exceeding that specified above at all operating conditions.
- D. The pumping unit mounting to the baseplate and the foundation shall all be designed to withstand the forces imposed under the full test pressure specified for the appropriate piping system. The forces imposed shall be the (pressure x area) force at the pump nozzle for the specified test pressure.
- E. The pumps shall meet the following design criteria for respective service:

Service	Irrigation
Number of Pumps	Three (2 Duty, 1 Standby)

Design Point	2800 gpm. at 165 ft.
Design Point Efficiency (min.)	84%
Design Point NPSHr (max.)	16 ft.
Supplemental Point	2,000gpm at 195 ft.
Supplemental Point Efficiency (min.)	80%
Supplemental Point NPSHr (max.)	11 ft.
Shutoff Head (min.)	222 ft.
Suction Size	10 in.
Discharge Size	8 in.
Motor Horsepower (max.)	150 HP
Motor Speed (max.)	1,800 RPM
Electrical Service	480V / 3-phase / 60 Hz
Operation	Variable Frequency Drive
Basis of Design	Patterson

Service	Transfer
Number of Pumps	Two (1 Duty, 1 Standby)
Design Point	1,400gpm at 80 ft.
Design Point Efficiency (min.)	85%
Design Point NPSHr (max.)	8 ft.
Supplemental Point	1,120 at 88.5 ft.
Supplemental Point Efficiency (min.)	85%
Supplemental Point NPSHr (max.)	6 ft.
Shutoff Head (min.)	96 ft.
Suction Size	8 in.
Discharge Size	6 in.
Motor Horsepower (max.)	40 HP
Motor Speed (max.)	1,200 RPM
Electrical Service	480V / 3-phase / 60 Hz
Operation	Variable Frequency Drive
Basis of Design	Patterson

2.02 PUMPING UNIT

- A. The pump shall be the centrifugal, horizontal suction, horizontal discharge, single stage, double suction, double volute type, with horizontal split casing. The unit shall be complete with pump, motor, bedplate for pump and motor, coupling, guard and accessories and oriented as shown on the Contract drawings. The pump shall be Patterson or equal.

- B. Foundation and Anchor Bolts: Concrete foundation, properly located to suit the piping arrangement and of suitable size for the pumping unit, shall be provided. The pump manufacturer shall furnish anchor bolts of suitable

size and number for the anchoring of the pumping unit. The bolts shall be suitable for embedment of sufficient depth to withstand the thrust of the discharge piping to which the pump is attached. The detail of concrete foundation and anchor bolts shown on the drawings shall be used as a general guide and shall be considered as minimum requirements.

- C. **Bedplate:** The bedplate shall be of A36 structural steel, of sufficient depth and strength to provide a rigid mounting platform for the pump and motor. Accurately machined pads shall be provided for securing the pump and motor, with tapped holes to receive the hold-down bolts. Lugs with cored or drilled holes shall be provided on the bedplate to receive the anchor bolts. The bedplate shall also be provided with a suitable number of holes of the proper size for grouting. Each bedplate shall include drainage gutters for collecting drainage from packing boxes and miscellaneous sources. Gutters shall be provided with 1 inch tapped openings for connection to a drainage system.
- D. **Casings:**
1. Casings shall be gray iron castings conforming to ASTM A48 Class 40 minimum, or ductile iron conforming to ASTM A536 Grade 65-45-12 and shall be free from injurious defects. Surfaces shall be free from burnt-on sand and reasonably smooth. Risers, fins and projections used to facilitate the making of the casting shall be removed. Surface imperfections or minor defects over an area of not more than 5 square inches may be repaired by welding or threaded plugging provided the depth of the plug required is not greater than 50 % of the thickness of the section and the diameter of the plug does not exceed the depth of the plug. The manufacturer shall notify the Owner before attempting repairs to castings with any defects other than those defined above as minor. The Owner reserves the right to examine and reject any casting with any defect other than those described as minor. Castings shall be hydrostatically tested at a minimum pressure equal to twice the design head (TH) or one and one half (1-1/2) times the shut-off head whichever is greater. Certification by the manufacturer shall be furnished that hydrostatic tests in conformity with these specifications have been performed.
 2. The pump casings shall be horizontally split and the horizontal parting line shall be provided with flanges and an appropriate number of hexagonal head bolts or studs with hexagonal nuts. The parting flange faces shall be machined to a truly flat surface and scraped, if necessary, so that the flange joints shall be made tight by means of a pre-cut gasket; the use of red lead or similar material to make these joints tight will not be permitted. The backs of the

flanges shall be spot-faced at the bolt holes and the edges shall match up so as to show no jog or off-set when the casings are bolted together. The alignment of casing halves shall be assured by the use of dowel pins located at diametrically opposite points of the flanges. Jack bolts shall be provided to break the seal for disassembly.

3. Each upper casing half shall be provided with eye bolts, or other suitable arrangements for lifting, connections for air vent and seal water connections to the stuffing boxes. Stuffing box connections shall be made of not less than 1/4 inch brass piping or copper tubing, bent on easy curves to suit the points at which they originate and terminate, and shall be fitted with brass stop valves and solid brass unions, all completely finished and polished. The air vent connection at the top of the casing shall be 1-1/2 inch and provided with a lever handle petcock. Cocks shall be of brass, finished and polished all over.
 4. The lower casing half shall be provided with horizontal suction and discharge connections which shall be flanged and faced. Flanges shall meet the requirements of ANSI/AWWA C110/A21.10, having a water working pressure of 250 psi, and drilled and faced with same dimensions as Class 125 ANSI B16.1 flanges. On the horizontal and vertical centerline of the suction and discharge connections near the flange (or tapped flanges may be used), there shall be provided plugged reinforced taps, 3/8 inch pipe size, for pressure gage connections. Tapped and plugged holes shall also be provided in the lowest part of the casings for dewatering the pump. The lower casing halves shall be provided with integrally cast feet, with spot-faced holes and threaded dowel pins for securing the casings to the baseplate. Threaded dowel pins shall also be used for securing the motor mounting to the bedplate.
- E. Impeller and Case Wearing Rings: The suction eyes of the impeller shall be fitted with one (1) piece bronze (ASTM B148, Alloy 952) wearing rings. The rings shall be readily removable and fastened to the impeller in such a manner as will prevent rotative or axial movement, regardless of the direction of rotation of the pump. One-piece bronze (ASTM 584, Alloy 875) wearing rings to match the impeller rings shall be fitted into recesses machined within the top and bottom casing halves and secured against rotation.
- F. Impeller: The impeller shall be of cast bronze, double suction enclosed type, with all surfaces finished. The impeller shall be accurately balanced to avoid vibration and hydraulically balanced to prevent end thrust. The impeller shall be secured to the shaft with suitable provisions made to

maintain axial position. The rotor assembly shall be able to withstand 125% of normal forward speed in a reverse direction without damage to the pump.

- G. Shaft: The shaft shall be made of heat treated carbon steel, ASTM A-576, Grade 1045 ground and polished all over. The ends shall retain the original centers upon which the shaft was turned and ground, and the outboard end shall be exposed and contain an ample recess for the insertion of a hand mechanical tachometer. Where the shaft emerges from the bearings, it shall be fitted with grooves or collars to prevent oil from creeping along the shaft to outside the bearing brackets and shall also be provided with suitable collars outside the brackets to prevent the entrance of water or other foreign substances to the interior of the bearing houses.
- H. Shaft Sleeves: The shaft shall be protected by renewable one-piece machined cast bronze (ASTM B584, Alloy 932) sleeves, extending from the impeller hub to the outside of the stuffing boxes. Sleeves shall be closely fitted to the shaft and held in place against the impeller hub in a manner standard with the pump manufacturer.
- I. Bearings: The shaft shall be supported by anti-friction type bearings. Bearings shall be easily removable without disturbing any parts of the pump other than the bearings caps. The thrust bearings shall be of the anti-friction type, adequate to withstand all thrusts, and shall be designed and constructed to maintain the shaft in a fixed axial position without undue heating or the necessity of adjustment or attention. All bearings both radial and thrust, shall be ring oil lubricated. Each bearing shall include a Trico Constant Level bottle oiler. Bearings shall be designed and constructed for a L-10 life of not less than 100,000 operating hours.
- J. Bearing Frames: The bearing frames and housings may be of the manufacturer's standard design, and shall be of sufficient size and strength to adequately support the bearings for the 100,000 hours life specified above.
- K. Stuffing Boxes: Stuffing boxes shall be provided where the shaft penetrates the casing. The boxes shall be suitable to accept mechanical seals that are specified hereinafter. Boxes shall have renewable bronze bushings.
- L. Sealing: Sealing shall be by dual mechanical seal. Double cartridge mechanical seals shall be provided. The mechanical seals shall have materials to suit potable water service. Mechanical seals shall be readily and commercially available from third party sources other than the pump and motor manufacturer. Seals shall have flush water supplied by pipe

connections specified above. Double Mechanical seals shall be Chesterton Model 225, similar model of John Crane, or equal.

2.03 SHAFT COUPLING

- A. The motor's end of the shaft shall be provided with a forged or cast steel limited end float gear type flexible coupling, the product of The Falk Corporation, "Fast" coupling of Koppers Company, or equal. One-half (1/2) of the coupling shall be firmly fixed and keyed to the pump shaft with the other half (1/2) similarly secured to the motor shaft. The method of connecting the coupling halves shall be such as will permit a slight misalignment of the connected shafts without imposing any strain upon the adjacent bearings. The ends of the bolts and nuts shall be recessed beneath the surface or otherwise surrounded so as to satisfy all requirements of safety in operation. The coupling shall be turned and ground to exact dimensions to facilitate the checking of the alignment of the connected shaft. The coupling shall be placed as close as possible to the pump and motor bearings so as to make compactly arranged units, but with adequate space allowed for attaching dial indicator on either pump or motor shafts during alignment.
- B. An easily removable base mounted guard shall be furnished and installed for the coupling meeting all requirements of OSHA.

2.04 PUMP MOTORS GENERAL

- A. The motor shall be built and tested in accordance with the latest version of NEMA Standard No. MG1 and all other standards specified herein. Where this specification calls for higher qualities than Standard MG-1, the provisions of this specification shall govern.
- B. The motor shall be designed for operation in a damp environment and for use with a centrifugal water pump. The motor manufacturer shall coordinate with the manufacturer of the pump furnished to ascertain the actual WR^2 , the torque requirements for starting against a closed valve and for normal running, and mounting dimensions. The motor shall be designed for direct connection to its pump using a shaft coupling meeting the requirements specified above in the paragraph entitled, SHAFT COUPLING. Motors shall have high temperature switches mounted in the windings to protect the motors from high temperature overloads.
- C. The motor shall be the product of US Motors, Baldor, General Electric, or equal.

1. Nameplate Data: This shall be submitted in accordance with the NEMA Standard MG1, paragraph MG1-20.60 and shall include the following:
 - a. Manufacturer's name, machine serial number, etc.
 - b. Horsepower
 - c. Time rating
 - d. Temperature rise
 - e. Speed at rated load
 - f. Voltage, frequency, phases
 - g. Full load current
 - h. Code letter

2. Predicted Performance Data
 - a. Locked rotor, pull up and breakdown torques
 - b. Efficiency at 1/2, 3/4 and full load
 - c. Power factor of 1/2, 3/4 and full load

3. Motor Construction Details: Complete dimensioned drawings shall be provided as follows:
 - a. Motor Outline Drawings: Showing all principal overall dimensions and construction notes.

 - b. Motor Cross-section and Detail Drawings: Showing in specified detail, the construction of:
 - i. Stator and frame with windings
 - ii. Rotor
 - iii. Bearing assemblies including details of ring oil lubrication systems, bearing temperature detectors and installation and shaft current insulation at bearing assemblies.
 - iv. Access covers for bearings, etc.
 - v. Bill of Material: The drawings shall include a Bill of Material in which shall be keyed (by numbers) to all of the components of the motor identifying them by name and part or catalog number. The drawings shall in all respects, provide clear, detailed information which shall facilitate the ordering of spare or replacement parts by the Owner.

 - c. Motor Base Details: Showing correlated details of the motor connection to the pump shaft, including details of the shaft coupling.

4. Motor service and Maintenance: Details and information as follows:
 - a. Alignment: Detailed drawings of shaft-end which shall clearly indicate application areas for dial indicators, etc., for the purpose of shaft and coupling alignment for motor and pump.
 - b. Motor Shaft End Play: Detailed drawings and adjustment procedure.
 - c. Motor Lubrication Oil: Complete specification, weight, type, purchasing data, and maintenance recommendations.
- D. Testing: Tests shall be performed on the motor as follows:
 1. Routine tests at the factory: Routine tests shall be conducted as specified in NEMA Standard No. MG1-12.51 and certified test reports furnished per IEEE Standard 112, Form A-7.
 2. Complete initial heat run tests shall be conducted and certified reports submitted to the Engineer. The tests shall be as follows:
 - a. High potential test on stator windings
 - b. Insulation resistance
 - c. Efficiency at 4/4, 3/4, and 1/2 load at full speed
 - d. Stator and field or rotor resistance
 - e. Overspeed test
 - f. Measurement of air gap by gauge
 - g. Balance
 - h. Sound level-frequency band data
 - i. Bearing inspection
 - j. Motor temperature rise at full load
 - k. Rated full load slip
 - l. Breakdown torque
 - m. Locked rotor torque and amperage
 - n. Amperage draw at start-up within MG-1 specifications
 3. Field tests shall be performed on the motor by the factory field service engineer in accordance with the paragraph herein entitled, Manufacturer's Supervision. The field test shall be as follows:
 - a. Insulation Resistance: All windings shall be metered.

- b. Acceleration time for pump and motor from zero speed to maximum speed.
 - c. After motor has run for several hours and is at normal operating temperature, measure and record temperature of all bearings and motor temperature rise.
- E. Manufacturer's Supervision:
- 1. Scope: The services of the manufacturer's factory field service engineers shall be provided to examine and test the motor for correct installation prior to certifying the motor is ready to start. Final preparation and tests shall be performed by the factory field service engineer in the following areas.
 - a. Check shaft and coupling alignment.
 - b. Fill reservoirs to proper level with the factory recommended lubrication oil.
 - c. Verify direction of rotation with respect to pump rotation.
 - d. Check preparation of stress cones on motor main leads.
 - e. Perform field tests.
 - 2. Certificates and Data: A certificate for the motor shall be provided by the manufacturer in accordance with Section 01300, SUBMITTALS. All test and adjustment data shall be recorded and submitted in accordance with subparagraph herein entitled, TESTING.

2.05 MOTOR CONSTRUCTION FEATURES

A. Enclosure

- 1. The enclosure for the motor shall be the open, drip-proof, fully guarded type. It shall be of cast iron or welded steel plate construction. Motor shall be inverter duty rated for variable frequency operation.
- 2. Lifting eyes shall be provided.
- 3. Outboard end shall be accessible and contain an ample recess for the insertion of a hand mechanical tachometer.

B. Bearings:

- 1. The motor shaft shall be supported by ring oil lubricated anti-friction bearings. Each bearing shall include a Trico Constant

Level bottle oiler. Bearings shall be designed and constructed for a B-10 life of not less than 100,000 operating hours. All bearings must be capable of being replaced in the field.

2. The bearings frames and housing may be of the manufacturer's standard design, and shall be of sufficient size and strength to adequately support the bearings for the 100,000 hours of life specified above.
 3. Shaft current insulation shall be provided at the bearings to prevent current flow through bearing surfaces.
- C. Direction of rotation shall be shown on drawings.
- D. Motor terminal panels and connection boxes: The motor shall have extra-large terminal panels and cast iron or cast aluminum connection boxes to provide ample room for the connection of the conductors.
1. Motor main lead shall be brought out in a terminal connection box to provide for the making up of stress cones on the feeder connections.
 2. Bearing and winding temperature detector leads shall be brought out to a terminal strip in each respective monitoring relay panel.
- E. Sound Level: The total sound-pressure level for the motors shall not exceed 88 dBA, measured 10 feet from the motor at any speed.
- F. Balance: The amplitude of vibration of the motor, when operating at the speed specified shall not exceed the values specified in NEMA Standard MG1-20.52 when measured in accordance with NEMA Standard MG1-20.53.

2.06 MOTOR DETAILS

- A. Type: Horizontal squirrel cage induction type. Premium efficiency. Inverter duty rated. Continuous duty.
- B. Ratings:
1. Voltage - 460 volts for operation on a nominal 480 volts, 3 phase, 60 Hertz system.
 2. Size and Speed – As specified in the design criteria.
 3. Insulation – Class F.

4. Temperature rise above 104 deg F (40 deg C) shall not exceed the rated 176 deg F (80 deg C) rise for Class F insulation measured by resistance.
5. Service factor – 1.15
6. Efficiency – 95.8% minimum at full load.
7. Power Factor - 90% minimum at full load.
8. Inverter duty rated for variable speed operation.

2.07 SPARE PARTS

The following spare parts shall be provided for each pump:

1. One (1) full set of gaskets
2. One (1) set of mechanical seals
3. One (1) complete set of wear rings.
4. One (1) complete set of bearings (pump and motor).
5. Six months supply of pump and motor lubricant.

2.08 CONTROLS

Controls shall be as described in the Instrumentation and Control specifications and as shown on the Instrumentation Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

The Contractor shall install the pumping units and all related equipment as described in the Hydraulic Institute Standards, "Instructions for Installation, Operation and Maintenance" and in accordance with the manufacturer recommendations and as specified herein and shown on the Contract Drawings.

3.02 TESTING OF PUMPS, GENERAL

The pump and impeller shall be tested in accordance with the requirements of the latest edition of the Hydraulic Institute Standards and shall be certified by the manufacturer that they meet the performance and efficiency requirements

specified herein and shown on the Contract Drawings at the specified pumping speeds.

3.03 FACTORY CERTIFIED TEST

- A. Certified factory test shall be conducted on the pumping units at the manufacturer's facility. Test shall be certified and results shall be submitted to the Engineer for final approval of the unit before shipping and installation.
- B. Certified pump test shall demonstrate performance of the pump at the specified speeds. Test shall include flow characteristics, horsepower requirements, efficiency and NPSHR over the capacity range from shut-off to the design points and at the various speeds shown. As a minimum, pumping units shall be tested at the minimum and maximum speeds. The pump shall be tested with motor to be furnished in the field. The manufacturer's standard test driver shall not be used. Test results shall be submitted to the Engineer and shall include, tabulated data and results plotted as head vs. capacity, pump efficiency vs. capacity, brake horsepower vs. capacity, NPSHR (Required) vs. capacity, and amplitude of vibration at a frequency corresponding to the various speeds of the pump. All test results shall be signed and sealed by a registered professional engineer. Approval of results shall be precedent to shipment of pump.
- C. Should the pumping units fail to meet the specified requirements, the manufacturer shall make all necessary modifications to the unit and shall conduct all additional shop certified tests as necessary to ensure full compliance with the Contract Documents. Conducting such additional shop certified tests shall be borne by the Contractor and shall be at no additional cost to the Contract. The Contractor shall make note that any modification and additional testing which may be required shall be performed as expeditiously as possible to avoid exceeding the total contract time.

3.04 FIELD TESTING OF PUMPING UNITS

When the pump, motor, and electrical controls and all related piping have been installed, the Contractor shall conduct a field test of the pumping unit in the presence of, and as directed by, the Engineer. Field tests of head versus capacity shall be made. Field tests to determine the amplitude of vibration shall also be taken. All field testing need not repeat factory performance tests previously done, but shall be sufficiently complete to demonstrate that the pumping unit is operating in a satisfactory manner, in accordance with the requirements of these specifications and in such a manner to make possible the issuance of the "Manufacturer's Certificate."

3.05 PAINTING

Shop prime painting and field finish painting shall be as specified in Division 9,
FINISHES.

END OF SECTION 11211

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SECTION 11221

SUBMERSIBLE MIXERS

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SECTION 11221

SUBMERSIBLE MIXERS

PART 1 - GENERAL

1.01 DESCRIPTION

The Contractor shall furnish and install all labor, materials, equipment, and appurtenances necessary for the complete and satisfactory installation of the submersible mixers as shown on the drawings and as specified herein.

1.02 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of ten years experience in the manufacture of mixing equipment for similar applications.
- B. The Contractor shall conduct performance tests upon completion of the installation as specified herein.

1.03 SHOP DRAWINGS

- A. Shop drawings shall be submitted as specified under Section 01300, SUBMITTALS.
- B. Shop Drawings shall include the following:
 - 1. Manufacturer's literature, specifications and engineering data including dimensions, parts and materials list, electrical characteristics, weight, and data specifically requested herein.
 - 2. Fabrication, assembly, installation and wiring diagrams.
 - 3. Setting drawings, templates and directions for the installation of anchor bolts and other anchorages.
 - 4. Lubricant specifications of the type and grade necessary for the equipment furnished.

1.04 EQUIPMENT DESIGN

- A. Equipment design, workmanship, testing and operation shall be as specified under section 15000, GENERAL MECHANICAL REQUIREMENTS.

- B. Unless otherwise specified hereinafter, starters, pushbuttons, H-O-A switches and other electrical items for the equipment shall be as specified and provided under the Electrical sections of the specifications.

1.05 MANUFACTURER'S CERTIFICATE

The Contractor shall submit to the Engineer a Manufacturer's Certificate from the manufacturer of the submersible mixers as specified in section 01300, SUBMITTALS.

1.06 WARRANTY AND GUARANTEE

The Contractor shall provide warrants and guarantees to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective. Contractor shall make the necessary repairs and replacements any defective equipment at the convenience of the Owner for a Period of one year after the completion of the Contract. Warrants and Guarantees shall be in accordance with the provisions in Division 0 and 1.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE MIXERS

1. Submersible mixers shall be complete with electric motors, submersible cables, stainless steel guide brackets, stainless steel guide rail systems, controls and all appurtenances as shown on the Contract Drawings and as specified herein.
2. The submersible mixers shall be designed for the Aeration Distribution Structure. The tank dimensions are as shown on the contract drawings.
3. Design Criteria:

Aeration Distribution Structure MLSS Concentration	3000 mg/L
Electric Motor Horsepower	2 (maximum)
Power Requirements	460V, 3 phase, 60 Hertz
Maximum Motor Speed	1715 RPM

4. The submersible mixers shall be the design and fabrication of a single manufacturer which shall have sole responsibility for the equipment. The mixers shall be designed for continuous operation at the maximum operating torque rating.
5. The mixers shall be able to be raised and lowered and shall be easily removable for inspection or service without the need for personnel to enter the tanks. Sliding guide brackets shall be an integral part of the mixer units. The entire weight of the mixer units shall be guided by the single bracket which must be able to handle all thrusts created by the mixers. The mixers, with its appurtenances and cables, shall be capable of continuous submergence under water without loss of watertight integrity to a depth of 130 feet.
6. The mixers shall be of the integral design, close coupled, submersible type. All components of the mixers, including motor shall be capable of continuous underwater operation and at the maximum torque rating. In addition, all components of the mixers shall be capable of continuous operation completely unsubmerged, for two hours. All major mixer components shall be of stainless steel construction.
7. The submersible mixers shall be the model 4620 of ITT Flygt Corporation, Amamix Series manufactured by KSB, or equal.

B. CONSTRUCTION

1. Major mixer components shall be of stainless steel construction. The oil housing cover plate shall be of fiberglass reinforced vinylester or stainless steel. All exposed nuts and bolts shall be of stainless steel.
2. All cables shall be oil resistant chloroprene rubber jacketed. Unit shall be fitted with sufficient length of stainless steel lifting cable of adequate strength to permit rising and lowering the mixers from the top of the tanks, utilizing a portable davit crane.
3. The propellers shall be of 316 stainless steel dynamically balanced, non-clogging backward swept design. Each blade shall be welded to the hub.
4. The cable entry housing shall be an integral part of the back plate. Cable entry shall consist of two compressible rubber bushing to seal off motor area and relieve strain on the cable.
5. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top, and designed to render the motor

compartment leak proof from any liquid which may enter the terminal compartment. Epoxies, silicones, or other secondary sealing systems will not be acceptable.

6. All mating surfaces where watertight sealing is required shall be machined and fitted with of Nitrile rubber or Viton O-rings. Fitting shall be such that sealing is accomplished by metal to metal contact between machined surfaces. This shall result in controlled compression of the O-rings without requiring a specific torque limit. No secondary sealing compounds, rectangular gaskets, elliptical o-rings, grease or other devices shall be used.
7. All bearings shall have a minimum B-10 rated life of 100,000 hours and shall have inner and outer races of metal construction. The motor shaft shall be of stainless steel supported by two bearings, sized to transfer all radial and axial loads to the mixer housing.
8. Thermal sensors shall be provided to monitor stator temperatures. The stator shall be equipped with three thermal switches embedded in the end coils of the stator winding and set for 125°F. These shall be used in conjunction with and supplemental to, external motor overload protection and wired to the control circuitry as shown on the Contract Drawings.
9. Moisture detection system shall be provided to detect water in the stator chamber. The system shall consist of sensor and monitor. The sensor shall be used to detect the presence of water in the stator chamber. When activated, the sensor shall status the monitor. Provide power transformer as required.
10. The mixer assemblies shall incorporate 304 stainless steel jet rings for a full 360 degrees around the propellers. A maximum clearance of 1.5 inches shall be maintained between the propeller tip and the shroud in order to maintain hydraulic efficiency and power consumption.
11. Oil Housing: The oil housing shall contain two compartments consisting of an inner and an outer section with four ports to connect and facilitate oil flow. In the event that the mixed media bypasses the other seal, this design shall allow the outer compartment to collect the heavier (denser) fluids by means of a simple gravity process.
12. Mechanical Seals:
 - a. The mixers shall be provided with a double seal system with a mechanical seal on the outer side and mechanical or radial shaft seal on the inner side, running in oil and each working

- independently of the other. The mechanical seals shall contain both rotary silicon carbide faced rings.
- b. Only the seal faces of the outer seal assembly and its retaining clips shall be exposed to the mixed media. All other components shall be contained in the oil housing. All seal faces must be capable of relapsing.
 - c. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members will not be acceptable.
13. The multi-pole motor shall be directly connected to the propeller. The mixer motor shall be squirrel cage, induction, shell type design, NEMA B, housed in an air filled, watertight chamber and designed for continuous duty. The inner housing shall be cast iron and outer stator jacket shall be 316 stainless steel. The stator winding shall be insulated with moisture resistant Class F insulation rated 155°C, 40°C ambient plus 115°C rises, with a combined service factor of 1.10. The electric motor drive shall be designed for operation on 3 phases, 60 Hertz, 480 volt service and motors shall be designed with applicable IEEE, NEMA and ANSI standards.
14. Mixer Mount Assemblies:
- a. Stainless steel mixer mount assembly kits for each mixer shall be supplied by the mixer manufacturer to mount the mixer during operation and to guide the unit during installation and removal from service. The assemblies shall consist of an upper, lower and intermediate bracket made of 316 stainless steel for mounting where shown on the drawings.
 - b. The mixer mount assemblies shall include a field adjustable 304 stainless steel mixer support cable assembly. A permanently attached stainless steel lifting cable shall be supplied. A mast shall securely interface with the mixer manufacturer's upper, lower and intermediate brackets and integrate in such a way to securely support the mixer during operation. The mixer manufacturer shall specify the dimensions and thickness of the mast. All support bracket assemblies shall be supplied by the mixer manufacturer in order to ensure the integrity of the system under operational loads.
 - c. The assembly shall also be provided with cable holders to secure the mixer electric power cable (every 5 ft. or less) from becoming entangled in the mixer propeller during operation. In addition, the mast shall be constructed with a positioning locking plate which

shall work in conjunction with a lock pin on the upper guide holder to positively lock the mast in place at various operating angles. The assembly shall be the Safe-Slide System of ITT Flygt Corp., or equal

15. Hoisting:

The mixer manufacturer shall furnish one portable davit crane hoist. Also shall furnish stainless steel lifting cable and stainless steel hoist mastwells for each mixer locations. The stainless steel lifting cable shall be connected to the submersible mixer of sufficient length for attachment to the portable crane hoist, as specified for general use. The cable shall be 1/4 inch in diameter with a shanked ball end suitable for the winch of the portable hoist. The ball end shall be 303 stainless steel in accordance with Federal Standard 66. The ball end shall be of the Military Standard Design MS20664 with a 0.567 inch diameter ball after swaging. The cable shall have the capability of being readily transferred to a replacement mixer. The cable ball end shall be retained in an accessible location at the top of the tank by a keyhole slot apparatus. All submersed hardware shall be stainless steel. The distance from the bottom of the submersible mixer base feet to the top of the lifting eye shall be a maximum dimension of 60 inches. The mixer manufacturer shall be responsible for the hoist pick-point and proper hoisting operations.

C. CONTROLS:

The submersible mixers controls shall be as shown and described on the Instrumentation Drawings and specifications.

D. PAINTING

All exposed metal parts of the submersible mixers shall be cleaned, primed and finished with manufacturer's standard paint system.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The mixing equipment shall be installed by the Contractor in accordance with the Contract drawings, approved shop drawings and manufacturer's instructions.
- B. All anchor bolts and nuts and other fasteners furnished for the mounting of the equipment shall be furnished by the equipment manufacturer, and shall be Type 316 Stainless Steel of ample size and strength for the purpose

intended. Anchorage items shall conform to the applicable requirements of Division 5.

- C. Contractor to anchor all cables according to manufactures recommendations.

3.02 FACTORY TESTS

The mixers manufacturer shall perform the following inspections and tests on the mixers prior to shipment from the factory and shall furnish a statement so stating:

- A. Propeller, motor rating, and electrical connections shall first be checked for compliance with the specification.
- B. A motor and cable insulation test for moisture content or insulation defects shall be made.
- C. Prior to submergence, the mixers shall be run dry to establish correct rotation and mechanical integrity.
- D. The mixer shall be run for 30 minutes submerged at minimum of three feet.
- E. After operational test, the insulation test shall be performed again.

3.03 ACCEPTANCE TESTS

Performance Test Procedure: After installation and initial checking of equipment and controls has been completed, Contractor shall demonstrate the performance of the mixing equipment in accordance with the following.

- A. Testing shall be arranged with the Engineer with at least two week's notice.
- B. Testing shall be performed in the presence of the Engineer.
- C. The tests shall consist of operating submersible mixers for six hours total to demonstrate its ability to operate continuously without vibration, jamming, damage, jerking, oil leakage, or overheating. The test shall also demonstrate continuity of concentration through-out the tank. The tank shall be sampled at a minimum of 6 locations, each at two different elevations. The collected data shall yield a maximum of 0.50 percent difference between any two given data points.
- D. The Contractor shall perform modifications, adjustments or repairs to the mixers that fail to meet required performance criteria and reschedule

testing's. The Contractor shall give the Engineer one week's notice prior to scheduling a repeat of the acceptance test.

3.04 MANUFACTURER'S INSPECTION AND START-UP

The Contractor shall furnish the services of the submersible mixers manufacturer's qualified field representative to inspect the equipment after installation and check all mixers for excessive vibration, overheating, and electrical overload. Check mixers to demonstrate automatic level shut down features and supervise its initial operation for a minimum of one 8-hour day for each mixing service, as specified under section 01300, SUBMITTALS.

3.05 MANUFACTURER'S TRAINING

The manufacturer shall provide the services of the factory trained field service engineer for a period of not less than (1) 8- hour day for instructing the plant operating personnel in the proper care and operation of the equipment. The Owner reserves the right to videotape all training sessions related to the equipment to be furnished under this contract in order to facilitate future training of operations and maintenance personnel.

END OF SECTION

SECTION 11260
DISK FILTER EQUIPMENT
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SECTION 11260
DISK FILTER EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all coordination, labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the equipment as shown, as specified and in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Furnish detailed shop drawings for all items specified herein in accordance with Division 1.
- B. Furnish detailed Operation and Maintenance manual for all items specified herein in accordance with Division 1.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.
- B. Electrical and Instrumentation equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Division 16 and 17.

1.04 QUALITY CONTROL

- A. The equipment manufacturer shall have a minimum of 10 years experience in manufacturing equipment similar, equal or larger size, to that specified.
- B. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience requirements. Installation information shall include, but not be limited to, the following:
 - 1. Name and location of the installation.
 - 2. Name of person in direct responsible charge for the equipment.
 - 3. Address and phone number of person in direct responsible charge.
 - 4. Month and year the equipment was placed in operation.

5. Capacity of Equipment

- C. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.06 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein. Services shall be provided as required to ensure complete and operational equipment.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.07 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, signed by an authorized representative of the Manufacturer, certifying that the equipment is installed in a complete and satisfactory manner and has been functionally tested such that it is ready for operation.

1.08 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be

provided by as required to ensure Owner's personnel understanding of equipment.

1.09 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective. Contractor shall make the necessary repairs and replacements any defective equipment at the convenience of the Owner for a period of one year after the completion of the Contract.

PART 2 - PRODUCTS

2.01 FILTER DESIGN CRITERIA

A. The self-cleaning filter system shall remove all particles larger than 3 microns from the influent. The filter(s) shall fit in the space on the plans.

B. Service Conditions shall be:

Max flow rate per filter (MGD)	4.66 MGD
Quantity of filters in system	4
System source water	Treated Effluent
Total suspended solids (TSS)	<10
System operating temperature (°F)	40-50
Power Source, (V AC, Phase, Hertz)	460, 3, 60
Spray water source	Filtered Effluent
Backwash Pump Characteristics:	130 gpm @ 35TDH
Backwash pump motor (HP)	7.5

2.02 FILTER MANUFACTURERS

A. Filters: Acceptable manufacturers are listed below.
1. Aqua-aerobic Systems Inc., Aquadisk Tertiary Concrete Filter
2. Or equal.

B. Backwash Pump
1. Gorman Rupp
2. Or equal.

2.03 FILTER EQUIPMENT

A. Filter
1. Each basin shall include ten cloth disk assemblies. Each filter unit shall have a total of 645.6 square feet of minimum effective submerged filtration area. Cloths shall be of fiber pile construction having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed. The pile cloth shall be free chlorine resistant cloth. Pile cloth media with nylon material of construction is not free chlorine resistant and shall not be

acceptable. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type media with no filtration depth are not acceptable. To avoid excessive media movement, deformation and folding during backwash, the maximum distance between cloth restraints must not exceed 36 inches.

2. Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.
3. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.
4. Each cloth disk assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Effective submerged filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area. Each disk shall be divided into no more than six (6) segments and shall be easily removable for service.
5. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the cloth frame to the inside. Systems with flow paths from the inside to the outside of the cloth frame that collect filtered solids and plastic debris on the interior surfaces of the cloth frame will not be acceptable.
6. Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.
7. Submittal information shall include calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations
8. The operator shall be able to bring a drained filter on line by simply opening the influent isolation device. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back on line with a single switch shall be provided to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device.

9. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.
 10. Submittals shall include a hydraulic profile through the filter showing the following:
 - a. Influent weir length
 - b. Influent weir elevation
 - c. Influent weir nappe at design and peak flow
 - d. Effluent weir length
 - e. Effluent weir elevation
 - f. Effluent weir nappe at design and peak flow
- B. Backwash and Solids Removal System
1. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface. Each disk shall be cleaned by a minimum of two backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface.
 2. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.
 3. The backwash system shall include 304 stainless steel backwash shoe supports with UHMW backwash shoes, 316 stainless steel springs reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifolds, and PVC sludge collection manifold.
- C. Backwash/Waste Pump Assemblies
1. Each backwash/waste pump assembly shall include two (2) backwash/waste pump(s), valves and gauges. In the external piping shall be backwash and solids waste valves, 3" recirculation ball valve(s), 3" manually operated flow control gate valve) for each pump, vacuum gauge(s), and pressure gauge(s).
 2. The backwash/waste pump(s) shall be shipped loose for field installation by the installing contractor. Backwash piping between the filter basin and pump(s) as well as piping following the pump(s) shall be supplied by the installing contractor. Installing contractor shall supply unions or flanges for service, and interconnecting wiring.
 3. The backwash/waste pump(s) shall be an externally mounted centrifugal pump. Pump shall be provided with a 460-volt, 3 phase, 60 Hz motor and operate at 1750 RPM. Pump shall be rated for 130 gpm at 35 ft TDH. Motor shall be Baldor, Teco, Weg or approved equal. Each pump shall be provided with a painted 304 stainless steel support stand with wedge anchors. Backwashing shall be initiated by basin water level, timer, or manually through the operator interface. Operator

shall have the ability to specify backwash time interval elapses through the operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-pressurized backwash flow will not be accepted.

4. Pump manually operated threaded gate valve shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valve shall conform to MSS SP-80 and shall be Nibco or approved equal.
5. The 3 inch threaded ball valves shall be a two-piece, full port, with a brass body. Valves shall be Nibco or approved equal.
6. The vacuum gauge(s) shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" Hg vacuum range, liquid filled, 1/4" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, Ashcroft or approved equal.
7. The pressure gauge(s) shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, 1/4" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.
8. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

D. Valves

1. Each filter shall include six (6) 2" backwash valve(s). Valve(s) shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions. Because of fouling that can be caused by stringy material, non full port valves such as butterfly valves or plastic valves shall not be acceptable.
2. Each filter shall include one (1) 2" solids waste valve. Valve shall be 2 piece, flanged end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.
3. Each filter shall include a solids waste removal system consisting of perforated manifold, mounted on the floor of the filter basin. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.

2.04 INSTRUMENTATION/CONTROLS

Controls shall be provided to control or monitor equipment as described in the contract drawings. The control system shall include the following control components and practices.

A. PRESSURE TRANSDUCER

A submersible pressure transducer shall be supplied for each filter basin. The pressure transducer shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 psi to 5 psi. Units shall monitor the water level in the filter basin. Pressure transducer shall be provided with a mounting bracket and 316 stainless steel anchors. Electrical connection shall be 2-wire, loop powered through a shielded integral cable comprised of 22 AWG conductors and separate drain wire. An aneroid bellows providing vented gage atmospheric reference shall be supplied for contractor installation in junction box. The installing contractor shall provide junction box, bellows mounting and interconnecting wiring. Transducers shall be KPSI Model 710 series or approved equal.

B. FLOAT SWITCH

A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing hermetically sealed and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

C. VACUUM TRANSMITTER

The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 to 30 inHG. Transmitter shall be an IFM Effector PX series or approved equal.

D. TURBIDITY MONITORING SYSTEM INSTALLATION

Turbidity measurement shall be taken by directing an intense, focused beam of light from the sensor head assembly directly down into the sample in the turbidimeter body. Light scattered at 90 degrees by suspended particles in the sample shall be detected by a submerged photocell, mounted in the wall of the instrument body. The amount of light scattered shall be proportional to the amount of turbidity in the sample.

Provide a total of two turbidity meter system(s), one common influent and one common effluent. A single turbidimeter system shall consist of one turbidimeter sensor, a power supply, an interface with signal output module and internal bubble trap which prevents false high turbidity indications by rejection of bubbles in the unit.

The system shall also include a remote display that can be used for continuous readout of measurement values from the sensor.

System range of operation shall be 0 to 100 NTU with an accuracy of +/- 2% of reading from 0-40 NTU and +/- 5% of reading from 40-100 NTU. Operating temperature shall be 32°F to 104°F and the sampling temperature shall be 32°F to 122°F. Sample inlet connection shall be ¼" NPT female. The drain fitting shall be ½" NPT hose barb.

One pump shall be provided for each turbidity monitoring system to feed the turbidity sensor. The pump shall mount in the effluent channel and be rated for a 300 GPH @1' and 12.0 shut off head. The pump shall be a Little Giant 1/40 HP model PE-2F-PW or approved equal. The pump shall operate on 115 V, 60 Hz single phase power. Tubing shall be provided from the pump to the sensor/analyzer. The installing contractor shall provide 115 volt single phase power to each enclosure. If the feed pump is not located within 15 feet of the system, the installing contractor shall provide a GFI outlet for pump power supply.

Unit and feed pump shall be field mounted by the Installing Contractor.

E. ENCLOSURE

Sensor, analyzer and display module shall be mounted in a separate NEMA 4X fiberglass enclosure.

F. MISC/SPARE PARTS

- (2) Frame and cloth assemblies.
- Backwash/solids waste valve and actuator.
- Viton V-ring effluent port/centertube seal.

G. CONTROL SYSTEM

The automatic and manual controls for operation of the Aqua Disk® Filter system shall be furnished fully assembled, wired and pre-programmed in a UL 508A Certified Industrial Control Panel. Controls shall be provided to control or monitor equipment as described in the contract drawings. The control system shall include the following control components and practices:

H. CONTROL PANEL WIRING AND ASSEMBLY

All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.

Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door.

Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

I. CONTROL PANEL QUALITY ASSURANCE

All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

- Point to point testing of all wiring prior to application of power.
- Intended supply voltage shall be applied to the enclosure
- All components shall be tested for proper operation and calibration
- The PLC and operator interface program shall be loaded and functionally checked
- All components shall be checked to confirm proper mounting specifications have been

followed

Enclosure shall be inspected for defects and repaired if necessary
All labeling of wires and devices are correct, properly installed and clean

The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

J. CONTROL ENCLOSURE

The automatic controls shall be provided in a UL listed, NEMA Type 4X rated fiberglass wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. The color of the enclosure shall be gray, inside and out. Enclosure shall include painted white, mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal. The control enclosure shall be mounted remotely.

K. CORROSION INHIBITOR

Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure. The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

L. MAIN DISCONNECT CIRCUIT BREAKER

A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or approved equal.

M. MOTOR STARTER

A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

A full voltage non-reversing IEC Style motor starter shall be provided for motor applications over 15 kW. Each starter shall consist of a circuit breaker, contactor and

overload relay. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a minimum 18 kA @ 480VAC and 25 kA @ 240 VAC interrupt rating on short circuit when used in combination with a PowerPact circuit breaker. The starter shall have a mechanical durability of 15 million operations. The solid state overload relay shall have class 10 tripping characteristics with trip current adjustment, phase loss and unbalance protection.

N. TRANSFORMER

A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

O. TRANSFORMER PRIMARY AND SECONDARY FUSE

Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

P. CIRCUIT BREAKER

All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

Q. FUSE

Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

R. OPERATOR DEVICE

Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

All operator devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections. Operator device function shall be identified with an

engraved white Gravoply nameplate with black letters. Operator devices shall be Allen-Bradley 800H, Square D 9001, or approved equal.

S. GROUND FAULT DUPLEX RECEPTACLE

A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

T. CONTROL RELAY

UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

U. TERMINAL BLOCK

Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

V. PROGRAMMABLE LOGIC CONTROLLER

Automatic operation of the Filter shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in RS-232 and Ethernet TCP/IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: Internal RAM 4096 kB, real-time clock and calendar, battery backed RAM, an operating temperature range between 32 °F and 140°F (0 °C and 60°C), UL Listed. The PLC processor shall be a Modicon M340 BMXP342020 or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the equipment and appurtenances in accordance with the manufacturer's recommendations.
- B. Manufacturer shall provide templates, certified drawings showing all anchors bolt locations and sizes as required for proper embedding in the concrete equipment support structure. The Contractor shall provide all anchor bolts in accordance

with the manufacturer's recommendations. Anchor bolts shall be 316 stainless steel.

- C. Tolerance on concrete work shall be in accordance with the equipment manufacturer's recommendations.
- D. Installation of the equipment shall not be attempted until the equipment manufacturer has provided detailed installation manuals to the Contractor and the Contractor and manufacturer have instructed key field personnel in detail regarding installation of the equipment.

3.02 LUBRICATION

- A. Lubricate the equipment in accordance with manufacturer's recommendation prior to startup and refill as necessary until the operation of the equipment is turned over to the Owner.
- B. Provide a list of recommended lubricants and a lubrication schedule in accordance with Division 15.
- C. Furnish one year's worth of all types of premium lubricants that the equipment requires.

3.03 PAINTING

All exposed metal parts of the equipment shall be cleaned, primed and finished with the manufacturer's paint system that is in accordance with Division 9. All field touch-up painting shall be in accordance with Division 9.

3.04 ADJUSTING

Furnish qualified personnel to balance and adjust equipment to minimize reactionary forces, excess noise and vibration that are outside the limits of the manufacturer's recommendation. Provide corrective measures as recommended by the manufacturer or Owner's representative. Equipment Alignment shall be in accordance with Section 15000, General Mechanical Requirements.

3.05 CLEANING

Clean the equipment and work area from all construction debris in accordance with Division 1. The equipment provided shall be free from debris prior to placing into service.

SECTION 11287

WEIR PLATES AND ACCESSORIES

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SECTION 11287

WEIR PLATES AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnish and install weir plates and accessories, complete with all necessary gaskets, mounting fixtures, fasteners and, anchors in accordance with the following specifications and as shown on the Contract Drawings.

1.02 RELATED SECTIONS

- A. The specifications sections listed below are an integral part of this equipment specification. The Contractor shall be responsible for providing these sections to the equipment supplier:
 - 1. Section 01300 - SUBMITTALS
 - 2. Section 05500 - METAL FABRICATIONS

1.03 REFERENCES

- A. ASTM A-167
- B. ASTM A-276

1.04 SUBMITTALS

- A. Submit shop drawings for equipment provided under this section. The format and contents of the shop drawing submittal shall conform to the requirements specified in Section 01300..

1.05 SPARE PARTS

- A. Furnish the following spare parts in clearly-identified containers:
 - 1. Washers - Two each type.
 - 2. Butt Plates - Two each type.
 - 3. Neoprene gasket – Two 20 foot pieces.

PART 2 - PRODUCTS

2.01 WEIR PLATES

- A. Weir plates shall be fabricated of Type 304 stainless steel. Each weir plate shall be of the depth, thickness, and overall length as indicated on the Contract Drawings.
- B. Each weir plate shall be provided with mounting holes as shown on the Contract Drawings.
- C. All weirs attached to concrete surfaces shall be fastened to minimize leakage under or around the weir plates, while maintaining the vertical adjustability of each weir plate.

2.02 BUTT PLATES

- A. Butt plates for weir plates shall be 6-inch by plate height for straight weirs.
- B. Butt plates shall be arranged to allow for horizontal expansion.
- C. Butt plates shall be of the same material type and thickness as their corresponding plates.

2.03 NEOPRENE GASKETS

- A. Neoprene gaskets for mounting of weir plates to walls and troughs shall be 1/4 inch thick.
- B. The neoprene gaskets shall be continuous one-piece gaskets running the entire length of the wall and shall have a depth extending from the top of the wall to the bottom of the weir plates.

2.04 FASTENERS

- A. All bolts, nuts, washers, and other fasteners shall be made of Type 316 stainless steel unless otherwise noted.
- B. Anchor bolts shall be minimum 5/8-inch diameter, Type 304 stainless steel Hilti-style epoxy anchors.
- C. Washers shall be minimum 5 inches diameter and minimum 1/8-inch thickness.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Not Required.

3.02 EQUIPMENT INSTALLATION

- A. Install weir plates to the elevations shown in the weir schedule in the Drawings with no more than $\pm 1/16$ -inch variation.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. All weir plate installations shall be leakage tested for four hours to assure a watertight installation.
- B. Supply all plugs, pumps, weirs, etc., necessary to conduct the tests.
- C. Tests shall be witnessed by Engineer.
- D. The leakage test shall consist of an exfiltration test wherein the particular treatment tank or distribution box upon which the weir plate is installed shall be filled with water to the top of the weir plate.
- E. This water level shall be maintained throughout the test period.
- F. During the test period, any leakage from the treatment tank or distribution box that is associated with the weir plate installation shall be cause for failure of the leakage test.
- G. In the case of leakage test failure, the Contractor shall make all necessary repairs or replacements and shall repeat the leakage test until a satisfactory test is obtained.

3.04 TRAINING

- A. Not Applicable.

3.05 SERVICE OF MANUFACTURER'S REPRESENTATIVE

- A. Not Applicable.

3.06 EQUIPMENT WARRANTY

- A. Provide equipment warranty in accordance with Section 01740

3.07 WEIR SCHEDULE

- A. Pertinent information on weir sizing and installation details is contained in the weir schedule provided in the Contract Drawings.

END OF SECTION 11287

SECTION 11288

FIBERGLASS CLARIFIER ACCESSORIES

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SECTION 11288

FIBERGLASS CLARIFIER ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish and install fiberglass clarifier accessories (including weir plates, scum baffles, and density current baffles) for two 85-foot diameter Secondary Clarifiers (SC- 401, SC-402) complete with all necessary gaskets, mounting fixtures, fasteners, and anchors in compliance with the following specifications and as shown on the Contract Drawings.
- B. Density current baffle dimensions and mounting angle shall be as shown on the Contract Drawings.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.
 - 1. Section 01300 – SUBMITTALS
 - 2. Section 01650 – START-UP
 - 3. Section 01740 – WARRANTIES AND BONDS
 - 4. Section 09900 – PAINTING
 - 5. Section 11335 – CLARIFIER EQUIPMENT

1.03 REFERENCES

- A. ASTM A167
- B. ASTM A276

1.04 DESIGN REQUIREMENTS

- A. Fiberglass plates shall be a minimum of 1/4-inch nominal thickness unless otherwise indicated in this section or on the Drawings.
- B. All weir plates, scum baffles and density current baffles shall be fabricated of

molded fiberglass reinforced plastic with resin rich surfaces and edges to prevent migration and “fiber blooming.”

- C. All surfaces shall be smooth; resin rich; free of voids and porosity; without dry spots, crazes, or non-reinforced areas; and shall provide for corrosion resistance and weathering.
- D. Glass content of the laminate shall be 30 percent +/- 2%, using Type “C” surfacing mat with silane finish on both sides of the laminate and Type “E” glass fiber reinforcement with chrome or silane finish.
- E. Inorganic fillers shall consist of no less than 40 percent of resin mixture. Final laminate thickness shall be within +/- 10 percent of the specified thickness.
- F. Resin laminates shall be resistant to the corrosive effects of sewage having a pH of approximately 6.0. A maximum of 4 percent by weight of a thixotropic agent may be added to the resin to prevent runoff.
- G. Resin with sufficient thixotropic agent added to form a suitable seal mix shall be used to seal any machined edges.
- H. All FRP components shall contain U.V. light absorbing additive.
- I. All FRP components shall be suitable for continuous submergence in wastewater.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 and as specified herein. Submittals shall include as a minimum:
 - 1. Manufacturer’s experience and qualifications (waived for named manufacturers).
 - 2. Shop drawings.
 - 3. Manufacturer’s installation certificate
 - 4. Manufacturer’s equipment warranty.

1.06 SPARE PARTS

- A. Furnish the following spare parts in clearly identified containers:
1. Washers: Four (4) each type
 2. Support Brackets
 - a. Two (2) separate stainless steel brackets
 - b. Two (2) brackets when bracket is integral within baffle

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. All fiberglass clarifier accessories shall be provided by one of the manufacturers listed below, or-equal:
1. NEFCO, Inc. Palm Beach Gardens, FL
 2. Dorr-Oliver EIMCO, Salt Lake City, Utah
 3. Warminster Fiberglass, Southampton, PA
- B. In the case of an “or-equal”, the Contractor shall demonstrate in writing, to the satisfaction of the Owner at the time of the shop drawing submittal that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the bid date.

2.02 EQUIPMENT DESIGN

- A. Weir Plates, Scum Baffles, and Accessories
1. Each weir plate shall be of the depth and overall height as indicated on the Drawings and shall contain 90-degree V-notches where noted.
 2. Each weir plate shall be provided with mounting holes as shown on the Drawings. All weirs attached to troughs or concrete surfaces shall be fastened a maximum of 24 inches on center, along the perimeter to minimize leakage under or around the weir plates, while maintaining the vertical adjustability of each weir plate.

3. Butt plates for weir plates shall be 12” wide, the same height as the weir plate, and arranged to allow for horizontal expansion. Butt plates shall be of the same type and thickness as their corresponding plates and baffles.
4. Butt plates for V-notch weirs shall be notched such that they do not obscure weir notches.
5. Neoprene gaskets for mounting of weir plates to walls and troughs shall be provided as shown on the Drawings.
6. All weir plates, scum baffle plates, and butt plates shall be fiberglass reinforced plastic pressure molded by the matched die method to produce uniform, smooth surfaces.

B. Density Current Baffles

1. Clarifier density current baffles shall have a radius of curvature equal to that of the tank to ensure that each deflector section fits the curve of the effluent trough.
2. Provision shall be made to vent gases, which may accumulate beneath the baffle through installation of vents located in the panels.
3. Brackets shall be fabricated from Type 304 stainless steel or shall be integrally molded of FRP as part of a baffle panel module.
4. All stainless steel support brackets and hardware to secure support brackets to the baffle plates and tank walls shall be furnished by the baffle plate assembly supplier.
5. Triangular-shaped brackets shall be provided to support the deflector at the angle shown on the Contract Drawings.

C. Fasteners

1. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel, unless otherwise noted.
2. Anchor bolts shall be Type 304 SS HILTI-style epoxy anchors.

3. Minimum washer thickness shall be 1/8-inch.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Not required.

3.02 EQUIPMENT INSTALLATION

- A. Furnish and install the equipment according to the Contract Documents and the manufacturer's instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. Not applicable.

3.04 TRAINING

- A. Not applicable.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of a manufacturer's field representative for one 8-hour day excluding travel time to inspect and certify the installation of the fiberglass clarifier accessories were installed correctly.
- B. Provide jointly to the Owner and the Engineer an installation certificate from the equipment manufacturer or their approved representative stating that the equipment has been properly installed and tested to their satisfaction and that all final adjustments required have been made.

3.06 WARRANTY

- A. Provide equipment warranty in accordance with Section 01740

- B. The baffle supplier shall warrant that all materials furnished shall be free of defects in materials and workmanship for a period of five (5) years from the date of acceptance.

END OF SECTION 11288

SECTION 11290

STOP LOGS

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SECTION 11290

STOP LOGS

PART 1 – GENERAL

1.01 SUMMARY

Furnish and install stop logs and accessories, complete with all necessary gaskets, mounting fixtures, fasteners and, anchors in accordance with the following specifications and as shown on the Contract Drawings.

1.02 GENERAL

- A. The equipment provided under this section shall be fabricated, assembled, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer unless exceptions are noted by the engineer.

1.03 SUBMITTALS

- A. Shop drawings shall be submitted for all items specified herein as specified under DIVISIONS 0 AND 1. In addition shop drawings shall include the following:
1. Complete description of all materials including the material thickness of all structural components of the stop logs and stop log lifter.
 2. Installation drawings showing all details of construction, details required for installation and dimensions.
 3. Maximum bending stress and deflection of the stop logs under the maximum design head.
 4. Leakage measurement results from shop tests.
 5. Maximum fiber Stress Calculations (ultimate and/or yield). Deflection shall be Calculated to withstand the maximum seating head with a deflection less than $L/360$ of the gate width, or 1/4-inch, whichever is less.
- B. Complete Operations and Maintenance Manuals shall be submitted as specified under DIVISIONS 0 AND 1.

1.04 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective in accordance with warranty requirements prescribed in the General Conditions.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Plasti-Fab Inc.
- B. FRP Composites Inc.
- C. Or Equal.

2.02 FRP LOGS AND GUIDES

- A. Each log shall be individually molded to the exact dimensions and types shown on the Contract Drawings, and shall be manufactured of reinforced thermoset plastic containing ultraviolet stabilizers. Construction utilizing foam core sandwich that is completely encased by FRP skins shall be used to obtain the necessary structural reinforcing.
- B. Material
 - 1. Fiberglass reinforced isophthalic polyester resin contact-molded composite laminate.
 - 2. Nominal Thickness: As required by design.
 - 3. Molded-In Reinforcement: As required by design.
 - 4. Gel-Coat Finish: 10 to 20 mils thick on both sides, with ultraviolet inhibitor.
 - 5. Cut Edges: Seal with polyester resin.
 - 6. Glass: Type E, random chopped with chrome or silane finish.
 - a. Binder: Compatible with resin.
 - b. Glass Strand Length: Minimum 1 inch.
 - 7. Adequate contact molding pressure to ensure complete resin wet-out of glass fibers.
- C. The FRP structural characteristics for an 1/8" glass mat laminate shall meet the following minimum physical properties.
 - 1. Tensile Strength: 14,700 psi.
 - 2. Flexural Modulus: 800,000 psi.

3. Flexural Strength: 23,300 psi.
4. Barcol Hardness: 35.
5. Impact Strength: 9.0 ft-lbs./in.
6. Water Absorption: <0.13% (in 24 hrs).

- C. Lifting Pins or Lifting Eyes shall be made of T-303 Stainless Steel Material.
- D. Lifting Beam shall automatically latch to stop logs and be provided for stop logs that weigh more than 75 pounds. Lifting Beam and Hooks shall be made of Galvanized Steel.
- E. Guide Frames shall be fiberglass reinforced polyester manufactured by the pultrusion process and shall incorporate a polymeric fiber surfacing material for high corrosion and weather resistance.
 1. Guide frame shall be concrete embedded. The guide frames shall have a minimum 3/8 inch by 1-1/2 inch deep slot for embedded guides. The back of the embedded portion of the guide shall have a continuous lip or flange extended not less than 1/4" on both sides thus forming a key into the concrete.
- F. The log shall be equipped with in-Channel seals to reduce leakage. A flush bottom neoprene seal shall be provided in the bottom guide groove. The following characteristics shall apply:
 1. Specific Gravity: 1.25
 2. Hardness: 55-65 Shore A Durometer
 3. Tensile Strength: 1,500 psi
 4. Elongation: 300%
 5. Low Temperature Brittleness: -40⁰ F

2.03 SEALS

- A. Each stop log shall be outfitted with a continuous resilient lip seal along the bottom and both sides to restrict leakage in accordance with the requirements listed in this specification.
 1. The continuous lip seal shall be constructed of urethane or rubber and shall be mechanically retained to the stop log.
 2. The lip seal shall be activated by a combination of the weight of the stop log and the differential water pressure, which pushes the seal against the inside of the groove assembly.
 3. Stop logs that utilize rubber "J" seals or "P" seals are not acceptable.

2.04 LIFTER

- A. One stop log lifter shall be provided for each different guide frame width.
 - 1. The lifter shall be constructed of stainless steel and shall be outfitted with UHMW guide bars and stainless steel fasteners.
 - 2. The lifter shall be provided with lifting hooks designed to engage the slots in the top of the stop logs. A lanyard release will be incorporated into the design.
 - 3. The lifter shall be capable of installing and removing all stop logs of the same width whether they are installed or at the operating floor level.

PART 3 - EXECUTION

3.01 INSTALLATION

Logs shall be installed in accordance with the manufacturer's recommendations.

3.02 MANUFACTURER'S INSPECTION AND START-UP

The Contractor shall furnish the services of the Stop Log manufacturer's qualified field representative to inspect the equipment after installation, as specified under DIVISIONS 0 AND 1.

3.03 FIELD TESTS

- A. Log's shall be checked for leakage by the contractor after installation (refer to the Performance section herein, for approval criteria).

END OF SECTION 11290

SECTION 11291

FABRICATED SLIDE AND WEIR GATES

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SECTION 11291

FABRICATED SLIDE AND WEIR GATES

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all coordination, labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the equipment as shown, as specified and in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Furnish detailed shop drawings for all items specified herein in accordance with Division 1.
- B. Furnish detailed Operation and Maintenance manual for all items specified herein in accordance with Division 1.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.

1.04 QUALITY CONTROL

- A. The equipment manufacturer shall have a minimum of 10 years experience in manufacturing equipment similar, equal or larger size, to that specified.
- B. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience requirements. Installation information shall include, but not be limited to, the following:
 - 1. Name and location of the installation.
 - 2. Name of person in direct responsible charge for the equipment.
 - 3. Address and phone number of person in direct responsible charge.
 - 4. Month and year the equipment was placed in operation.
 - 5. Capacity of Equipment

- B. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.06 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein. Services shall be provided as required to ensure complete and operational equipment for minimum of four (4) eight (8) hour days.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.07 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, signed by an authorized representative of the Manufacturer, certifying that the equipment is installed in a complete and satisfactory manner and has been functionally tested such that it is ready for operation.

1.08 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment

installed. Training shall be provided by as required to ensure Owner's personnel understanding of equipment for a minimum of four (4) hours.

1.09 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective for a period of (1) one year from the date of final acceptance.

PART 2 - PRODUCTS

2.01 SLIDE AND WEIR GATES

A. General Design

1. Installation shall conform to manufacturer installation guidelines and Contract Drawings. Gates shall be self-contained or non self-contained of the rising or non-rising stem configuration as indicated on the Contract Drawings. Gates shall consist of a frame on which are mounted the rails and a movable slide. Wedging action upon closure is obtained by constructing the seating surface of the frame at an angle to the vertical mounting of the gate.
2. Gate shall be substantially watertight under the design head conditions. See the slide gate schedule on the Contract Drawings for the design conditions. Leakage shall not exceed 0.1 US gallons per minute per foot (0.02 l/s per meter) of seal periphery under the design seating head and 0.2 US gallon per minute per foot (0.04 l/s per meter) of seal periphery for the design unseating head.
3. See paragraph 2.03 of this section for detailed material requirements.

B. Frame

1. The gate frame shall be constructed of structural members or formed plate welded to form a rigid one-piece frame. The frame shall be of the integral flange back design suitable for mounting on a concrete wall (CW), wall thimble (WT), concrete wall embedded or existing concrete channel mounted. Frame lengths shall be coordinated to suit non-self contained and self contained gates as shown on the Contract Drawings.
2. Where shown on Contract Drawings, frames shall be designed to use flush bottom closure.

3. Minimum material thickness shall be 1/4", except for gates having an opening of 16 square feet or less, where 3/16" will be allowable.

C. Slide

1. Shall be reinforced with angle, channel, or plate stiffeners as required to limit the deflection at maximum specified head to 1/360 of span and the maximum stress of 12,000 PSI.
2. Minimum material thickness shall be 1/4", except for gates with openings of 16 squared feet or less, where 3/16" will be allowable.
3. Stem connectors shall consist of two vertical members welded to the slide. Each stem shall be bolted to the stem connector with two stainless steel attachment bolts.

D. Guides And Seals

1. Guides shall be made of the "True" UHMWPE (ultra high molecular weight polyethylene) and shall be of such length as to retain and support at least two thirds (2/3) of the vertical height of the slide in the fully open position.
2. Side seals shall be made of the "True" UHMWPE (ultra high molecular weight polyethylene) of the self-adjusting type. A compression cord shall ensure contact and maintain efficient sealing between the UHMWPE seals and the slide in all positions.
3. Seals shall maintain the specified leakage rate in both seating and unseating conditions. The flush bottom seal shall be made of ASTM D2000 resilient neoprene set into the bottom member of the frame.
4. Gates shall seal on all sides.

E. Yoke

Self-contained gates shall be provided with a yoke made of structural members or formed plates. The maximum deflection of the yoke shall be 1/360 of the gate's span when operating at maximum head specified. The yoke shall be located as required to provide full travel of the slide. The slide shall be removable through the yoke opening or by disassembly/removal of the yoke.

F. Manufacturers

1. HydroGate Corp.

2. Waterman
3. Whipps
4. Or Equal.

2.02 LIFT ASSEMBLIES

A. Stem And Couplings

The operating stem shall be of 316 stainless steel designed to transmit in compression at least 2 times the rated output of the operating manual mechanism with a 40 lb (178 N) effort on the crank or handwheel.

1. The stem shall have a slenderness ratio (L/R) less than 200. The threaded portion of the stem shall have machine cut threads of the Acme type.
2. As applicable, where a hydraulic, pneumatic or electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition.
3. For stems in more than one piece and with a diameter of 1-³/₄ inches (45 mm) and larger, the different sections shall be joined together by solid couplings. The couplings shall be grooved and keyed and shall be of greater strength than the stem. Stems with a diameter smaller than 1-³/₄ inches (45 mm) shall be pinned to an extension tube. The couplings shall be grooved and keyed and shall be of greater strength than the stem.

B. Gates having a width equal to or greater than two times their height shall be provided with two lifting mechanisms connected by a tandem shaft.

C. Stem Guides

Stem guides shall be fabricated from 316 stainless steel. Stem guides shall be equipped with a UHMWPE bushing. Guides shall be adjustable and spaced in accordance with the manufacturer's recommendation. The L/R ratio shall not be greater than 200.

2.03 MATERIALS

Part	Material
Frame, yoke, stem guides, slide, stem extension, rails.	Stainless steel ASTM A-240 or A276, Type 304L or 316L.

Part	Material
Stem guide bar	Ultra high molecular weight polyethylene (UHMWPE), ASTM D-4020-96
Bottom seal	Neoprene ASTM D-2000 Grade 2 BC-503
Threaded stem	Stainless steel ASTM A-276, Type 303MX or 316
Fasteners	ASTM F593 and F594 GR1 for Type 304
Gasket (between frame and wall)	EPDM ASTM 1056
Stem cover	Polycarbonate ASTM A-707
Lift nut	Manganese bronze , ASTM B584, UNS-C86500
Top and side seals	EPDM ASTM D2000-01 BA910 C12 and ASTM D2000-01 BA415

2.04 MANUAL OPERATORS

A. General:

1. Components: Withstand a minimum of 250 percent of design torque or thrust at extreme operator positions without damage.
2. Sizing: Include hydraulic down-pull load for heads greater than 30 feet and for nominal gate widths greater than 5 feet.
3. Gear train and gate stem sections shall produce a self-locking drive train.
4. Lift Nuts: Internally threaded with cut or cold-rolled Acme threads corresponding to stem threading.
5. Roller Bearings: Ball-thrust or tapered above and below lift nut to support both opening and closing thrusts.
 - a. Grease lubrication fittings for bearings.
 - b. Input pinions with needle or ball bearings.
6. Lubrication: Furnish gates with an insert lubricator flange, with grease fitting for greasing stem threads below stem nut.

- B. Yoke Mounted, Gear Manual Offset Operator
 - 1. Provide an offset gear actuator with a rising stem on slide gate and non-rising stem on extension stem.
 - 2. Provide stainless steel universal joints as needed.
 - 3. Provide a cast iron floor box with a 2" operating nut and non-rising stem. Floor box shall be set in concrete as shown in Contract Drawings.

2.03 PAINTING

- A. All ferrous parts of the slide gate and the stem guides shall be painted with two shop coats of amine modified polyamide epoxy suitable for sewage. Surfaces shall be blast-cleaned to bare metal before painting. The shop coat shall be applied after assembly. All machined iron surfaces, including drilled and tapped holes, shall be coated with protective grease.
- B. The operator floor stand shall be finished in accordance with Division 9, Finishes for ferrous metals.
- C. The Contractor shall touch-up paint any items damaged during shipping or installation in accordance with Division 9, Finishes.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the equipment and appurtenances in accordance with the manufacturer's recommendations.
- B. Manufacturer shall provide templates and certified drawings showing all anchor bolt locations and sizes as required for proper embedding in the concrete equipment support structure. The Contractor shall provide all anchor bolts in accordance with the manufacturer's recommendations. Anchor bolts shall be 316 stainless steel.
- C. Tolerance on concrete work shall be in accordance with the equipment manufacturer's recommendations.
- D. Installation of the equipment shall not be attempted until the equipment manufacturer has provided detailed installation manuals to the Contractor and the Contractor and manufacturer have instructed key field personnel in detail regarding installation of the equipment.

3.02 LUBRICATION

- A. Lubricate the equipment in accordance with manufacturer's recommendation prior to startup and refill as necessary until the operation of the equipment is turned over to the Owner.
- B. Provide a list of recommended lubricants and a lubrication schedule in accordance with Division 15.
- C. Furnish one year's worth of all types of premium lubricants that the equipment requires.

3.03 PAINTING

All exposed metal parts of the equipment shall be cleaned, primed and finished with the manufacturer's paint system that is in accordance with Division 9. All field touch-up painting shall be in accordance with Division 9.

3.04 FACTORY PERFORMANCE TESTS

The completely assembled gates, in vertical position, shall be shop inspected for proper seating. Seat facings shall be machined with wedges adjusted to exclude a 0.004 inch thickness gauge between the frame and disc seating surfaces. The gate disc shall be fully opened and closed in its guide system to insure that it operates freely.

3.05 FIELD PERFORMANCE TESTS

The Contractor shall field test for leakage all slide gates in the presence of the manufacturer's representative. Tests shall be performed by filling the wet well with plant water or primary effluent to the top of the slide gates, in their fully closed position. Testing shall continue until leakage through all gates is deemed to be relatively equal and of an acceptable rate not to exceed 0.1 gpm/lf of wetted perimeter.

3.06 ADJUSTING

Furnish qualified personnel to balance and adjust equipment to minimize reactionary forces, excess noise and vibration that are outside the limits of the manufacturer's recommendation. Provide corrective measures as recommended by the manufacturer or Owner's representative. Equipment Alignment shall be in accordance with Section 15000, General Mechanical Requirements.

3.07 CLEANING

Clean the equipment and work area from all construction debris in accordance with Division 1. The equipment provided shall be free from debris prior to placing into service.

END OF SECTION 11291

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SECTION 11300

PUMPING EQUIPMENT-GENERAL

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SECTION 11300

PUMPING EQUIPMENT-GENERAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pump suction and discharge pressure gauges.
- B. Nameplate requirements.
- C. Shop and field tests.
- D. Services of manufacturer's representative.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.
 - 1. Section 01300 - SUBMITTALS
 - 2. Section 01650 - STARTUP OF SYSTEMS
 - 3. Section 09900 – PAINTING
 - 4. Section 11305 – RETURN SLUDGE AND WASTE SLUDGE PUMPS
 - 5. Section 11309 – SCUM CHOPPER PUMPS
 - 6. Section 11312 – VERTICAL TURBINE PUMP
 - 7. Section 11313 – VERTICAL PROPELLER PUMP
 - 8. Section 11345 – CHEMICAL FEED PUMPS
- B. All equipment and wiring shall be in full compliance with Division 16 and 17 specification sections.

1.03 SUBMITTALS

- A. Shop Drawings shall be submitted in accordance with Section 01300 and as specified herein. Submittals shall include as a minimum:
 - 1. Submit a schedule of all gauges with proposed ranges
 - 2. Pump Nameplate Designations

PART 2 - PRODUCTS

2.01 PRESSURE GAUGES

- A. Pressure gauges shall be installed on the suction and discharge sides of pumps in accordance with the following specifications.
1. Gauges shall be of the bourdon tube type with 4-1/2-inch diameter dial and with diaphragm seal.
 2. Case and ring shall be black epoxy coated aluminum, bourdon tube shall be phosphor bronze with a brass tip and window shall be glass.
 3. Gauges shall be stem mounted and shall be installed close to the suction and discharge flanges of the pump.
 4. Gauges shall be calibrated to read zero at atmospheric pressure.
 5. Suction pressure gauges shall be of the compound type to indicate both pressure and vacuum; they shall be calibrated to read 25 feet of water above and below zero.
 6. Discharge pressure gauges shall be calibrated to read from 0 feet to a minimum of 5 feet of water pressure above pump shutoff head.
 7. Pressure gauges shall be Ashcroft No. 1379A (discharge) and No. 1379AC (suction); U.S. Gauge; or equal.
 8. All pressure gauges shall be provided with continuous duty, clamped Teflon diaphragm seals as manufactured by Ashcroft, Type 300; U.S. Gauge; or equal.
 9. Each diaphragm seal shall have Type 316 stainless steel upper and lower housings.
 10. The lower housing shall be a threaded connection.
 11. Gauges and diaphragm seals shall be by same manufacturer and shall be shipped as complete units, factory filled with silicone fluid.

12. Each gauge and diaphragm seal unit shall be connected with the necessary brass pipe fittings and a brass stopcock.
13. Contractor shall coordinate with the various pump manufacturers so that all pressure gauges are of one manufacturer.
14. No pressure gauges shall be required for sump, polymer feed, or screw pumps.

2.02 NAMEPLATES

- A. A brass or stainless steel nameplate shall be furnished for each pump with stamped characters readable under ordinary lighting conditions.
 1. Nameplate shall include the rated pump capacity in gallons per minute, discharge pressure at rated capacity, maximum operating speed, and efficiency.
 2. Additional data may be in accordance with the manufacturer's regular practice.
 3. Nameplates shall be securely attached and NOT PAINTED OVER.

2.03 PAINTING

- A. Painting, including surface preparation, shall be in full accordance with Section 09900. The pump manufacturer shall coordinate fully with the Contractor the system and application of paints used.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Shop testing shall be performed on the pumps in accordance with requirements specified in Section 01650 and as follows:
 1. Each pump shall be shop tested to determine compliance with the specified performance conditions. Contractor shall submit five certified copies of manufacturer's test data for review and approval by Engineer before shipment to the project site.

2. Engineer reserves the right to witness pump shop testing. Contractor shall give ample notice in advance of the testing so that Engineer can arrange to witness the testing, if desired.
3. Final acceptance of pumps shall depend on successful completion of field testing after installation.

3.02 EQUIPMENT INSTALLATION

- A. Pumping equipment shall be installed by the Contractor in accordance with Sections 01650 and 15000.

3.03 FIELD TESTING

- A. Field tests shall be performed for all pumps. Testing shall conform to requirements specified in Section 01650.
- B. Preliminary field tests shall be performed after installation of the pumps. Final field tests shall demonstrate the following:
 1. That the pumps have been properly installed, are in proper alignment, and operate without over-heating or overloading of any parts and without objectionable vibration.
 2. That there are no mechanical defects in any of the parts.
 3. That the pumps can deliver the specified capacity at the specified pressure and speed. Field tests shall be conducted with clean water from the water supply system. Contractor shall provide all temporary flow measurement devices necessary for accurate measurement of the pumped flow rate.
 4. That the pumps can pass the size of solids specified and the type of liquid for which the pumps are to be used.

3.04 TRAINING

- A. Not Applicable.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Contractor shall arrange for the equipment manufacturer to furnish the services of a qualified field service representative in accordance with requirements specified in the equipment specifications.
- B. For each series of pumps of the same model and size, the representative shall inspect the installation and supervise startup, field testing and initial operation for not less than two days and instruct the operators in proper operation, maintenance and repair procedures for not less than one day.

3.06 EQUIPMENT WARRANTY

- A. Provide equipment warranty in accordance with Section 01740 and the equipment specifications

END OF SECTION 11300

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SECTION 11305

RETURN SLUDGE AND WASTE SLUDGE PUMPS

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SECTION 11305

RETURN SLUDGE AND WASTE SLUDGE PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish, install, and test three (3) self-priming centrifugal pumps as Return Sludge Pumps (PBB-RS-611, PBB-RS-612, and PBB-RS-613) including v-belt drive, motor and controls, complete with all necessary accessories, in compliance with the following specifications and as shown on the Drawings.
- B. Furnish, install, and test two (2) self-priming centrifugal pumps as Waste Sludge Pumps (PBB-WS-601 and PBB-WS-602) including v-belt drive, motor and controls, complete with all necessary accessories, in compliance with the following specifications and as shown on the Drawings.
- C. Provide all pipe fittings to connect the supplied equipment to the piping shown on the Drawings.
- D. Unless otherwise noted, controls for motorized equipment specified in this section shall be furnished by the control systems integrator and shall be in full compliance with Divisions 16 and 17, Electrical and Process Control System Specifications.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.
 - 1. Section 01300 – SUBMITTALS
 - 2. Section 01650 – START-UP OF SYSTEMS
 - 3. Section 09900 – PAINTING
 - 4. Section 11300 – PUMPING EQUIPMENT - GENERAL
 - 5. Section 15000 – GENERAL MECHANICAL REQUIREMENTS
- B. All electrical equipment, controls and wiring shall be in full compliance with Division 16 and 17, Electrical Specifications.

1.03 REFERENCES

ANSI/HI 1.1-1.6	Centrifugal Pumps
ANSI/HI 9.1-9.5	Pumps – General Guidelines
ANSI/HI 9.6.1	Centrifugal and Vertical Pumps for NSPH Margin
ANSI/HI 9.6.3	Centrifugal and Vertical Pumps Allowable Operating Range
ANSI/HI 9.6.4	Centrifugal and Vertical Pumps. Vibration Measurements and Allowable Values
ASTM A48	Specification for Gray-Iron Castings
ASTM A532	Specification for Abrasion-Resistant Cast Iron
ASTM A743	Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Corrosion-Resistant for General Application
UL 1004-Motors	Electric
ANSI	American National Standards Institute
AFBMA Std. 11	Load and Fatigue Life for Roller Bearings
NEMA MG 1	Motors and Generators

1.04 PERFORMANCE REQUIREMENTS

- A. Pumps shall be capable of pumping settled sludge from the Final Clarifiers with a solids concentration of up to 2.0 percent without clogging.
- B. Pumps PBB2-RS-611, PBB2-RS-612, and PBB2-RS-613 shall each be capable of operating under the following conditions:
 - 1. Primary design point: 365 gpm at 5.5 ft TDH during design flow conditions
 - 2. Secondary design point: 1,300 gpm at 19 ft TDH, during peak flow conditions
 - 3. Minimum safe pump capacity: 200 gpm
 - 4. Shutoff head, at full speed: 60 feet
 - 5. Maximum speed: 1050 rpm
 - 6. Minimum efficiency at primary design point: 50 %
 - 7. Minimum efficiency at secondary design point: 60%
 - 8. Suction diameter: 8 in.
 - 9. Discharge diameter: 6 in.
 - 10. Maximum Motor Horsepower: 15 Hp
 - 11. Repriming lift: Flooded Suction
 - 12. Minimum Sphere Size Passing: 3 in.
 - 13. Minimum NPSH Available: 25 ft
 - 14. Drive: Variable Speed

- C. Pump PBB2-WS-601 and PBB2-WS-602 shall be capable of operating under the following conditions:
1. Primary design point: 250 gpm at 15 ft TDH
 2. Shutoff head, at full speed: 30 feet
 3. Maximum speed: 850 rpm
 4. Minimum efficiency at design point: 50 %
 5. Suction diameter: 4 in.
 6. Discharge diameter: 3 in.
 7. Maximum Motor Horsepower: 5 Hp
 8. Repriming lift: Flooded Suction
 9. Minimum Sphere Size Passing 3 in.
 10. Minimum NPSH Available 25 ft
 11. Drive Variable Speed

1.05 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 and as specified herein. Submittals shall include as a minimum:
1. Manufacturer's catalog information, descriptive literature, specifications, etc., for pumps, motors and accessories inclusive of pump seal assemblies.
 2. Manufacturer's certified installation drawings containing all critical dimensions, piping connection sizes, weights, etc. required for the installation of the equipment.
 3. Manufacturer's written installation instructions, including any special requirements for shipping, handling and storage of equipment prior to installation.
 4. Certified pump curves demonstrating compliance with specified performance requirements.
 5. Motor information conforming to the requirements specified in Section 15000.
 6. Manufacturer's equipment warranty.
- B. Operation and Maintenance Manuals shall be submitted in accordance with Section 01300 submittals.
- C. Manufacturer's Certificate for equipment and installation shall be submitted in

accordance with Section 01300, Submittals.

1.06 SPARE PARTS

- A. Furnish the following spare parts in clearly identified containers for PBB-RS-611, PBB-RS-612, and PBB-RS-613:
1. One (1) mechanical seals (complete) with all gaskets, seals, sleeves, and o-rings required to be replaced during the replacement of the seal.
 2. One (1) impeller and one set of impeller clearance adjustment shims required to be replaced during replacement of the assembly.
 3. One (1) quarts of seal lubricant.
 4. One (1) cover plate o-rings.
 5. One (1) rotating assembly and o-rings required to be replaced during replacement of the assembly.
 6. One (1) wear plate .
 7. Two (2) suction flap valve assemblies.
- B. Furnish the following spare parts in clearly identified containers for PBB-WS-601 and PBB-WS-602:
1. One (1) mechanical seals (complete) with all gaskets, seals, sleeves, and o-rings required to be replaced during the replacement of the seal.
 2. One (1) impeller and one set of impeller clearance adjustment shims required to be replaced during replacement of the assembly.
 3. One (1) quarts of seal lubricant.
 4. One (1) cover plate o-rings.
 5. One (1) rotating assembly and o-rings required to be replaced during replacement of the assembly.
 6. One (1) wear plate .
 7. Two (2) suction flap valve assemblies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Return Sludge Pumps and Waste Sludge Pumps equipment manufacturer shall be the following or equal:
1. Gorman-Rupp Company, Mansfield, Ohio

- B. In the case of an “or-equal”, the Contractor shall demonstrate in writing, to the satisfaction of the Owner at the time of the shop drawing submittal that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the bid date.

2.02 EQUIPMENT DESIGN

A. Pump Casing

1. Casing shall be constructed of high-grade cast iron, in accordance with ASTM A48, and shall be designed to withstand hydrostatic heads equal to 1—1/2 times the maximum shutoff head without leakage or distortion or deflection.
2. The casing shall be foot supported with a horizontal centerline suction and vertical discharge.
3. Casing discharge flange spool shall be provided with a 1-inch tap for vent line, and suction and discharge flange spools shall be provided with 1/4-inch taps for gauge connections.
4. A minimum 1-1/4 inch diameter drain hole shall be provided for attachment of the pump drain kit for each pump.
5. The pump casing shall have a priming fill port, 3 1/2-inches in diameter, with a safety lock bar cover.
6. Pump suction and discharge piping connections shall be faced and drilled to American Standard flange dimension, Class 125.
7. Fasteners on areas requiring access for maintenance and lubrication shall be manufacturer’s standard equipment and shall be designed for quick removal and ease of maintenance.
8. All openings, internal passages, and internal recirculation ports shall be large enough to permit the passage of the specified solids.

B. Cover Plate

1. The cover plate shall be removable to allow removal of blockage and to allow access to the internal pump components for easy access for maintenance and repairs without having to remove the suction or discharge piping.
2. Replacement of wear plate, impeller, seal and suction check valve shall be accomplished through the removable cover plate.
3. Two O-rings manufactured of Buna-N material shall seal the cover plate to the pump casing.
4. A handle shall be mounted to the face of the cover plate.

C. Wear Plate

1. Wear plate shall be constructed of AISI 1015 hardened alloy steel and shall be of self cleaning design.
2. Wear plate shall be of sufficient width to maintain the manufacturer's recommended clearance between the entire edge of each impeller vane and the wear plate.
3. The wear plate shall be bolted to the cover plate by means of two threaded studs welded to the wear plate.
4. Attachment hardware shall be located out of the direct flow path of the liquid into the impeller.

D. Impeller

1. Impeller shall be ductile iron, two vane, semi-open, non-clog design with integral pump out vanes on the back shroud.
2. Impellers shall be capable of passing wastewater solids and stringy or fibrous material.
3. The entire rotating assembly must be capable of being removed for inspection or repair without disturbing the pump volute or the suction and discharge piping connections.
 - a. The rotating assemblies shall be dynamically and hydraulically balanced for all operating speeds.

- b. The rotating assembly shall be attached to the volute casing by four (4) bolts.
 4. The impeller shall thread onto the pump shaft and be secured by a corrosion resistant lockscrew.
 - a. The lockscrew shall be covered by a cone shaped shroud to prevent wear of the lockscrew.
 5. The impeller vanes shall have blunt, backward-sloped leading edges.
- E. Shaft and Shaft Sleeve
 1. Shaft shall be AISI 4150 alloy steel and protected in the mechanical seal area by an AISI 4130 alloy steel shaft sleeve.
 2. The shaft sleeve shall be sealed to the shaft with an O-ring, pressing the sleeve to the shaft, or using a hooked design and locking the sleeve in place by the impeller to positively prevent intrusion of the pumped liquid between the shaft and sleeve.
 3. Sleeve shall extend the full length of the seal housing and under the gland.
- F. Shaft Seal
 1. Shaft seal shall be oil lubricated mechanical type.
 2. Stationary and rotating seal faces shall be silicon carbide alloy.
 3. Mechanical seal faces shall be lapped to a tolerance of three light bands (35 millionths of an inch) as measured by an optical flat under monochromatic light.
 4. The stationary seal seat shall be double floating by virtue of a dual O-ring design. An external O-ring shall secure the stationary seat to the seal plate and an internal O-ring shall hold the seal faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton and cage and spring shall be stainless steel.
 5. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not be used to lubricate both the shaft seal and shaft bearings.

G. Bearings

1. Each pump shall be provided with anti-friction ball or tapered roller bearings, which are sized and properly designed to withstand all radial and thrust loads expected during normal operation.
2. Bearings shall be lubricated from a separate reservoir.
3. Provide oil level sight glass for visual indication of oil level in bearing cavity.
4. Minimum B-10 life for bearings shall be 100,000 hours at the maximum operating conditions.

2.03 ACCESSORIES

A. Gauges

1. Contractor shall furnish and install pressure gauges in suction and discharge piping for each pump. Pressure gauges shall comply with requirements specified in Section 11300.

B. Fabricated Steel Base

1. A steel base shall be provided for the pump and motor assembly. The base shall be comprised of a base plate, perimeter flange, and reinforcements. The base plate shall be fabricated of steel not less than 1/4-inch thick and shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. The base plate and/or flange shall be drilled for hardware used to secure unit base as shown on the contract drawings. The unit base shall contain provisions for lifting the complete pump unit during shipping and installation.
2. Bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel.

C. Pump Drain Kit

1. Each pump shall be fitted with a drain kit consisting of a stainless steel pipe nipple, stainless steel bushing, bronze ball valve and stainless steel quick connect male Kamlock fitting. The manufacturer shall provide for each pump, one (1) 10' length of plastic hose with a stainless steel quick connect female Kamlock fitting on one end of the hose.

D. Anti-Clog Bar Kit

1. Each pump shall be equipped with an anti-clog bar kit consisting of a substantial metal bar fastened securely to the pump cover and wear plates. The anti-clog bar kit shall help break up solids with a shearing action and reduce the potential for pump clogging. The kit shall not affect the pump's hydraulic performance and shall require minimal routine maintenance.

2.04 MOTORS AND DRIVES

- A. Drive motors for the pumps shall be provided by the equipment manufacturer designed for specific use with the process equipment being served. Motors shall be provided with operating characteristics as specified herein and shall be suitable for operation with PWM type variable frequency drives.

B. Motor Parameters – for PBB-RS-611, PBB-RS-612, and PBB-RS-613

a.	Motor Horsepower	15
b.	Motor Type:	Horizontal, Inverter Duty Rated
c.	Motor Speed (Nominal):	1950 RPM
d.	Motor Efficiency (Minimum):	89.5% guaranteed at full load
e.	Design:	NEMA Design B
f.	Duty:	Continuous
g.	Insulation:	Inverter Grade
h.	Voltage:	460V, 3 Phase, 60 Hz.
i.	Service Factor:	1.0 on Inverter Power, 1.15 on Sinewave Power
j.	Motor Enclosure:	TEFC, Cast Iron Construction
k.	Protection:	Normally Closed Integral Motor Winding Thermostats (minimum 1 per phase winding)

C. Motor Parameters – for PBB-WS-601 and PBB-WS-602:

a.	Motor Horsepower	5
b.	Motor Type:	Horizontal, Inverter Duty Rated
c.	Motor Speed (Nominal):	1950 RPM
d.	Motor Efficiency (Minimum):	89.5% guaranteed at full load
e.	Design:	NEMA Design B
f.	Duty:	Continuous
g.	Insulation:	Inverter Grade

- h. Voltage: 460V, 3 Phase, 60 Hz.
- i. Service Factor: 1.0 on Inverter Power, 1.15 on Sinewave Power
- j. Motor Enclosure: TEFC, Cast Iron Construction
- k. Protection: Normally Closed Integral Motor Winding Thermostats (minimum 1 per phase winding)

- D. Motors shall be capable of supplying the maximum rated horsepower and rpm at the conditions and within the ranges required per the equipment manufacturer. The motor shall be capable of withstanding all forces that may be imposed during the course of normal operation.
- E. Motors shall be of cast iron construction, fully guarded, self-ventilated with approved number of adequate size openings to provide ventilation throughout. Motors shall be provided with an oversized motor terminal box compared to NEMA requirements and engraved stainless steel nameplates. External paint shall be factory applied, corrosion resistant, mill and chemical duty paint. External screw and bolts shall be plated to resist corrosion.
- F. Thrust and radial bearings shall be fully regreasable, spherical, anti-friction type. Motors shall have extended grease fittings in the opposite drive end to facilitate re-lubrication. Ventilation fans shall be corrosion resistant, non-sparking material.
- G. V-Belt Drive Transmission
 - 1. Power shall be transmitted from motor to pump by means of a v-belt drive assembly. The drive assembly must be selected to establish proper pump speed to meet the specified operating conditions.
 - 2. Each drive assembly shall have a minimum of two (2) v-belts. In no case will a single belt drive be acceptable. Each v-belt drive assembly shall be selected on the basis that adequate power will be transmitted from driver to pump based on the data developed in accordance with drive calculations.
 - 3. Upon request of the Engineer, the pump manufacturer shall submit power transmission calculations with the following:
 - a. Ratio of pump speed as related to motor speed.
 - b. Pitch diameter of driver and driven sheaves.
 - c. Number of belts per drive assembly.

- d. Theoretical horsepower transmission per v-belt, based on performance data published by the v-belt drive manufacturer.
- e. Center distance between driver and driven shafts.
- f. Center distance and combined arc-length correction factor applied to theoretical horsepower transmission per v-belt.
- g. Service factor applied to established design horsepower.
- h. Safety factor that shall be calculated as the ratio of power transmitted per drive assembly to brake horsepower requirements of the pump.

H. V-Belt Drive Guards

1. Pump drive transmissions shall be enclosed on all sides in a guard constructed of any one or combination of materials consisting of expanded, perforated, or solid sheet metal, except that maximum perforated or expanded openings shall not exceed ½-inch.
2. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component and shall be securely fastened to the unit base.
3. All metal shall be free of burrs and sharp edges. Structural joints shall be continuously welded. Panels may be riveted to frames with not more than 5-inch spacing. Tack welds shall not exceed 4-inch spacing.
4. The guard shall be primed with a minimum of 1.5 mils of zinc-based synthetic primer. A finish acrylic enamel coating (minimum 1.5 mils) shall be applied in accordance with Section 3, Color Definitions, of ANSI 253.1:1967 - Safety Color Code for Marking Physical Hazards.
5. Fasteners: All nuts, bolts, and washers shall be cadmium or zinc plated steel.

I. Drive Assembly

1. Power shall be transmitted from the motor to the pump by a v-belt drive assembly.
 - a. Drive assembly must be selected to establish proper pump speed and proper power transmission to meet the specified operating conditions.
2. The drive assembly shall have a minimum of two v-belts.
3. The drive assembly shall have a minimum safety factor of 1.5.

- a. Computation of safety factors shall be provided by the manufacturer in the shop drawing submittal and shall be based on performance data published by the drive manufacturer.
- 4. Belt guards shall be furnished with the drive assembly.
 - a. Guards shall be manufactured to permit complete removal from the pump unit without interference with any unit component.
 - a. Guards shall meet or exceed the requirements of all applicable codes.

2.05 FABRICATION REQUIRMENTS

- A. The equipment shall be shop assembled and tested according to Sections 01300.
- B. Shop surface preparation shall be done using an iron phosphate cleaning system. A prime coat shall be applied in accordance with Section 09900, system M-2
- C. Field painting, and other pertinent detailed painting specifications shall be in accordance with Section 09900.
- D. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- E. Anchor bolts shall be Type 304 SS HILTI-style epoxy anchors.
- F. Grease fittings shall be hydraulic type Alemite #1600 Series or Lincoln.
- G. Backpaint metals in contact with concrete or masonry with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- H. Isolate dissimilar metals with dielectric using appropriate fasteners.
- I. Welds shall be continuous unless noted otherwise.
- J. 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.
- K. Nameplates shall be provided for each pump.
 - 1. Equipment nameplates of stainless steel shall be engraved or stamped and

fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.

2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.
- L. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Shop testing shall be conducted for all pumps prior to shipment to demonstrate that the pumps meet the Design Requirements specified herein.
1. At minimum, testing shall include:
 - a. Design point.
 - b. Secondary design point.
 - c. Design point with motor speed reduction at specified percentage (if applicable).
 - d. Shutoff head.
 2. Deviation of actual data from specified performance criteria shall not exceed +/- 3%.
 3. Develop pump curve for each pump type using at least 10 actual data points.
 4. Development at least 5 pump curves at different speeds for units specified to be operated with a VFD.
 5. Record motor amperage and brake horsepower and efficiency at each data point along the pump curve.

- B. Engineer shall be informed of any factory pump testing date a minimum of 14 days in advance.
- C. Results of factory testing shall be made available to the engineer for review prior to shipment of units.
- D. Include results of factory testing in the O&M Manual.

3.02 EQUIPMENT INSTALLATION

- A. Furnish and install the equipment according to the Contract Documents and the manufacturer's instructions.
- B. The Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.
- D. The Contractor shall repair finish on pump after installation is complete in accordance with Section 09900.
- E. The Contractor shall arrange for field alignment of all mechanically driven equipment shafting, drives, and/or couplings by an Owner approved company specializing in the particular equipment prior to operating the units. The Contractor shall present the Engineer with field alignment calculations and certification that all equipment is properly aligned per specifications and manufacturer's instructions.
 - 1. Field align existing mechanically driven equipment which has been moved or relocated by the Contractor during the Construction Contract regardless of whether the unit(s) had been properly aligned before moving.
 - 2. The machinery shaft alignment shall be preapproved by the Engineer.
 - 3. Tolerances:
 - a. A softfoot of 0.003 inches or less shall be considered acceptable.
 - b. Equipment shall be laser aligned to meet the following requirements:

	PARALLEL OFFSET	ANGULAR GAP	SPACER SHAFTS
RPM	(mils)	(mils/10")	(mils/in)
600	9.0	15.0	3.00
900	6.0	10.0	2.00
1200	4.0	8.0	1.50
1800	3.0	5.0	1.00
3600	1.5	3.0	0.50
7200	1.0	2.0	0.25

4. The Contractor shall be responsible for correcting any equipment that fails to comply.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. Start-up and initial operation shall be performed in accordance with Section 01650 and this specification section.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Adjust, repair, modify, or replace any components of the system that fail to meet all specified requirements.
- D. Field Performance Tests: The manufacturer's technical representative shall inspect the completed installation, instruct operating personnel in the proper operation and maintenance of the equipment and submit a written report, which includes the following:
 1. Gauge readings, total dynamic head, and operating speed for each pump.
 2. Nameplate information.
 3. Certification that equipment has been properly installed and lubricated and is in accurate alignment. Certify that V-belt drive was aligned using a laser alignment instrument.
 4. Certification that the equipment has been operated fully loaded and that it operated satisfactorily.

5. Results of electrical tests including voltage and amperage readings.
- E. A vibration test shall be performed on the pumps by an independent firm hired and paid for by the Contractor.
1. The equipment shall be subject to the specific displacement tolerances of EASA's (Electrical Apparatus Service Association, Inc.) General Machinery Vibration Severity Chart "good range."
 2. Test Description – vibration readings will be taken on each bearing in two radial directions 90 degrees apart and one axial direction per coupled shaft at the bearing adjacent to the coupling or v-belt drive.
 3. Both filtered and unfiltered readings will be taken.
 4. The Contractor must give Owner 7 days notice prior to requiring vibration testing. The Contractor is responsible for coordinating vibration testing of equipment with the Owner and the Engineer.
 5. Written certification from the Testing Service personnel should be received by the Contractor and the Engineer for each equipment item – certification form to be provided by the Contractor.
 6. Vibration testing shall be performed by a testing service preapproved by the Engineer.
 7. Align, shim, or provide additional support of equipment to meet the following vibration tolerances:

FREQUENCY BAND	ACCEPTABLE	NOT ACCEPTABLE
0 TO MAX (OVERALL)	≤ .25 IPS	> .25 IPS
SUB & 1XRPM	≤ .20 IPS	> .20 IPS
2XRPM	≤ .15 IPS	> .15 IPS
3-5XRPM	≤ .15 IPS	> .15 IPS
BEARING BAND 1	≤ .10 IPS	> .10 IPS
BEARING BAND 2	≤ .08 IPS	> .08 IPS
HIGH FREQUENCY BAND	≤ 2.0 G'S	> 2 G'S

Note: ips = inches per second
 g's = gravitational constant

8. The Contractor shall be responsible for correcting all equipment that fails to comply.

3.04 TRAINING

A. Operations and Maintenance Training

1. The manufacturer shall furnish the services of a qualified, factory trained operations and maintenance serviceman to instruct and train plant personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:
 - a. Theory of operation.
 - b. Actual operation.
 - c. Mechanical maintenance.
 - d. Optimization of the system.
 - e. Safe operating and working practices and operation of safety devices.
2. Training shall be completed after the mechanical check-out and dry start of the units. Time, location, and duration of all training sessions shall be coordinated with plant personnel.
3. Training sessions will be held at the project site on weekdays only selected by the County. All training shall be conducted between the hours of 8:00 a.m. and 4:00 p.m.
4. One (1) training session is required.
5. Hands-on training and demonstrations shall use the installed equipment.
6. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of a qualified manufacturer's field representative to inspect the equipment after installation, instruct plant personnel in its operation and maintenance and supervise its initial operation for a minimum of two 8 hour days.

- B. Provide jointly to the Owner and the Engineer an installation certificate from the equipment manufacturer or their approved representative stating that the equipment has been properly installed and tested to their satisfaction and that all final required adjustments have been made.

3.05 WARRANTY

- A. The equipment manufacturer shall guarantee for a period of three-years starting at the time of equipment delivery to the job site or one-year starting at the time of Substantial Completion (whichever is shorter) that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

END OF SECTION 11305

SECTION 11308

SUBMERSIBLE PUMPS

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SECTION 11308

SUBMERSIBLE PLANT WATER PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the pumps as specified herein and as shown on the Contract Drawings.

1.02 SHOP DRAWINGS

Shop drawings including dimensioned drawings, descriptive literature, capacity performance data, electrical characteristics and materials of construction shall be submitted for all items specified herein and as specified under section, SUBMITTALS.

1.03 EQUIPMENT DESIGN

Equipment design, workmanship, testing and operation shall be as specified herein and in sections, GENERAL MECHANICAL REQUIREMENTS and PUMPING EQUIPMENT (GENERAL).

1.04 MANUFACTURER'S INSPECTION AND START-UP

The Contractor shall furnish the services of the pump manufacturer's qualified field representative to supervise all initial start-up operations as required to determine satisfactory operation of each facility, as specified under section, SUBMITTALS.

1.05 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, as specified under section SUBMITTALS, certifying the pumps have been installed in a complete and satisfactory manner ready for operation.

1.06 QUALITY CONTROL

A. The Submersible Pumping Units shall conform to all applicable requirements of NEMA, IEEE, ASTM, ANSI and NEC. For purposes of this specification, the revision and/or version of the referenced standards in effect on the date of public bid opening shall apply.

- B. The Submersible Pumping Units specified shall be the products of reputable manufacturers who have been regularly engaged in the design, manufacture and furnishing of Pumping Equipment for at least ten (10) years. The manufacturer of the pump shall either manufacture the submersible motor or shall assume full responsibility for its compatibility with the application and shall warrant it as part of the integral Pump Unit. Manufacturers who do not manufacture the Submersible motor and who limit their warranty to that of the motor manufacturer shall not be acceptable. Additionally, the products of third party packagers, assemblers or distributors shall neither be considered equal, nor shall they be acceptable.

PART 2 - PRODUCTS

2.01 SUBMERSIBLE PUMPS

- A. The Contractor shall furnish and install submersible utility water pumps in the locations shown on the Contract Drawings and/or specified herein. The pump system including the pump, motor and power cable shall be approved for use in areas classified as “hazardous locations” in accordance with the NEC Class I, Division 1, Group C and D service as determined and approved by a U.S. nationally recognized testing laboratory (U.L., FM, CSA) at the time of the bidding of the project. Equipment specified herein is intended to be standard equipment for pumping raw sewage.
- B. The Submersible Pumping Units shall be self contained, equipped with close coupled pump motors designed to operate at continuous full load. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two parallel guide bars extending from the top of the station to the wet well mounted discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
- C. Power and pilot cable supports shall be provided and consist of a wire braid sleeve with attachment loops or tails to connection to the under side of the access frame. Each pump shall be provided with control and status monitoring unit along with motor winding temperature sensor and float leakage sensor for control and alarms condition. Pump shall be model NP 3069, as manufactured by Flygt or approved equal.

Plant Water Pumps

The pumps shall meet the following design criteria:

Design Point Capacity	105 gpm
Design Point Total Head	35 ft
Design Point Efficiency (min)	39
Design Point NPSHR (max)	8.6 feet
Shutoff Head (min.)	54 feet
Discharge Size (min)	2 inches
Motor Horsepower (max)	2
Pump/Motor Speed (max)	2700 rpm
Solids Passage (min)	2 inches diameter

D. Pump Construction

1. Pump Casing

- a. Major pump components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities. All exposed nuts or bolts shall be AISI type 304 stainless steel. All metal surfaces coming into contact with the pumped media, other than stainless steel, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
- b. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Pump/Motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Joint sealing will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific bolt torque limit.

2. Pump Impeller

- a. The impeller shall be of a multi-vaned, double shrouded, non-clogging design and shall have large passages to provide smooth flow transition and unimpeded passage of large spherical solids. Impellers shall be statically and dynamically balanced to provide vibration-free operation. The pump manufacturer shall assume full responsibility for the operation of the pumping unit within the vibration

limits set forth in the Hydraulic Institute Standards for this class of pumping equipment.

- b. The impeller shall be constructed of ASTM A-48, Class 35B close grained cast iron and shall be securely fastened to the shaft with a stainless steel key and impeller locknut, or heavy capscrew.

3. Wearing Rings

A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller. Each pump shall be equipped with a brass, or nitrile rubber coated steel ring insert that is drive fitted to the volute inlet. This pump shall also have a stainless steel impeller wear ring heat-shrink fitted onto the suction inlet of the impeller.

4. Pump / Motor Shaft

Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be C1035 Carbon Steel and shall be completely isolated from the pumped liquid.

5. Bearings

The pump/motor bearings shall be specifically selected to carry all radial and axial loads imposed by the pump and motor. All bearings shall have a Class 3 internal fit conforming to AFBMA Standard 20. Bearings shall be rated to provide a minimum L10 Bearing Life of 100,000 hours at any design operating point within plus or minus 40 percent of the best efficiency point (BEP) of the pump performance curve. Bearing selection shall limit the bearing temperature rise to a maximum of 60 degrees C under full load operation.

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single roller bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings shall not be acceptable. All bearings shall be commercially available from third party sources other than the pump/motor manufacturer.

6. Hardware and Nameplates

All external hardware including nameplates on the Pump/ Motor shall be 316 stainless steel.

E. Pump Hoisting

Each pump shall be provided with a chain sling assembly and grip eye combinations for a minimum useful load of 500 lbs. The assembly shall include a length of high tensile strength chain attached to the pump lifting-bale with retaining cable. The forged Steel Grip Eye shall be attached to the hoist lifting hook. The retaining cable shall be stainless steel braid with retaining hook at hatch level. The retaining cable shall be furnished with locking ring hardware to store securely at retaining hook. The Pump Hoisting Assembly shall be furnished by ITT Flygt Pump Company.

2.02 SUBMERSIBLE NON-CLOG PUMP MOTOR CRITERIA

A. General

1. Each unit shall be provided with an adequately designed cooling system. The water jacket shall encircle the stator housing; thus, providing heat dissipation for the motor regardless of the type of installation. Impeller back vanes shall provide the necessary circulation of the cooling liquid through the water jacket. The cooling media channels and ports shall be non-clogging by virtue of their dimensions. Provisions for external cooling and seal flushing shall also be provided. The cooling system shall provide for continuous pump operation in liquid temperature of up to 104 degrees F. Restrictions below this temperature are not acceptable.

2. Motor Nameplate Data: This shall be submitted in accordance with the NEMA Standard MG1-1978, paragraph MG1-20.60 and shall include the following:

- a. Manufacturer's name, machine serial number, etc.
- b. Horsepower
- c. Time Rating
- d. Temperature Rise
- e. Speed at Rated Load
- f. Voltage, Frequency, Phases
- g. Full Load Current
- h. Code Letter

3. Predicted Performance Data Shall be Submitted:

- a. Locked rotor, pull up and breakdown torques
- b. Efficiency at 1/2, 3/4 and full load
- c. Power factor at 1/2, 3/4 and full load

B. Motor Construction

1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant Class F insulation rated for 155 deg. C (311 deg. F). The stator shall be dipped and baked three times in Class F varnish and shall be heat shrink fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous handling of pumped media at 40 deg. C (104 deg. F) and capable of up to 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125 deg. C (260 deg. F) the thermal switches shall open, stop the motor and activate an alarm. A leakage sensor shall be available to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a capacitance or resistance type sensor used to detect the presence of water in the stator chamber. When activated, the FLS shall send a trouble alarm. Use of voltage sensitive solid state sensors and trip temperature above 125 deg. C (260 deg. F) shall not be allowed.
2. The thermal switches and FLS shall be connected to a MiniCAS (Control and Status) monitoring unit. The MiniCAS shall be designed to be mounted where shown on the Contract Drawings. The MiniCAS shall be capable of monitoring the thermal switches embedded in the stator end coils, the FLS (float switch type) water-in-stator housing sensor. The MiniCAS shall monitor both the series connected thermal switches and leakage sensor(s) by outputting 12 VDC on a single two wire circuit. When FLS leakage sensors are specified they shall be connected in parallel with each other and then in series with the thermal switches.
3. The MiniCAS circuitry shall operate on the current sensing principle whereby a change in temperature or leakage condition shall change the resistance of the associated sensor and thus alter the current in the sensing circuit. The MiniCAS shall contain two sets of form C dry contacts, one for overtemperature and one for leakage. The dry contacts shall change status upon occurrence of an overtemperature or leakage condition so as to indicate that

condition to other control components in the pump control panel. In the case of an overtemperature, and in keeping with ITT Flygt's warranty policy, the overtemperature dry contacts shall be used to trip the pump off line. The MiniCas shall be designed to be plugged into a standard 11-pin circular socket and shall be powered by a 24 VAC supply. Detailed technical data and wiring connections shall be found in the MinCAS Manual.

4. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer o-ring seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Wire nuts or crimping type connection devices are not acceptable. The motor and pump shall be designed and assembled by the same manufacturer.
5. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40 deg. C (104 deg. F) ambient and with a temperature rise not to exceed 80 deg. C. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
6. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the control enclosure junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chloroprene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
7. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
8. Shaft Sealing
 - a. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating tungsten-

carbide ring. The upper, secondary seal unit, located between and the lubricant chamber and the motor housing, shall contain one stationary tungsten-carbide seal ring and one positively driven rotating tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing.

- b. The following seal types shall not be considered acceptable “or equal” to the dual independent seal specified: shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. Cartridge type systems will not be acceptable. No system requiring a pressure differential to offset pressure and to affect sealing shall be used.
 - c. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.
 - c. Seal lubricant shall be FDA approved, non-toxic.
9. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a terminal board, which shall isolate the interior from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable. The cable shall be fitted with a gas/vaportight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, separate grounding conductors, and termination fittings, as specified in National Electrical Code.

- C. Testing: Tests shall be performed on the motor as follows:
1. Routine tests at the factory: Routine tests shall be conducted as specified in NEMA Standard No. MG1-12.51-1987 and certified test reports furnished per IEEE Standard 112, Form A-1.
 2. Complete initial heat run tests shall be conducted in accordance with NEMA and IEEE Standard 112, Test Standards. Certified test reports shall be submitted and shall be based on IEEE Standard 112, Form A-2.
 3. Certificates and Data: A certificate for the motor shall be provided by the manufacturer in accordance with the paragraph entitled, SUBMISSION OF MANUFACTURER'S CERTIFICATES in the section entitled, SUBMITTALS. All test and adjustment data shall be recorded and submitted in accordance with subparagraph herein entitled, TESTING.
- D. Electrical Ratings
1. The submersible motor shall be NEMA Design B, squirrel cage induction.
 2. The nameplate ratings of the motor shall be based on 40 degrees C ambient environment. All motors shall be furnished and certified per IEEE 117 with Class F rated insulation materials or better. All motors not having IEEE 117 certified insulation systems shall be considered not acceptable. Insulation materials rated lower than Class F (i.e. Class B or A) are specifically prohibited.

2.03 CONTROLS

The pumps shall be controlled as specified DIVISION 17 and as shown on the Contract Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

Install the pumps and appurtenances in accordance with the manufacturer's recommendations.

3.02 CERTIFIED DRAWINGS AND PUMP TESTS FOR PLANT WATER PUMPS

Certified drawings and pump tests of each unit furnished shall be provided. The pumps shall be tested in accordance with the standards of Hydraulic Institute. The pumps shall be fully tested at the manufacturer's plant before shipment. Tests shall consist of instantaneous readings of head, capacity, efficiency and brake horsepower, at such conditions of head and capacity to properly establish the performance curve. Flow measurements shall be made with a venturi meter. Certified copies of test reports shall be submitted to the Engineer. The standards of the Hydraulic Institute shall govern all procedures and calculations for these tests. Proof of meter set-up and reports shall be submitted to the Engineer. The performance curve sheets are to include "Pump Efficiency", "Brake Horsepower" and "Net Positive Suction Head Required".

3.03 FACTORY PERFORMANCE TESTS

- A. The pumps shall be tested at their place of manufacture to obtain all curves and NPSH points as specified hereinbefore and as approved by the Engineer. Test results recorded and sealed by a professional engineer who may be an employee of the pump manufacturer.
- B. The Contractor shall furnish six (6) certified prints of each test performance curve and all test data.

3.04 PUMP FIELD TESTS

- A. When the pumps and electrical controls and all related piping have been installed, the Contractor shall conduct a field test of the pumping units in the presence of the Engineer. The tests need not repeat performance tests previously done in the shop, but shall be sufficiently complete to demonstrate that the pump units are operating in a satisfactory manner within acceptable vibration limits, in accordance with the requirements of these specifications and in such a manner to make possible the issuance of the "Manufacturer's Certificate" described in section, GENERAL MECHANICAL REQUIREMENTS.
- B. The sewage pumping units shall meet the hydraulic and field vibration requirements and limits of the "Standards of the Hydraulic Institute", latest edition.

3.05 PAINTING

All exposed metal parts of the submersible pump / motor unit shall be cleaned, primed and finished with the manufacturers standard paint system. All field touch-up painting shall be in accordance with specification section, HIGH PERFORMANCE COATINGS.

END OF SECTION

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SECTION 11309

SCUM PUMPS

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SECTION 11309 SCUM PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish, install, and test, two (2) non-clog, submersible scum pumps (SPS-SPC-501, 502), complete with motors and all necessary accessories, in compliance with these specifications and as shown on the Drawings.
- B. Pump manufacturer shall be responsible for supplying the submersible chopper pumps with motors, guiderail brackets, discharge base elbow and lifting cable. Contractor shall be responsible for coordination and supply of all additional items specified.
- C. A davit crane shall be furnished by the Contractor for raising and lowering the pumps for servicing as shown on Drawing M03.01.
- D. Unless otherwise noted, controls for equipment specified in this section shall be furnished by the control systems integrator and shall be in full compliance with Divisions 16 and 17 specifications. Coordination between the supplier of the pump control panel and the pump manufacturer shall be the responsibility of the Contractor.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.
 - 1. Section 01300 – SUBMITTALS
 - 2. Section 01660 – STARTUP OF SYSTEMS
 - 3. Section 09900 – PAINTING
 - 4. Section 15000 – GENERAL MECHANICAL REQUIREMENTS
- B. All electrical equipment and wiring shall be in full compliance with Division 16 and 17, Electrical Specifications.

1.03 REFERENCES

- A. Standards of the Hydraulic Institute, latest edition.

- B. AFBMA Std. 11 – Load and Fatigue Life of Roller Bearings.
- C. ASTM A36 - Structural Steel, Carbon Steel.
- D. ASTM A48-83 - Gray Iron Castings.
- E. ASTM A276-83 - Standard Specifications for Stainless Steel and Heat Resisting Steel Bars and Shapes.
- F. ASTM A322-82 - Steel Bars, Alloy Standard.
- G. NEMA MG1-78 - Motors and Generators.
- H. UL 1004 - Motors, Electrical.
- I. ANSI - American National Standards Institute.
- J. NEC - National Electric Code.

1.04 PERFORMANCE REQUIREMENTS

- A. The submersible chopper pumps shall be capable of continuous operation while pumping scum containing hair, and fibrous materials.
- B. The integral pump/motor shall not require external cooling with heat transfer accomplished by convection through the stator wall to the surrounding liquid. Designs requiring cooling jackets shall not be acceptable.
- C. The materials shall be chopped/macerated and conditioned by the pumps as an integral part of the pumping action. The pump must be capable of chopping and pumping high concentrations of solids such as plastics, hair balls, paper products and stringy materials without plugging, both in tests and field applications.
- D. The pumping system shall have a recirculation nozzle, which shall be used to mix up the contents of the wet well. The recirculation nozzle shall be operated by an automatic valve supplied by the pump manufacturer and bolted to the pump. The valve shall be actuated by using the hydraulics of the pump.
- E. Submersible chopper pumps shall conform to the following:
 - 1. Number of Units - 2
 - 2. Service - Intermittent
 - 3. Drive - Constant Speed
 - 4. Capacity at Design Point (gpm) - 150
 - 5. Pump Head (TDH) at Design Capacity (ft) - 25
 - 6. Minimum Pump Efficiency at Design - 50%

	Point		
7.	Minimum Shutoff Head (ft)	-	37
8.	Minimum Pump Capacity (gpm)	-	50
9.	Maximum Pump Capacity (gpm)	-	350
10.	Pump Head (TDH) at Maximum Pump Capacity (ft)	-	7
11.	Liquid to be Pumped	-	Scum
12.	Maximum Pump Speed (rpm)	-	1705
13.	Maximum Motor Size (hp)	-	3
14.	Power Supply	-	480 V
15.	Discharge Flange Size (in)	-	4
16.	Flange Rating (psi)	-	150

1.05 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 and as specified herein. Submittals shall include as a minimum:
1. Complete fabrication, assembly and installation drawings, together with detailed specifications and data covering material used, parts, devices, and other accessories forming a part of the pumping unit.
 2. Prior to startup, the Contractor shall submit manufacturer's operation and maintenance manuals and recommended spare parts list for the pump.
 3. Manufacturer's certificate, including installation certificate for all equipment furnished under this section.
 4. Submit catalog cut for davit crane.
 5. Shop drawings shall present complete and accurate information relative to all working dimensions, equipment weights, assembly, and section views, and all necessary details pertaining to coordinating the work of the contract. Shop drawings shall contain information such as special tools and other items of information that are required to demonstrate detailed compliance with the Contract Documents.
 6. Where deviations from the contract specifications and drawings are proposed, a list of these deviations shall be furnished with the submittal with reference to either the specification section or drawing.
 7. Pump-Specific Submittals

- a. Pump manufacturer, type, model, size, weight, dimensions, speed, size of discharge nozzle, and type of bearings.
- b. Motor manufacturer data shall include type, model, type of bearings and lubrication, weight, rating size of motor, temperature rating, service factor, efficiency at full load and pump design points, full load current, and locked rotor current.
- c. Certified pump performance curve showing the shutoff head, minimum safe operating capacity, head, capacity, maximum pump capacity, efficiency, and brake horsepower for the specified speed. The design total dynamic head at the specified capacity shall clearly be indicated on the curve. The pump curve shall include a minimum of five operating points including shutoff head, run out condition, design operating point and two additional points in order to clearly define the pump curve.
- d. Written certification that the motors are explosion proof suitable for a Class 1, Division 1 Groups C and D atmosphere.
- e. Manufacturer's equipment warranty.

1.06 SPARE PARTS

- A. Provide the manufacturer recommended spare parts in addition to the ones listed below. The spare parts shall be provided in clearly identified containers for each pump model:
 1. One (1) Mechanical Seal
 2. One (1) Cutter Bar
 3. One (1) impeller
 4. One (1) set of bearings

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The scum pumps for shall be model NS3085.092 as manufactured by Flygt Corporation, or equal.
- B. In the case of an "or-equal", the Contractor shall demonstrate in writing, to the satisfaction of the Owner at the time of the shop drawing submittal that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the bid date.

2.02 EQUIPMENT DESIGN

A. General

1. The pumps shall be of the wet pit mounted, submersible, nonclogging, centrifugal sewage pumps with vertical mounted direct-connected motor, bottom inlet, and side discharge.
2. All major components of the pumping unit (i.e. discharge elbow, impeller volute casing, stator housing, etc) shall be manufactured from grey cast iron, ASTM A-48, Class 35B.
3. All metal surfaces coming in contact with the pumpage, except stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish.

B. Pump Volute Casings

1. Casing shall be constructed of close-grained cast iron, ASTM A48 Class 35B and shall be designed to withstand hydrostatic heads equal to 1-1/2 times the maximum shutoff head without leakage or undue distortion or deflection.
2. The discharge connections shall be flat faced and drilled to American Standard flange dimension, Class 125.

C. Impeller

1. Type N impeller
 - a. Impeller shall be grey cast iron, Class 35B, non-clog design.
 - b. The impeller vanes shall have screw-shaped leading edges that are hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water.
 - c. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located in the volute suction, which shall keep them clear of debris, maintaining an unobstructed leading edge.

- d. The impeller hub shall be keyed to the pump shaft and secured by a impeller bolt, threaded with a corrosion inhibitor, and shall be easily removed for installation of impeller without the use of special tools.

D. Pump Shaft

1. The shaft shall be constructed of stainless steel, AISI type 431.
2. The pump shaft is an extension of the motor shaft; couplings shall not be acceptable.

E. Mechanical Seals

1. The mechanical seals shall have independent, tandem, double mechanical pressure compensating seals, running in an oil reservoir; seals shall be composed of one stationary and one positively driven rotating, tungsten carbide lapped face rings.
2. The lower compression spring shall be protected against exposure to the pumped liquid.
3. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.
4. Seal lubricant shall be FDA approved, nontoxic.

F. Bearings

1. Each pump shall rotate two radial bearings.
2. Bearings shall be independent of the casings. Upper bearings shall be single deep groove ball bearing. Lower bearing shall be angular contact bearing.
3. Bearings shall be sized to carry the loads imposed under continuous service without undue heating.
4. Motor bearings shall be permanently grease lubricated.
5. Minimum B-10 life for bearings shall be 50,000 hours at the maximum operating conditions.

G. Discharge Elbow

1. The pump design shall be such that the pump will be automatically connected to the discharge piping by a simple single linear downward motion of the pump, pressing tightly against the discharge connection.
2. The entire weight of the pump shall be guided by into place with no less than two non-load supporting guide rails with no weight of the pump bearing directly on the tank floor.

2.03 ACCESSORIES

A. Power Cable

1. Power cable, moisture detection sensor cable and motor thermal overload sensor cable shall be attached together and protected by common protective sheath. If separate instrumentation cables are required, these shall be shielded.
2. The cable shall be fitted with a stainless steel split-lace kellum which shall be secured to the upper guide holder assembly and pulled tight. The kellum shall safeguard the power cable from abrasion and/or piercing objects in the fluid.
3. Each pump shall be provided with sufficient length of electric cable with the number and size conductors as required for the motor power leads and thermal switches to reach the junction box or manufacturer's control panel. Engineer will verify required length during shop drawing review.
4. Cable entry shall be watertight, with strain relief at the junction chamber, strain relief and water sealing shall function separately.

B. Moisture Detection - The unit shall be supplied with a leakage sensor for the detection of water in the oil casing. Detection of moisture in the oil shall require an inspection of the oil, but not an immediate shut down of the pump

C. Pump Mount Assembly

1. Pump mounting accessories shall be made of 304 stainless steel and include a safety hook assembly, upper guide bar bracket, intermediate guide bar brackets (where required-10 ft. maximum spacing), and lifting cable.

2. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the walkway to the discharge connection.
3. The pump manufacturer shall furnish all necessary Guide Bar Brackets, while the contractor shall furnish all guide bars per the pump manufacturer's requirements.
4. The pump shall be easily removable, requiring no personnel to enter the tank to remove bolts, nuts or fastenings. Pumps shall be able to be lifted from the tank without personnel entering or dewatering the wet well.

D. Mix Flush Valve

1. Each pump shall be provided with a recirculation valve designed to vigorously mix the contents of the scum wet well for an adjustable period of 20-50 seconds after the pump is started.
2. The valve shall be attached to the volute.
3. The valve shall not require any electrical components or cables.
4. Valve shall be Flygt Mix-Flush Model 4901 or equal.

E. Davit Crane

1. Davit crane and equipment shall be as manufactured by Halliday Products or equal.
2. Crane shall be self-supporting unit of tubular construction with a pedestal base. Unit shall be stainless steel construction using stainless steel fasteners and accessories.
3. Crane shall provide 360-degree rotation with a sleeve bearing in the base.
4. Crane boom shall be adjustable with a telescoping boom and a height adjustment with ratchet-style screw jack.
5. Provide manual stainless steel winch attached to crane for load raising and lowering.

6. The cable shall be flexible, high-strength, 304 stainless steel wire rope, and have a load safety factor of at least 5 to 1. Cable shall be of adequate length to reach lower level floor.
7. The load block shall be of rugged construction containing a stainless steel swivel hook with anti-friction bearings.

2.04 MOTORS AND DRIVES

- A. Motors – Motors shall be in full compliance with Section 15000, except for motor efficiency requirement.

	Motor Parameters	SPS2-SCP-101, SPS2-SCP-102
1.	Motor Horsepower	3.0 Hp
2.	Motor Type	Explosion proof, squirrel cage, induction, shell-type
3.	Motor Speed (Nominal)	1705 rpm
4.	Motor Efficiency	77.5%
5.	Design	NEMA Design B
6.	Duty	Variable Frequency
7.	Insulation	Class H
8.	Voltage	460V, 3 Phase, 60 Hz.
9.	Service Factor	1.15
10.	Motor Enclosure	Stainless Steel ASTM 48, Class 40 or Class 35B
11.	Protection	Integral Motor Winding Thermostats (minimum 1 per phase winding), Seal fail sensor
12.	Starts per hour	10 evenly spaced

- B. Motor shall be explosion proof.
- C. The pump motor shall be housed in an air-filled, watertight chamber.
1. The stator winding shall be insulated with moisture resistant Class H insulation which will resist a temperature of 180°C
 2. The rotor bars and short circuit rings shall be made of aluminum.
 3. The stator housing shall be equipped with a moisture detection device wired to the interface relay located in the control panel.
- D. Thermal sensors shall be used to monitor stator temperatures.
1. The stator shall be equipped with three thermal switches embedded in the end coils of the stator winding.

2. These shall be used in conjunction with, and supplemental to, external motor overprotection and wired to the control panel.

2.05 CONTROLS

- A. Unless otherwise noted, controls for equipment specified in this section shall be furnished by the control systems integrator and shall be in full compliance with Divisions 16 and 17.

2.06 FABRICATION REQUIREMENTS

- A. Surface preparation, shop painting and field painting and other pertinent detailed painting specifications shall be in accordance with Section 09900.
- B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- C. Anchor bolts shall be Type 304 SS HILTI-style epoxy anchors.
- D. Backpaint metals in contact with concrete or masonry with 5 mils of Themec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- E. Isolate dissimilar metals with dielectric using appropriate fasteners.
- F. Welds shall be continuous unless noted otherwise.
- G. 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.
- H. Nameplates shall be provided in accordance with Section 15000.
 1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
 2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.
- I. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

PART 3 -EXECUTION

3.01 SHOP TESTING

- A. Shop testing shall be conducted for each submersible pump prior to shipment to demonstrate that the pumps meet the Design Requirements specified herein. Shop tests shall be in accordance with Sections 01650,11300 and this section.
 - 1. At minimum, testing shall include:
 - a. Design point.
 - b. Secondary design point (if applicable).
 - c. Design point with motor speed reduction at specified percentage (if applicable).
 - d. Shutoff head.
 - 2. Deviation of actual data from specified performance criteria shall not exceed +/- 3%.
 - 3. Develop pump curve for each pump type using at least 10 actual data points.
 - 4. Development of at least 5 pump curves at different speeds for units specified to be operated with a VFD.
 - 5. Record motor amperage and brake horsepower and efficiency at each data point at the pump curve.
- B. Engineer shall be informed of factory pump testing date a minimum of 14 days in advance.
- C. Results of factory testing shall be made available to the engineer for review prior to shipment of units.
- D. Include results of factory testing in the O&M Manual.

3.02 EQUIPMENT INSTALLATION

- A. Furnish and install the equipment according to the Contract Documents and the manufacturer's instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. Start-up and initial operation shall be performed in accordance with Section 01650 and this specification section.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Final acceptance of the equipment will be made after each submersible pump has been demonstrated in the field to meet the following:
 - 1. The equipment can meet the performance requirements stated in this specification under all normal operating conditions and verification that the motors are not overloaded in normal operating conditions.
 - 2. The pump casing, motor, and base plate shall be checked for abnormal noise and vibration while the pump is running throughout the normal range of motor speeds. Abnormal noise or excessive vibration will constitute failure of pump.
 - 3. The mix flush valve is in proper working condition as specified by the manufacturer.
- D. Adjust, repair, modify, or replace any components of the system, which fail to meet all specified requirements.

3.04 TRAINING

- A. Operations and Maintenance Training
 - 1. The manufacturer shall furnish the services of a qualified, factory trained operations and maintenance serviceman to instruct and train plant personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:
 - a. Theory of operation.
 - b. Actual operation.
 - c. Mechanical maintenance.
 - d. Optimization of the system.
 - e. Safe operating and working practices and operation of safety devices.
 - 3. Training shall be completed after the mechanical check-out and dry start of the units. Time, location, and duration of all training sessions shall be coordinated with plant personnel.
 - 4. Training sessions will be held at the project site on weekdays only

selected by the County. All training shall be conducted between the hours of 8:00 a.m. and 4:00 p.m.

5. One (1) training session is required.
6. Hands-on training and demonstrations shall use the installed equipment.
7. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Provide services of the equipment manufacturer or their approved representative in accordance with Sections 01300 and 01650.
- B. Provide jointly to the Owner and the Engineer an installation certificate from the equipment manufacturer or their approved representative stating that the equipment has been properly installed and tested to their satisfaction and that all final adjustments required have been made.

3.06 EQUIPMENT WARRANTY

- A. The equipment manufacturer shall guarantee for a period of three-years starting at the time of equipment delivery to the job site or one-year starting at the time of Substantial Completion (whichever is shorter) that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

END OF SECTION 11309

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SECTION 11313

VERTICAL PROPELLER PUMPS

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SECTION 11313

VERTICAL PROPELLER PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes the requirements for the labor, materials, equipment and services necessary for the furnishing and installing of vertical propeller pumps.

1.02 QUALITY ASSURANCE

- A. The intent of these specifications is that all equipment shall be furnished by a single manufacturer qualified and experienced in the production of similar equipment. The manufacturer shall with the Contractor, assume the responsibility for proper installation and function of the equipment.
- B. The manufacturer shall have a minimum of 10 years of experience and shall provide evidence of previous performance by submitting an installation list with a minimum of 10 similar installations to the Engineer.
- C. The specified equipment shall be in accordance with SECTION 15000, GENERAL MECHANICAL REQUIREMENTS.

1.03 SUBMITTALS

- A. Shop drawings including dimensioned drawings, descriptive literature, capacity performance data, electrical characteristics and materials of construction shall be submitted for all items specified herein as specified under SECTION 01300, SUBMITTALS. Performance curves of the pumps shall be submitted showing head versus capacity, pump efficiency versus capacity, brake horsepower versus capacity, and submergence and NPSHR versus capacity over the operating ranges of the pump from shut off head to run-out point. Curves shall include velocity head, column and discharge head losses for full speed and minimum speed conditions described herein and as shown on the Contract Drawings.
- B. Operating and Maintenance manual shall be provided in accordance with Specification SECTION 01300, SUBMITTALS.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. The equipment shall be delivered to the site ready for installation; the packaging shall be of quality and strength to prevent damage or deformation during shipping, and to maintain the integrity of the equipment during storage.
- B. The equipment shall be handled in a manner to prevent damage such as buckling or distortion of frames, marring of surfaces or any other damage to the units, electrical system, controls, etc.
- C. All damaged items shall be replaced by the Contractor at no expense to the Owner.

1.05 MANUFACTURERS' INSPECTION AND START-UP

The Contractor shall furnish the services of the vertical propeller pump manufacturer's qualified field representative to inspect the equipment after installation, instruct plant personnel in its operation and maintenance, and supervise its initial operation for a minimum of two 8 hour days as specified under Section, SUBMITTALS.

1.06 MANUFACTURERS' CERTIFICATE

The manufacturer shall submit certification that the vertical propeller pumps and accessory materials supplied under this contract comply in full with all specifications directly and indirectly addressing the vertical propeller pumps installation. The certification shall have support documentation which specifically addresses the electrical, hydraulic, mechanical, and general considerations specified herein. Written certification shall be provided after startup, by the manufacturer stating that the vertical propeller pumps and accessory equipment have been correctly installed and are in good operating condition.

1.07 GUARANTEE

- A. The complete vertical propeller pumps, including all accessories, shall be guaranteed against defects in design, materials, and workmanship for a period of one year from the date of acceptable operation, as determined by the Engineer and Owner.
- B. A factory technician supplied by the manufacturer shall assist in the adjusting and testing of the vertical propeller pumps and accessory equipment. This certification shall be provided prior to the performance test specified hereinafter.

PART 2 - PRODUCTS

2.01 MANUFACTURER

The vertical propeller pumps shall be as described herein and as shown on the Contract Drawings. The vertical propeller pumps shall be the #12AF Axial Flow Pumps series as manufactured by Cascade, or equal.

2.02 DESIGN CRITERIA

A. The vertical propeller pumps shall be designed to meet the following criteria:

Location	Chlorine Contact Tank
Design Point Total Capacity	3,860 gpm
Design Point Total Head (TDH)	12 ft
Design Point Efficiency (min)	75%
Design Point NPSHR (max)	3 ft
Supplementary Point Capacity	1,500 gpm
Supplementary Point Total Head (TDH)	9.5 gpm
Supplementary Point Efficiency (min)	60%
Supplementary Point NPSHR (max)	2 ft
Shutoff Head (min.)	15.2 ft
Discharge Size (min)	14 in
Motor Horsepower (max)	20 hp
Pump/Motor Speed (max)	1175 rpm
Minimum Submergence Above Suction Bell	2.5 ft
Depth, Finished Floor To Bottom of Well	17.00 ft

[Note: capacities and heads shown are total values, not bowl values]

B. See Division 17 of the specifications, for controls and instrumentation.

2.03 VERTICAL PROPELLER PUMPS

A. The vertical propeller pumps shall be the vertical, open line shaft, multi-stage type with below the floor discharge. The pumps shall be of the vertical

submerged axial flow propeller/mixed flow type and to be suspended from a mounting baseplate. The pumping element shall be suspended on a sufficient length of column to permit dewatering the sump to elevation.

- B. The discharge connection shall be plain end suitable for a flexible pipe coupling/flanged with an ASA rating of A53 Grade B pipe, and shall have a minimum thickness of 0.375-inches. The suction inlet shall be flared to resist the formation of damaging vortices. The complete unit when operating within the specified head range shall be free of excessive vibration, cavitation and noise. The design of component parts shall be flanged on each end with a register machined on centers to assure positive alignment when connected to mating parts. The pump driver shall incorporate a thrust bearing capable of withstanding the hydraulic thrust produced by the pump when operating at any condition in the specified head range of the pump. Design shall be such that no damage will occur in the event of reverse rotation caused by backflow of water through the pump.
- C. The suction and discharge bowls shall be of cast iron with a minimum tensile strength of 30,000 psi. The propeller shall be cast bronze and locked to the bowl shaft by a key and thrust collar. The bowl shaft shall be made from type 416 stainless steel and polished at each bearing journal. The size of the shaft shall be sufficient to safely transmit the required brake horsepower to the impeller for producing the specified performance. Bronze bushings shall be provided immediately above and below the impeller/propeller.
- D. The elbow and column shall be of fabricated mild steel with a minimum thickness of 1/4". The elbow shall be 45 degree insert vaned type. The lower section may be tapered for connection to the discharge bowl. The lineshaft shall be made from carbon steel and supported by bearings. The lineshaft bearings shall be threaded externally to act as a coupling for extra heavy steel enclosing tubes. The lineshaft bearings shall be bronze of the removable type and must be provided with a means of passing oil from one bearing to the next. A means shall be provided for tension loading of the enclosing tube.
- E. The lineshaft bearings shall be lubricated by a drip-feed oil system utilizing an oil reservoir and needle valve dripper. The suction bowl bushing shall be grease packed.

2.04 PUMP MOTOR

Motors shall be TEFC of NEMA design, Premium Efficiency, inverter duty, vertical solid shaft, squirrel cage, induction type with a non-reversing ratchet. The motor shall

be suitable for operation through a 480 volt, 3-Phase service as shown on the Contract Drawings. Bearings shall be designed and constructed for an AGMA B-10 life of not less than 100,000 operating hours. The upper thrust bearing shall be of an anti-friction type as standard with the motor manufacturer and shall be adequately sized to carry the weight of all the rotating parts, withstand the thrusts by the pump and have an ample safety factor. Guide bearings shall be standard with the manufacturer. Bearings shall be of the oil lubricated type to suit the manufacturer's standard method of lubrication.

2.05 SPARE PARTS

The pump manufacturer shall furnish the following spare parts for each pump:

- One (1) set of Bowl Bushings/Bearings
- One (1) Line Shaft Bearing
- One (1) Bowl Shaft

PART 3 - EXECUTION

3.01 SHOP CERTIFIED TEST

- A. Certified shop tests shall be conducted on the pumping units at the manufacturer's facility. Tests shall be certified, and results shall be submitted to the Engineer for final approval of the unit before shipping and installation.
- B. Certified pump test shall demonstrate performance of the pump at the specified maximum speed and minimum speed. Test shall include flow characteristics, horsepower requirements, efficiency and NPSHR over the capacity range from maximum motor horsepower to the design points. The pump shall be tested with motor to be furnished in the field. The manufacturer's standard test motor shall not be used. Test results shall be submitted to the Engineer and shall include tabulated data and results plotted as head vs. capacity, pump efficiency vs. capacity and brake horsepower vs. capacity. Approval of these results shall be precedent to shipment of pump.
- C. Should the pump fail to meet the specified requirements, the manufacturer shall make all necessary modifications to the unit and shall conduct all additional shop certified tests, to show full compliance at no cost to the owner. The manufacturer shall note that any modification and additional testing which may be required shall be performed as expeditiously as possible to avoid exceeding the total contract time.

3.02 FIELD TESTING OF PUMPING UNITS

After the pump, motor, and electrical controls and all related piping have been installed by others, the manufacturer's representative shall conduct a field test of each pumping unit in the presence of, and as directed by, the Engineer. Field tests of head versus capacity shall be made at a minimum of three different points at the specified speed. Field tests to determine the amplitude of vibration shall be taken at maximum, intermediate, and minimum speeds. Measured vibration shall be within limits indicated in Hydraulic Institute Standards. All field testing shall be sufficiently complete to demonstrate that the pumping unit is operating in a satisfactory manner, in accordance with the requirements of these specifications and in such a manner to make possible the issuance of the "Manufacturer's Certificate" described under Section, SUBMITTALS.

3.03 PAINTING

The pumps shall be finished as follows:

- A. The inside and outside of the pumps columns, and the outside of the suction bell and pump bowls shall be shop primed and factory painted. Surface preparation shall be in accordance with the recommendations of the paint manufacturer.
- B. The exterior of the pumps and motors above the floor shall be shop primed and factory finished with two coats of enamel.

END OF SECTION 11313

SECTION 11320
GRIT REMOVAL SYSTEM
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SECTION 11320

GRIT REMOVAL SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all coordination, labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the equipment as shown, as specified and in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Furnish detailed shop drawings for all items specified herein in accordance with Division 1.
- B. Furnish detailed Operation and Maintenance manual for all items specified herein in accordance with Division 1.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.
- B. Electrical and Instrumentation equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Division 16 and 17.

1.04 QUALITY CONTROL

- A. The equipment manufacturer shall have a minimum of 10 years of experience in manufacturing equipment similar, equal or larger size, to that specified.
- B. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical type to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience requirements. Installation information shall include, but not be limited to, the following:
 - 1. Name and location of the installation.
 - 2. Name of person in direct responsible charge for the equipment.
 - 3. Address and phone number of person in direct responsible charge.
 - 4. Month and year the equipment was placed in operation.
 - 5. Capacity of Equipment

- C. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.06 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein. Services shall be provided as required to ensure complete and operational equipment for minimum of six (6) eight (8) hour day.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.07 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, signed by an authorized representative of the Manufacturer, certifying that the equipment is installed in a complete and satisfactory manner and has been functionally tested such that it is ready for operation.

1.08 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be provided by as required to ensure Owner's personnel understanding of equipment and shall provide training for a minimum of four (4) days.

1.09 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective. Provide a (2) two-year warranty from the date the system is placed in operation which shall be upon completion of operation tests.

PART 2 – PRODUCTS

2.01 DESIGN REQUIREMENTS

A. Design Criteria

Future Peak Flow Rate:	14 MGD (Total)
Future Average Flow Rate:	4 MGD (Total)
Current Peak Flow Rate:	9 MGD (Total)
Current Average Flow Rate:	2 MGD (Total)
Current Low Flow Rate:	1 MGD (Total)
Rated Capacity:	7.0 MGD(Each)
Grit Capture of 2.65 SG Material @ Rated Capacity:	95% of grit >50 mesh in size 85% of grit 50-70 mesh in size 65% of grit 70-100 mesh in size
Influent Channel Width:	30 inches
Effluent Channel Width:	30 inches
Influent/Effluent Orientation:	360 degrees
Upper Chamber Diameter:	10 ft
Upper Chamber Depth:	3.75 ft
Upper Chamber Extension Above Grade:	2.17 ft
Lower Chamber (Hopper) Diameter:	3 ft
Lower Chamber (Hopper) Depth:	5.5 ft
Vortex Drive Motor HP:	1 HP
Maximum Impeller Speed:	21 rpm
Grit Removal:	Self Priming Pump
Pump Capacity Requirements:	250 gpm
Pump Total Dynamic Head Requirements:	_____
Pump Motor HP:	7.5 HP Max

B. Each Grit Removal System shall be comprised of the following components:

1. Grit Vortex Tank
2. Grit Pump
3. Grit Washer
4. Control Panels

C. The Grit Removal System and all appurtenances shall be supplied by a single supplier.

D. The system to be furnished hereunder shall be made by a manufacturer regularly engaged

in such work and who has furnished similar installations and had them in successful and continuous operation for a minimum period of ten years.

- E. Data on performance testing, service history and operation of existing installations using the submitted equipment shall be made available to the Engineer, upon request, for use in determining that the Grit Removal components offered meets the intent of the contract, performance requirements and criteria stated in these specifications.
- F. The Grit Removal Tank technology shall be designed utilizing Computational Fluid Dynamics (CFD) and field data to verify its flow regime, headloss and grit removal characteristics. Upon request, data on the computation methods used and generic simulation results shall be made available to the engineer.
- G. The grit removal system shall be manufactured by Westech, S&L or approved equal.

2.02 GRIT VORTEX TANK AND GRIT PUMP

A. Operation

The influent is tangentially introduced into the vortex chamber where impeller blades create a forced vortex causing the organics to separate from the grit and be lifted up with the effluent while the heavier grit particles settle to the bottom of the lower chamber. A slurry pump shall pump the grit into the grit dewatering equipment.

B. Vortex Grit Separator Drive Unit

- 1. Design Parameters: The drive unit shall be manufactured by the vortex grit separator equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values and speeds previously listed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L10 life of 50 years or 450,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 5 rating when rated in accordance with AGMA 2001-B88. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

All gearing shall be designed per AGMA standard 2001-B88 for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the two values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.

No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.

- Any and all welding on the drive unit shall be done using E70XX weld rod.
2. **Physical Characteristics:** The drive unit shall consist of a solid external main gear, turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the operating platform frame and support the entire rotating load of the mechanism. The main external gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. All speed reducers shall be fully enclosed and running in oil or grease. Support base for the drive shall be of welded steel to assure rigidity. Oil and dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set with fully contoured raceways hardened to a minimum 58-60 Rc. The main gear and pinion shall run in an oil bath or be grease lubricated. If an oil bath is used, an oil sight glass, fill pipe, and drain line shall be provided for the reservoir. Lubrication fittings shall be readily accessible.
 3. **Turntable:** The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29×10^6 psi. The drive shaft shall be fastened to and supported from the gear hub. Ball bearings shall be of the highest quality high carbon chrome alloy steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals.
 4. **Speed Reducing Unit:** The speed reducing unit shall consist of cycloidal or helical speed reducers directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.

The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft.

Speed reducer helical gearing shall be manufactured to AGMA standards. The speed reducer shall have a service factor of 1.25.

The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and run in a totally submerged oil bath or be grease lubricated.

5. **Motor:** The motor shall be an 1800 RPM, squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a service factor of 1.15. A motor canopy shall be provided. The motor shall be designed for 3 phase, 60 hertz, 480/240 volt power supply.

C. Vortex Grit Separator Equipment

1. Torque Tube and Impeller: The torque tube shall be attached to the drive gear, and shall be fitted with adjustable axial flow impeller blades to rotate the upper chamber contents about the vertical axis. All components shall be constructed from type 304 stainless steel
2. Grit Lift Pipe: The grit lift pipe shall be a single length of standard weight pipe ending in a flange. The pipe shall extend through the center of the drive torque tube and be supported from the stationary part of the drive gear housing. The pipe shall be constructed from type 304 stainless steel.
3. Scour Piping: Water scour piping shall be provided to extend down from the drive to within 6 inches of the lower chamber floor. Piping shall be 1-1/2 inch standard weight 304 stainless steel pipe. A manual brass body ball valve and solenoid valve shall be supplied by the manufacturer for installation on the scour piping. The scour system requires washwater supplied at 30 gpm @ 40psi.

D. Grit Removal Pump – Self Priming Type

1. Grit Pump: One (1) pump shall be supplied for each vortex system. Pumps shall be horizontal, self-priming, centrifugal type, and shall be designed for pumping the specified flow at the indicated total dynamic head and at the specified horsepower. The pump shall be furnished complete with a ductile iron volute capable of passing a 3” sphere solid, hard iron (ADI) with 400 BRN hardness impeller and seal plate, and wear plate of hardened alloy steel. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means with no special tools or shims. The pump shaft shall be 4150 alloy steel with a double oil lubricated mechanical seal with silicon carbide faces, assembled on a replaceable shaft sleeve. Suction and discharge spool flanged shall be one-piece cast iron, class 30. Each spool shall have one 1-1/4” NPT and one 1/4” npt tapped hole with pipe plugs for mounting gauges and other equipment. The pump shall be mounted on a common base plate (pump over motor design) with the applicable configuration motor with constant speed V-belt drives and guard. The pump motor shall be designed for non-overload operation conditions and should be suitable for service in wet conditions. The motor shall be a NEMA design, 1800-RPM, TEFC, severe-duty unit with 1.15 service factor. Power supply to the motor shall be 3 phase, 60 Hz with 230-460 VAC.
2. Frost Protection: Pump shall be equipped with a heater and fitted with an insulating jacket from non-combustible, tear resistant fabric with refractory ceramic fiber insulation. The jacket shall be removable and custom fitted specifically for the model of grit pump provided.

E. Valves and Accessories

1. The Grit Vortex Tank shall be supplied with the following items:
 - a. Solenoid Valve: One (1) normally closed solenoid valve shall be provided to control flow to the water scour. The brass body valve shall be 120 Volt,

single phase, 60 Hz with a NEMA 7 housing.

- b. Thermostat: One (1) ambient temperature thermostat shall be provided to control power to the heat trace cable. The thermostat shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing. The temperature setpoint shall be selectable by an adjustable dial.

2.03 GRIT WASHER

A. Operation

- 2. The grit slurry will be fed into the top of the conical shaped washer tank through a radial flow initiator to reduce velocity and enhance grit settlement. The dirty grit falls by gravity through water flowing counter currently, which is being injected from the tank bottom. The difference in specific gravity between the organic and inorganic matter causes a separation to occur. The grit forms a bed in the tank bottom, which acts as a sand filter. Slow-turning stirring arms move through the water and grit bed, loosening and dislodging organic matter that has been trapped on and within the grit.
 - c. The height of the bed is measured by a true power monitor which detects the power draw of the agitator motor, and maintained by periodically withdrawing washed grit with a shafted screw. The shafted screw conveys the clean grit upward to above the liquid level of the system, turning very slowly to allow ample time for the grit to drain before discharging.
 - d. Wash water shall be introduced into the bottom of the grit washer by a combined radial spray header and cone shaped grit be support system that evenly distributes wash water throughout the grit bed. The rising flow of water sweeps the separated organics upward where lighter material exits out the overflow and dense organic material will be drained away by an automated valve. Units that require perforated diaphragm membranes, perforated plate, or slotted plate bed supports are not allowed.

B. Grit Washer Construction

- 1. Grit Screw: The grit washer shall be composed of a screw conveyor inclined as indicated in the design criteria and operated in a 304 stainless steel tube. The spiral flights on the screw shall be sectional type, hi-tensile steel two thirds-pitch base section welded to a steel pipe with solid steel stub shaft. Spiral flight thickness shall be 0.6 inches for the inner flight and 0.75 inches for the outer flight, and spiral OD shall be as indicated in the design criteria. Clearance between spiral od and tube id shall be controlled to 1mm. Shaftless spirals are not acceptable as well systems that require wear liners or wear shoes.
- 2. Screw Auger Bushing: A stub shaft shall be welded to an end plate at the bottom of the grit inlet hopper. A maintenance free composite bushing shall support the lower end of the screw. Units that require greasing of the screw auger lower

bearing or bushing shall not be acceptable.

3. Drive Unit: The grit washer agitator and screw drive units shall consist of a helical speed reducer and motor. The speed reducer shall be directly coupled to the motor and flange-mounted directly to the screw conveyor shaft. The drive shall rotate the conveyor at the specified speed and shall be designed for 24 hour a day operation under normal moderate shock loadings.
 - a. Speed reducers shall be manufactured to AGMA standards.
 - b. The reducer includes an internal tapered roller bearing of proper size for all mechanism loads and runs in a totally submerged oil bath.
 - c. The motors shall be TEFC, 1800 RPM, 230/460 Volt, 3 phase, 60 Hz. The motors shall be NEMA design code B and be direct coupled to the reducer. Horsepower of each motor is as given in the design criteria.
4. Agitator Assembly: The agitator assembly slowly turns through the water and grit bed to loosen and free organics contained within the grit. This equipment is manufacturer dependent.
 - a. Agitator Shaft: The agitator shaft from type 304 stainless steel will be a solid keyed shaft for direct insertion into the hollow shaft of the agitator drive reducer.
 - b. Stirring Arms: Multiple stirring arms will be welded to the agitator shaft. Stirring arms shall be from type 304 stainless steel.
 - c. Skimmer Arm: An arm with skimmer device at the end will be welded to the agitator shaft. Skimmer arms shall be from type 304 stainless steel.
5. Inspection Hatch/Covers: Grit washer shall include covers on top of the unit to completely enclose the unit for hygienic purposes. A vent connection shall be provided and three (3) removable covers for inspection. Covers provided with lifting handles that are easily removed by one person. Removal of covers shall reveal openings fitted with grating for safety purposes. Grating can be removed for tank access.
6. Conical Shaped Inlet Hopper: One 8-inch pipe connection shall be provided on the top of the grit washer. An effluent weir shall be provided allowing the effluent to overflow to a 10-inch effluent pipe connection. An odor control pipe connection shall be provided – 4-inch plain ended pipe.
7. Grit Bed Washing:
 - a. Wash water shall be introduced into the bottom of the grit washer at four points into the coned shaped distribution ring. The coned shaped distribution ring evenly distributes wash water throughout the fixed grit bed removing organic material from the grit towards the overflow weir. Units that require perforated diaphragm membranes, perforated plate or slotted plate bed supports are not allowed.

- b. Wash water is controlled by a 1-1/2 inch wash water solenoid valve, manual ball valves, pressure reducing valve, ball float water meter and pressure gauge.
- 8. Drain Valve: A 2-inch drain shall be provided near the bottom of the grit washer. Drain connection provided with a brass / PVC body ball valve.
- 9. Freeze Protection: Grit washer tank and auger to be provided with removable, heat-traced insulating blanket. Blanket to be manufactured from a 16 oz. Teflon jacket containing one inch of insulation and secured to washer using straps, D-rings, and Velcro, and can be removed to change wear bars or perform maintenance.

C. Valves and Accessories

- 1. The Grit Washer shall be supplied with the following items:
 - a. Solenoid Valve: Per each washer, one (1) normally closed solenoid valve shall be provided to control flow to the grit bed washing assembly. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.
 - b. Solenoid Valve: Per each washer, one (1) normally closed solenoid valve shall be provided to control flow to the organics drain valve flush water assembly. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.
 - c. Solenoid Valve: One (1) solenoid valve shall be provided to control air flow to the organics drain valve. The brass body valve shall be 120 Volt, single phase, 60 Hz with a NEMA 4X housing.
 - d. Knife Gate Valve: One (1) electrically controlled 4 inch knife gate valve shall be provided for the 4-inch organics drain connection. Valve housing of epoxy coated ductile iron and the knife of 304 stainless steel. Valve complete with electrical actuator, aluminum alloy housing, polyurethane paint.

2.04 CONTROLS

A. MAIN CONTROL PANEL

- 10. The equipment supplier shall furnish all electrical items specifically called herein. The contractor shall supply all other electrical items, and interconnecting wiring of proper size, including all conduit and supports required to place the equipment into service. Each vortex system shall be provided with the following:
- 11. Control Panel: A 480 volt primary control panel shall be provided in a NEMA 4X type 304 stainless steel enclosure suitable for wall mounting.
- 12. Provide the following components in the main control panel to provide proper operation of the grit vortex tank and pump equipment:
 - a. Step down control transformer and disconnect.

- b. Branch circuit protection.
 - c. Vortex and pump drive motor starters.
 - d. Emergency stop pushbutton.
 - e. Vortex drive On-Off selector switch.
 - f. Hand-Off-Auto selector switches for the pump and water scour.
 - g. Cycle start pushbutton.
 - h. Hour meter for each motor.
 - i. Control power and run indicating lights.
 - j. Alarm light indicating over current, and starter overload.
 - k. Alarm reset pushbutton.
 - l. Programmable control relay to provide necessary control logic and monitor equipment mounted electrical devices.
 - m. Run and fault auxiliary contacts for use by SCADA.
 - n. GFCI circuit for heat trace.
13. Provide the following components in the main control panel to provide proper operation of the grit washing equipment:
- a. Drive motor starters.
 - b. Agitator and discharge screw HOA switches.
 - c. Organics drain valve, wash water, and drain valve flush OPEN-CLOSE-AUTO switches.
 - d. Load monitor shall provide overload protection by sensing motor current draw of the agitator and discharge screw.
 - e. True power monitor for grit bed measurement.
 - f. Hour meter for each motor.
 - g. Control power and run indicating lights.
 - h. Alarm light indicating over current, and starter overload.
 - i. Allen Bradley MicroLogix 1400 PLC.
 - j. Allen Bradley PanelView 800 operator interface terminal.
 - k. Run and fault auxiliary contacts for use by SCADA.
14. Provide a local control station with an E-stop pushbutton and Hand-Off-Auto selector switch for all of the following:
- a. Grit vortex drive
 - b. Grit pump
 - c. Agitator
 - d. Discharge screw

2.05 MATERIALS AND FINISHES

A. Materials

- 1. Materials of Construction: All structural steel shall conform to the requirements of ASTM A36. Steel pipe used for structural members shall conform to ASTM A53. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4". All aluminum shall be type 5052, 6061, or 6063 alloy unless noted.

B. Finishes

1. Shop Surface Preparation/Coating: All stainless steel welds and surfaces shall be cleaned and passivated to remove weld spatter, slag and discoloration. All carbon steel components shall be hot dip galvanized. Bearings, electrical devices, and drive shall be provided with the manufacturer's standard coating system.

2.06 ANCHORAGE AND FASTENERS

- A. Anchor Bolts: All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.
- B. Fasteners: All structural fasteners shall be type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the equipment and appurtenances in accordance with the manufacturer's recommendations.
- B. Manufacturer shall provide templates, certified drawings showing all anchors bolt locations and sizes as required for proper embedding in the concrete equipment support structure. The Contractor shall provide all anchor bolts in accordance with the manufacturer's recommendations. Anchor bolts shall be 316 stainless steel.
- C. Tolerance on concrete work shall be in accordance with the equipment manufacturer's recommendations.
- D. Installation of the equipment shall not be attempted until the equipment manufacturer has provided detailed installation manuals to the Contractor and the Contractor and manufacturer have instructed key field personnel in detail regarding installation of the equipment.

3.02 LUBRICATION

- A. Lubricate the equipment in accordance with manufacturer's recommendation prior to startup and refill as necessary until the operation of the equipment is turned over to the Owner.
- B. Provide a list of recommended lubricants and a lubrication schedule in accordance with Division 15.
- C. Furnish one year's worth of all types of premium lubricants that the equipment requires.

3.03 PAINTING

All exposed metal parts of the equipment shall be cleaned, primed and finished with the manufacturer's paint system that is in accordance with Division 9. All field touch-up painting shall be in accordance with Division 9.

3.04 FIELD PERFORMANCE TESTS

Prior to plant startup, all equipment shall be inspected for proper alignment, operation, connection, and satisfactory operation by means of a functional test. Contractor shall duly notify the manufacturer of any inabilities to perform functional testing prior to operator training.

3.05 ADJUSTING

Furnish qualified personnel to balance and adjust equipment to minimize reactionary forces, excess noise and vibration that are outside the limits of the manufacturer's recommendation. Provide corrective measures as recommended by the manufacturer or Owner's representative. Equipment Alignment shall be in accordance with Section 15000, General Mechanical Requirements.

3.06 CLEANING

Clean the equipment and work area from all construction debris in accordance with Division 1. The equipment provided shall be free from debris prior to placing into service.

END OF SECTION 11320

SECTION 11333
MECHANICAL SCREEN
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SECTION 11333

MECHANICAL SCREEN

PART 1 – GENERAL

1.01 DESCRIPTION

Provide all labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the two (2) mechanical bar screens with one (1) compacting conveyor and appurtenances as specified herein and as shown on the Contract Drawings.

1.02 SUBMITTALS

- A. Shop Drawings shall be submitted for all items herein as specified under **DIVISIONS 0 AND 1**.
- B. Complete operation and Maintenance Manuals shall be submitted for all items herein as specified under **DIVISIONS 0 AND 1**.

1.03 EQUIPMENT DESIGN

Equipment design, workmanship, testing and operation shall be as specified under **SECTION 15000, GENERAL MECHANICAL REQUIREMENTS**.

1.04 MANUFACTURER'S INSPECTION AND START-UP

The Contractor shall furnish the services of the mechanical screen and compactor manufacturer's qualified field representative to inspect the equipment after installation, instruct plant personnel in its operation and maintenance, and supervise its initial operation for a minimum of one 8 hour day as specified under **DIVISIONS 0 AND 1**.

1.05 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, as specified under **DIVISIONS 0 AND 1** certifying the mechanical screen with compactor and appurtenances have been installed in a complete and satisfactory manner ready for operation.

PART 2 – PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

1. Each screen shall be capable of processing a peak flow of 4.5 Million Gallons per Day (MGD) of municipal wastewater with no less than 1.5 ft of freeboard when installed in a 3.0 ft wide channel 5.5 ft deep. Inclination of the bar rack shall be 75 degrees. Effective screen area shall have a minimum of 70% free open-area for water flow. The Screen shall lift and discharge screenings at an elevation of 4.0' above the bottom of the channel onto a discharge chute without use of brushes or spray washers. Bar spacing shall be 1/4" (6 mm).
2. Minimum flow through the screen shall be 0.2 MGD
3. The downstream water level at peak flow will be approximately 10 inches above channel bottom.
4. The maximum upstream water level shall not exceed 48 inches above channel bottom. The screen shall be capable of processing the peak flow without exceeding the maximum upstream water level based on a 50% reduction of the screen's free open-area.
5. The rake mechanism shall be capable of 2 cleaning speeds. Normal speed shall have a ten second cleaning interval and high speed shall have a five second cleaning interval.
6. All parts shall be designed and manufactured to handle the forces that may be exerted on the screen during fabrication, shipping, erection, and proper operation according to the O&M manual.
7. All components shall be so designed that jamming at any point will not result in structural failure, but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor and/or the maximum differential head at any channel water depth.

2.02 BAR SCREEN DESIGN SPECIFICATIONS

A. MATERIALS

1. Screen shall be manufactured from AISI 304 stainless steel shapes (rods, angles, and channels), pipes, and sheets. In particular, side frames and guides, bar rack, rake assembly, scraper assembly, shafting, discharge chute, fasteners and anchor bolts shall be made of this material.
2. Chains and sprockets shall be made of stainless steel. Chain rollers shall be made of 304 stainless steel.
3. Lower sprocket bearings shall have a stainless steel casing including a shaft made of white cast iron and a ceramic (silicium carbide) friction bushing.
4. Upper sprocket bearings shall have a paint coated cast iron casing and include ball bearings that are greased for life and shall be double-sealed with Nilos rings.

B. CONSTRUCTION

1. The bar screen shall remove debris (screenings) from the incoming wastewater by means of a positively cleaned bar rack that is installed in a concrete channel. The screen shall retain debris at the bar rack. A multitude of rake blades shall remove and lift the debris to a discharge mechanism. The bar rack shall be cleaned by a series of rakes engaging the bar rack from the upstream side (front) at the bottom of the channel and then moving up along the bar rack. The debris shall be lifted above the channel and dropped on a discharge chute at the downstream side (back) of the screen. Screens with single rakes shall not be approved. Screens employing brushes and spray water for screenings removal shall not be approved.
2. The bar rack shall consist of equally spaced, straight bars that are inclined from the horizontal with the inclination angle specified above. The lower ends of the bars shall be provided with a minimum 10/64" (4 mm) thick curved base plate such that the rakes positively remove all screenings from the bottom of the bar rack. Bars shall have a teardrop or continuous taper cross section. The bar rack shall be securely fastened to the frame of the screen and be readily removable.
3. The bar screen shall be provided with a dead plate extending from the bar rack to the discharge chute. The dead plate shall be made of a minimum 10/64 inch or 4 mm thick stainless steel plate and shall be stiffened by structural members so that it is flat without undulation so that the tips of the rake's teeth ride at a distance between 5/64 and 10.64 inch (1 to 2 mm) over the dead plate. The dead plate shall be securely fastened to the side frames.

4. A discharge chute shall be provided that fully encloses the discharge section of the screen. An access hatch with hinges and a handle shall be provided in the chute permitting easy access. The discharge chute shall be mounted to direct screenings into the appropriate receiving container or conveyor. The chute shall have a slope of minimum 30 degrees. The discharge chute shall be made of a minimum 10/64 inch or 4 mm thick stainless steel plate.
5. A frame shall be provided supporting all required loads. Side frames shall be made of 0.16" (4 mm) thick 304 stainless steel plates with a minimum of four axial. The side frames shall be connected with each other through channels having a minimum thickness of 10/64 inch (4 mm). The side frames shall be connected to support frames. The support frames shall be securely anchored onto the operating floor.
6. The screen shall be provided with easily removable, sufficiently stiffened covers made of 3/64 inch (1.5 mm) thick stainless steel plates with edges on all sides. The covers shall be provided with turn locks and handles.
7. Each side frame shall include separate roller tracks to guide the rakes. The roller tracks shall be bolted to the frame so that they can easily be replaced. The roller tracks shall be made of 10/64" (4 mm) thick L-profiles.
8. Drive chains for the rakes shall be roller type chains and be made of hardened steel. Each chain shall have strength of 12.3 tons (112 kN). Drive chains, chain guides, sprockets and their bearings shall be replaceable without removing the screen from the channel.
9. Upper bearings shall be ball bearings, shall be greased for life and shall be maintenance free.
10. Lower bearings shall be slide bearings in a stainless steel casing and shall be maintenance free. Bearings employing slide bushings made of plastic or metal material shall not be accepted.
11. Rake blades with a minimum thickness of 5/16" (8 mm). The rake blades shall have teeth matching and engaging the bars of the bar rack. The rake blades shall each consist of several pieces with teeth such that only one of the pieces needs to be replaced in case that a tooth should be damaged.
12. A pivoting scraper mechanism shall be positioned at the point of discharge and shall be attached to the side frames. The scraper shall clean the rake on each pass and return to its rest position with minimal shock. The scraper shall be designed such that screenings do not wrap around the rake or scraper. The

scraper shall be provided with a scraper bar made 10/64" inch (4 mm) thick channel profile and an adjustable wiper made of Polyethylene.

17. The drive shaft shall include an integral rocker arm assembly on the drive end that flexes if the screen rakes get jammed.
18. The rocker arm assembly shall consist of a drive unit mounted to a stainless steel arm. The stainless steel arm will be held in place by a flanged roller bearing connected to the drive shaft and two heavy duty tension springs. The flange bearing shall be connected to the rocker arm by four bolts. The rocker arm shall be maintained in the standard operating position by the two tension springs. If the screen rakes experience a jam, the force will cause the rocker arm to rotate around the drive shaft, compressing one of the tension springs. This motion shall be limited by a rocker guide. When the rocker arm rotates out of the normal operating position a proximity sensor will send a signal to the PLC causing the motor to enter a self clearing mode. If the self clearing mode should prove unsuccessful then the system shall initiate an alarm signal.
20. The bevel gear reducer shall be a totally enclosed unit. Gear reducer shall have ball or roller bearings throughout with all moving parts immersed in oil. Gear reducers which require periodic disassembly of the unit and manual re-greasing of bearings are not acceptable. The nominal input power rating of the gear reducer shall be at least equal to the nominal horsepower of the drive motor. Gear reducer shall be designed and manufactured in compliance with applicable AGMA or equivalent standards. During continuous operation the oil temperature shall not exceed 200 degrees F (95 degrees C).
21. The rake assembly shall be driven by an electric motor. The motor shall be UL rated for operation in Class 1, Div 2 environment. The motor shall be rated 3.0 hp, 460 Volts, 3-phase, with a minimum service factor of 1.00.
22. Heat Tracing: The Debris Plate shall be Heat Traced, Insulated and Jacketed above the Operating Floor Level up to the top of the Debris Plate where screenings are discharged. Heat Tracing shall be suitable for Class 1, Division 1 areas. Insulation shall be approximately 1" thick. Jacketing shall be of 304SS material. The surface where Heat Tracing is installed shall be energized by a Thermostat that turns on the Heat Tracing when the outside air temperature reaches 40 degrees F. Heat Tape shall extend outside the pan for Field Termination in an enclosure provided by the Manufacturer that houses Contactors, Thermostat, Terminal Strips, etc. and is, in turn, wired to the Main Control Panel for the Bar Screen.
23. Bar screen shall be manufactured by Huber or Headworks, Inc.

2.03 CONTROLS AND INSTRUMENTATION

A. GENERAL

The control system shall be provided by the screen supplier.

The screen shall be pre-wired so that the Contractor is only required to make the electrical connections to the control panels and from the control panels to a junction box at the screens.

B. LOCAL CONTROL STATIONS

1. Two (2) NEMA 7 rated local control stations. One for each screen.

C. WATER LEVEL SENSORS

1. Bar screen manufacturer shall provide two (2) ultrasonic level sensors and electronics package for continuously monitoring of the differential water level for control of screen operation, as well as a back-up float switch. The sensors shall be rated for Class 1, Division 2 hazardous locations and shall be intrinsically safe without the use of additional barriers, complete with built-in temperature compensation and submerged shield. The transmitter shall be mounted in the control panel. Contractor shall install the sensor and provide wiring to the control panel.

D. CONTROL PANELS

1. Two (2) separate main control panels shall be furnished with lockable NEMA 4X corrosion-resistant stainless-steel enclosure together with two (2) local push button stations rated for a NEMA 4X, Cl.1/Div.2 environment. One main control panel shall be provided for each bar screen.
2. Controls panel shall be made by a U.L. listed company and shall bear a U.L. label.
3. Output Dry Contacts shall be provided for Fault and Run Status.

4. Control panel wiring shall be color coded, neatly cabled and supported in non-flammable wiring tracks. Wiring shall be minimum 14 gauge MTW stranded wire.

E. SEQUENCE OF OPERATION

1. In AUTO position the screen shall be controlled by water level sensors. Screen operation shall be started when the water level sensors monitor a certain differential water level setpoint, when the float switch senses high water level, or when a certain time has passed since the last operation of the screen. Screen operation shall be stopped with an adjustable delay time after the water difference is below a certain value and after the float switch ceases to indicate high water alarm, or after a certain run time has expired (if operation was started by timer).
2. Reset is manually performed after correction of any cause for a trip-out.
3. In HAND position the operator shall be able to run the rake assembly via a FORWARD, OFF, REVERSE selector switch.

2.04 SPARE PARTS

The following Spare Parts shall be included and supplied together with the equipment:

- a) 2 set of rake bars
- b) 5 feet of chains
- c) 1 shock absorber for scraper

Spare parts shall be packaged with labels indicating the contents of each package, and shall be delivered to Owner as directed.

2.05 CONVEYER/COMPACTOR SYSTEM

1. Equipment supplied shall be one (1) Shaftless Spiral Conveyor/Compactor. The system shall be designed to receive, positively convey and compact screenings discharged from the mechanical bar screen and have a maximum capacity of 133 cf/hr.
2. Shall reduce screenings volume by a minimum of 35% and produce a dry screening content of 25%.
3. Each unit shall be installed at an incline of 15 degrees from the horizontal and have support legs supplied as required for adequate support under

operating conditions. All anchor bolts, nuts and washers shall be ¾” diameter 304 Stainless Steel. The anchor bolts shall be supplied by the installing contractor.

4. Shaftless Spiral Assembly

- A. Shall consist of a spiral with an abrasive resistant brush along minimum one revolution of the spiral bolted to a stub end drive shaft. Shafted spirals shall not be allowed.
- B. Shall be manufactured from two concentric flights welded together to form a single spiral. The outer spiral shall be formed from ANSI 8620 high strength alloy bar with minimum Brinell hardness of 200. The outer thickness shall be ¾” (20mm) and the inner thickness shall be 9/16” (15mm). Spirals made from single flights shall not be allowed.
- C. Diameter of shaftless spiral assembly shall be 11.25 inches and shall be constant over its entire length.

5. U-Trough

- A. The U-Trough shall consist of a formed trough with side flanges for attaching the bolted covers. The U-Trough shall house the sieve zone and transport zone. The T-Trough shall be lined with a replaceable polyethylene liner.
- B. The U-trough shall be constructed of 11 gauge (3mm) grade 304 Stainless Steel. Fasteners shall be Grade 304 Stainless Steel.
- C. The trough covers shall be constructed of 14 gauge (2mm) Grade 304 Stainless Steel. The covers shall be supplied in maximum 10 foot long sections and cover the entire length of the U-Trough except at the inlet hoppers. The covers shall include a Neoprene seal minimum ¼” (6mm) thick along its entire length to seal it to the side flanges of the U-Trough.
- D. The liner shall be 3/8” (10mm) thick polyethylene material covering minimum 180 degrees of the trough bottom. The liner shall be supplied in sections maximum 4 foot long to facilitate replacement. The liner shall be held in place by stainless steel tabs welded to the U-Trough. There shall be a minimum six tabs per four foot long liner section.

- E. The sieve zone shall consist of a perforated section of a U-Trough located at a low end of the unit near the drive. The sieve zone shall also include a liquid collection chamber located directly under the perforated section with a 3" diameter drain connection. A flexible discharge tube, provided by others, shall direct the discharged liquid back to the influent channel.
- F. The perforated sieve zone shall be constructed of 14 Gauge (2mm) Grade 304 Stainless Steel plate with 1/8" (3mm) diameter perforations.
- G. The shaftless spiral assembly in the sieve zone shall have on abrasive resistant brush assembly welded to minimum one revolution of the spiral. The brush shall be composed of nylon.
- H. The transport zone shall consist of a constant size U-Trough with bolted removable covers.
- I. The transport zone shall include two inlet hoppers to direct screenings from the bar screens into the shaftless spiral conveyor/compactor. The inlet hoppers shall be constructed of 14 gauge (2mm) Grade 304 Stainless Steel and shall be bolted to the transport zone of the U-Trough. The inlet hoppers shall include a neoprene seal minimum 1/4" thick along its entire length to seal it to the side flanges of the U-Trough.

6. Dewatering Zone:

- A. The dewatering zone shall consist of a perforated dewatering basket housed in a dewatering box with hinged cover, flush water connection and drain; a force cone and discharge spout. The dewatering zone shall be bolted to the end of the U-Trough.
- B. The perforated dewatering basket shall be cylindrical and constructed of 14 gauge (2mm) Grade 304 Stainless Steel with 1/8" diameter perforations. The perforated material shall have minimum 30% open area.
- C. The dewatering box shall be constructed of minimum 14 gauge (2mm) grade 304 Stainless Steel. Fasteners shall be Grade 304 Stainless Steel.

- D. The dewatering box shall be fitted with a hinged cover to provide access to the dewatering basket for cleaning. The cover shall be held closed with quick release clamps.
- E. Periodically water shall be introduced into the dewatering box to flush organics and other fines to the drain. The flush water supply shall be approximately 10 gpm at 40 psi. Flushing shall occur at least once every five minutes during equipment operation for fifteen seconds in duration and be field adjustable. The flush water shall flow in a flexible tube from the dewatering box to the liquid collection chamber discharge tube or other suitable piping, provided by others, shall direct the discharged liquid back to the influent channel.
- F. The discharge spout shall be constructed of 11 gauge (3mm) grade 304 Stainless Steel and bolted to the end of the dewatering box. The clear height of the discharge spout shall be set at the minimum that allows for placement of a receptacle to collect the screenings.
- G. Heat Tracing shall be provided under the U-Trough and under the dewatering box.

7. DRIVE SYSTEM

- A. Electric Motor. The Electric Motor shall be maximum 3 HP, 230/460V, 3 Phase, 60 Hz, TEFC, rated for the required Electrical Area Classification.
- B. Gear Reducer. The design shall utilize a shaft mounted parallel helical type gear reducer driven by a direct coupled motor. The reducer shall have a cast iron housing with an output speed of maximum 15 RPM. The service factor shall be 1.0 minimum.

8. Controls

- A. The Shaftless Spiral Conveyor/Compactor Control Panel enclosure shall be sized as required to house the required components and shall be suitable for wall mounting or mounting to strut-type supports. The enclosure shall be stainless steel and rated NEMA 4X. The Control Panel shall be pre-wired and tested, requiring only wall mounting and connection to external wiring by the electrical contractor in the field. The panel shall be located in a non-classified area where no corrosive gases are present.

- B. The Shaftless Spiral Conveyor/Compactor Control Panel shall be controlled in synchronization with the upstream screening equipment. The Shaftless Spiral Conveyor/Compactor shall begin operation whenever the screening equipment begins operation and shall continue operation for a predetermined period of time after the upstream equipment stops.
- C. The Control Panel shall have front panel mounted NEMA 4X pilot lights indicating Power, Fault, and Running.
- D. The Control Panel shall include a disconnect, motor starter, control power transformer, adjustable timer, panel heater, elapsed time meter, and other components to allow for sequencing the system.
- E. Output Dry Contacts shall be provided for Fault and Run Status.
- F. The Control Panel shall be fitted with an adjustable Current Switch. Upon a Fault the equipment shall shut down and an alarm contact shall be initiated.
- G. Local Operator Station shall be provided in a NEMA 7 panel. The Local Operator Station shall include a Hand-Off-Auto selector switch, Forward-Off-Reverse selector switch, and an Emergency Stop pushbutton.

9. Spare Parts:

Spare parts shall be packaged with labels bearing the description and quantity of the contents.

Furnish the following spare parts for each shaftless screw conveyor/compactor:

- One (1) Brush
- One (1) Packing Rope (Shaft Seal)
- One (1) Set U-Trough Liners

10. Surface Finishes and Coatings

After all fabrication and welding has been completed all stainless steel surfaces shall be glass Bead Blasted prior to equipment assembly. The Bead Blast shall remove all weld discoloration and surface contaminants and provide for Spontaneous Passivation as recognized in ASTM A380-99,

Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

All purchased components such as motors, reducers, valves, switches, etc. shall be supplied with the manufacturers' standard finish.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The contractor shall install the mechanical screening and compactor equipment as indicated on the Contract Drawings and as specified herein.
- B. The equipment shall be erected in accordance with the manufacturer's recommendations and O&M procedures.

3.02 SHOP TESTING, ASSEMBLY, AND INITIAL LUBRICATION

- A. The mechanical screen, compactor and appurtenances shall be factory assembled and tested for a minimum of 2 hours prior to delivery, and shall be delivered to the site fully assembled. The motor/reducer unit, discharge chute and support legs shall be assembled at installation.
- B. All lubrication required for initial operation shall be furnished and applied in accordance with the manufacturer's recommendations, where applicable.
- C. The screening and compactor equipment shall be furnished with grease fittings, stainless steel extension tubes and lubricant reservoirs to suit maintenance access and frequency intervals.

3.03 INSPECTION, STARTUP AND TESTING

- A. The manufacturer of the equipment shall provide a representative to check the installation, make final adjustments, supervise the initial startup of each mechanism and prepare a written report for submission to the contractor in compliance with the manufacturer's certificate.
- B. The representative shall also instruct the Owner's personnel in the operation and maintenance of the equipment for a period of one (1) eight (8) hour day.
- C. The manufacturer's representative shall be available for a minimum of three (3) eight (8) hour days to perform the above. Whether or not these

days are consecutive shall be dependent on the construction schedule and training schedule approved by the Owner.

3.04 PAINTING

All items specified herein shall be painted as specified under **DIVISION 9, FINISHES.**

END OF SECTION 11333

SECTION 11335

CLARIFIER EQUIPMENT

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SECTION 11335

CLARIFIER EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish, install, and test, two (2) 85 foot diameter circular clarifiers (SC-403 and SC-404), complete with influent column, half-bridge, bridge between clarifiers, energy dissipating inlet well (EDI), center feedwell, center drive mechanism, spiral sludge scrapers, full radius scum trough with two skimmer assemblies, and all other necessary accessories in compliance with these specifications and as shown on the Drawings.
1. The clarifier manufacturer shall provide a torque sensor.

1.02 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 and as specified herein. Submittals shall include as a minimum:
1. Manufacturer's experience and qualifications.
 2. Shop drawings.
 3. Certified general arrangement drawing and tank dimensional drawings.
 4. Certificate of design stamped by a registered DE Professional Engineer stating that the equipment to be provided for this project meets or exceeds all design requirements of these Contract Documents. The certificate shall state the respective loads and design criteria.
 5. Certified structural steel calculations (walkway, sludge collectors, etc.) shall be sealed by a professional engineer registered in the state of DE.
 6. Calculations documenting the AGMA rating of the drive unit and life of the main bearing. Calculations shall be prepared and signed by a registered professional engineer in DE.
 7. Complete descriptive information and electrical schematic for torque overload device.
 8. Catalog cut sheets for purchased sub-components including the motor.
 9. Shop test results.
 10. Manufacturer's installation certificate.
 11. Manufacturer's equipment warranty.

- B. Complete Operation and Maintenance Manuals shall be submitted in accordance with specification section 01300.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.
- B. Electrical and Instrumentation equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Division 16 and 17.

1.04 DESIGN REQUIREMENTS

- A. Every component of the center drive mechanism shall be capable of developing a minimum AGMA 2001-C95 torque rating of 19,000 foot-pounds at the specified rotating speed on a 24 hour/day continuous basis for 20 years. The minimum rated strength of the mechanism shall be 42,000 foot-pounds (mechanism rated strength = output torque of the main spur gear at which the drive control indicator will register 100% load). The drive mechanism shall be designed to generate and withstand, without damage or deformation, a maximum torque greater than or equal to 82,000 foot-pounds. The AGMA rated torque of the drive shall be the lowest value computed for the worm gear and spur gear sets as stated in the aforementioned AGMA sections. Select conservative value for bending strength and pitting resistance life factors K1 and C1 based on a minimum of 420,000 cycles of the main gear.
- B. The mechanism shall be designed to sweep in a concrete topping, with a final depth average of 2 inches. Manufacturer shall provide any special instructions required for application of topping to contractor.
- C. Main and intermediate gear housings for the center drive mechanism shall be constructed using adequate wall thickness to resist full momentary peak load without deflection.
- D. The main gear bearing and housing shall be designed to support the center drive mechanism, the main gear, the center cage, the scum skimmer arm, the rotating underwater sludge collector mechanism.
- E. Gear Design and Rating Criteria

1. Gearing shall be designed and rated using the criteria established by the following American Gear Manufacturers Association (AGMA) Standards:
 - a) ANSI/AGMA 6034-B92 (Feb 1992)
 - b) ANSI/AGMA 2001-C95 (Jan 1995)
 2. Gears and pinions shall be manufactured to a minimum AGMA quality 6.
 3. The output torque rating of the drive shall be based on the limiting value determined from the AGMA Standard.
 4. The worm and worm gear shall be designed based upon AGMA 6034-B92 for the continuous AGMA rated torque stated in Section 1.04 A.
 5. The design calculations for the main gear shall identify the grade of material to be used, the rim thickness factor, and the tooth-loading factor. The main gear shall be designed to support the center cage, the scum skimmer arm and the rotating underwater sludge collector mechanism.
 6. Design the main drive bearings for the total rotating weight of the assembly and a minimum B-10 bearing life of 200,000 hours.
- F. The maximum allowable deflections at the periphery of the trusses shall not exceed the following:
1. Each truss shall be designed for a maximum vertical deflection of $L/480$ due to dead load only and maximum horizontal deflection of $L/480$ when loaded uniformly along the sludge collection truss at the design AGMA continuous 20-year torque rating.
 2. The combined horizontal deflection of the center drive cage and trusses shall not exceed 2 inches at 1.5 times the design strength of the mechanism.
- G. Center cage shall be designed such that the calculated stresses do not exceed the AISC allowable stress at twice the specified minimum AGMA continuous 20-year torque rating, plus all dead loads. Panel lengths and member sizes shall be selected such that the slenderness ratios do not exceed 200 for compression and 240 for tension.
- H. The allowable stress values used in the design shall be in accordance with the latest revisions of the specifications: AISC latest edition, AGMA 6034-B92 and AGMA 2001-C95, based upon 24 hour/day 20 year continuous usage.

- I. The sludge collector arms shall be designed to withstand 1.5 times the AGMA continuous 20-year torque rating plus all dead loads without exceeding the AISC allowable stress.
- J. The access bridges and bridge between clarifiers, as shown on Drawings, shall be designed to carry minimum 50 lb/sq. ft. live load plus all dead loads. Total combined deflection of bridge and grating shall be limited to $L/240$.

1.05 PERFORMANCE REQUIREMENTS

- A. The equipment shall be designed for flocculation of the liquid in the central portion and, after flocculation, for clarification of the liquid in the lower central and outer annular portions of the tank.
- C. Each machine shall adequately skim the surface of the tank and remove all floating material from the surface of the tank and surface of the center feedwell.
- D. Spiral rake blades shall be arranged to move the sludge that settles on the tank bottom to either:
 - 1. A rotating sludge withdrawal drum at the center of the tank or stationary sludge withdrawal drum at the center of the tank.
- E. The hydraulic design per clarifier shall be based on the flows indicated herein.
- F. Each complete machine shall be so designed that the hydraulic head loss through the center column (measured from the tank bottom to the top of the pipe) and clarifier equipment (including energy dissipating inlet and feedwell, but not including the outlet weir), shall not exceed the headloss shown below at the total peak flow:
 - 1. Maximum Headloss, feet 0.25
- G. The clarifier design shall be based on the following solids handling capability:
 - 1. Average Solids Loading Rate (lbs/day/sf) 13
 - 2. Peak Solids Loading Rate (lbs/day/sf) 26.3
- H. The equipment shall be capable of continuously handling normal return activated sludge having a range of solids concentrations from 0.5% to 1.5% with an occasional maximum of 5.0%, at the solids loading rates and return sludge flows indicated

above. The equipment shall remove sludge from the entire tank bottom with a minimum sludge disturbance. The complete machine for each tank shall be of sufficient structural strength and shall have sufficient mechanical ability to move through sludge up to 5 percent total solids content accumulated to a depth of 6 inches at the side walls.

1.06 QUALITY CONTROL

- A. The equipment manufacturer shall have a minimum of 10 years experience in manufacturing equipment similar, equal or larger size, to that specified.
- B. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience requirements. Installation information shall include, but not be limited to, the following:
 - 1. Name and location of the installation.
 - 2. Name of person in direct responsible charge for the equipment.
 - 3. Address and phone number of person in direct responsible charge.
 - 4. Month and year the equipment was placed in operation.
 - 5. Capacity of Equipment
- C. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements

1.07 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.08 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein for a minimum of two (2) eight (8) hour days. Services shall be provided as required to ensure complete and operational equipment.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.09 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, signed by an authorized representative of the Manufacturer, certifying that the equipment is installed in a complete and satisfactory manner and has been functionally tested such that it is ready for operation.

1.10 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be provided by as required to ensure Owner's personnel understanding of equipment for a minimum of four (4) hours.

1.11 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective for (2) two years from the date the system is placed in operation which shall be upon completion of operation tests.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The clarifier equipment manufacturer shall be the following or equal:
 - a. Ovivo USA
 - b. Westech

- B. Dimensions and locations shown on Drawings for equipment and accessories are based on Ovivo. Any change in the dimensions or location of equipment or accessories or type of accessories required to accommodate alternate manufacturers and models shall be at the Contractor's expense.
- C. In the case of an "or-equal", the Contractor shall demonstrate in writing, to the satisfaction of the Owner at the time of the shop drawing submittal that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the bid date.

2.02 DESIGN CRITERIA

- A. Each clarifier equipment shall continuously remove settled sludge as shown on the Contract Drawings. The equipment shall remove sludge from the entire tank bottom with a minimum of sludge disturbance to result in a clear effluent. Each clarifier shall be designed to operate at the following range of flow conditions:

- | | |
|------------------------|----------|
| 1. Design average flow | 1.58 MGD |
| 2. Design peak flow | 5.60 MGD |

- B. Each clarifier shall be designed to operate at the following process parameters:

- | | |
|---------------------------------|----------------------------|
| 1. Drive motor | 1 hp (max) |
| 2. Drive continuous torque | 28,000 ft-lbs at 0.045 rpm |
| 3. Drive 100% design torque | 70,000 ft-lbs |
| 4. Drive momentary peak torque | 105,000 ft-lbs |
| 5. Mechanism rotation | Clockwise |
| 6. Rake arm tip speed, constant | 8 - 10 ft/min |

- C. Each clarifier shall be designed to meet the following design requirements:

- | | |
|------------------------------------|----------|
| 1. Basin diameter | 85 feet |
| 2. Side water depth | 14'-1" |
| 3. Tank freeboard, min. | 1'-11" |
| 4. Floor slope | 1:12 |
| 5. Center column diameter | 24" |
| 6. Feedwell diameter | 22'-0" |
| 7. Feedwell submerged depth | 5'-0" |
| 8. Feedwell scum ports | four (4) |
| 9. EDI diameter | 8'-0" |
| 10. EDI submerged depth | 3'-0" |
| 11. Number of baffled EDI openings | Six (6) |

12.	Cage minimum size	4'-0" square
13.	Rake arm minimum size	3'-10" square
14.	Spiral blade height near tank wall	8"
15.	Spiral blade height near tank center	24"
16.	Rotating sludge drum diameter	5'-10"
17.	Rotating sludge drum height	26"
18.	Scum box width	full-radius

2.03 PRIMARY CLARIFIER EQUIPMENT

A. General Description

1. Clarifier shall be of the center feed, center pier supported type with peripheral overflow.
 - a. A cylindrical steel center column shall support the drive and mechanism and shall function as an influent pipe.
 - b. A central driving mechanism shall support and rotate a center cage.
 - c. Sludge and scum collector arms are attached to and rotated by the central driving mechanism.
2. Equipment shall include half bridge access walkway with handrails, grating, center platform around top of stationary influent support column, drive unit with overload control, energy dissipating inlet, center feedwell, drive cage, full-arm spiral scraper arms with adjustable spiral type scraper blades, outward scrapers, scum collection equipment, and full radius scum trough.
3. Assemble complete center drive mechanism in manufacturer's shop to ensure proper fitting of all parts, and match-mark for field erection.
4. Before assembly, the main and intermediate gear housings shall be thoroughly inspected for seep holes or inclusions and given a fully hydrostatic test to insure no leaks in the oil containment areas. Results of the test shall be included with the shop test inspection report.
5. The sludge and scum collector assemblies, access walkway and center platform are to be assembled in the shop to the fullest extent possible to assure proper fit when field assembled, marked with erection marks and shipped in sections as large as possible.
6. Fabricated assemblies shall be shipped in the largest sections permitted on public thoroughfares. At a minimum the following components shall be delivered fully assembled:

- a. Center Drive
 - b. Center Column
 - c. Center Cage - no more than 2 half-sections
 - d. Bridge/Walkways - no more than 2 half-sections per clarifier
 - e. Center Well - no more than 8 sections per clarifier
 - f. Truss Arms - no more than 6 half-sections per clarifier
7. Materials and equipment shall be standard commercial products in regular production by the manufacturer and suitable for the required service.
 8. Structural steel shall conform to current edition of ASTM A-36. The maximum allowable stresses on structural steel members under the peak torque conditions shall not exceed those permitted by the AISC, "Specifications for the Design Fabrication and Erection of Structural Steel for Buildings" latest edition.
 9. Castings shall be of special high grade ductile iron or cast steel having a tensile strength of not less than 48,000 psi, a yield strength of not less than 35,000 psi, a compressive strength of not less than 150,000 psi, a coefficient of elasticity of not less than 17,000,000, and a Brinell Hardness of not less than 196.
 10. Aluminum shall be alloy 6061-T6.
 11. Stainless steel shall be as specified in Section 05500.
 12. Sludge collector shall be designed to move settled sludge to centrally located sludge rotating drum.
 13. Design mechanisms so that no chains, sprockets, bearings or operating mechanisms are in contact with the liquid.
 14. All fastening hardware shall be Type 316 stainless steel.
 15. The minimum thickness for all steel on the secondary clarifiers shall be 1/4-inch.
 16. Design mechanisms to rotate at a constant speed.

B. Center Column

1. A stationary center column shall be provided which shall serve as the influent pipe and the support for the clarifier mechanism and one end of the access walkway bridge. Minimum center column thickness shall be 3/8".
2. One end of the column shall have a 1-1/4 inch support flange for bolting to the foundation with a minimum of eight (8) 1-1/4 inch diameter stainless steel anchor bolts as shown on the plans. A similar flange shall be provided at the top of the column for supporting and securing the center drive assembly. A steel template shall be provided to accurately locate these anchor bolts.
3. Influent openings shall be provided in the upper portion of the center column to allow unrestricted passage of the flow. Influent velocity shall be reduced by providing a total inlet port area a minimum of 135 percent of the center column cross sectional area.
4. Provide a heavy mounting plate at top to support center drive mechanism, set plumb with centerline.

D. Center Cage and Rake Arms

1. The center cage shall be of steel box truss construction, with connections for the two (2) sludge removal arms, rotating sludge collection drum and feedwell supports. The top of the cage shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The minimum angle size used for construction of the cage and rake arms shall be 2 inch x 2 inch x 1/4 inch members.
2. The clarifier mechanism shall include two (2) sludge removal arms of steel truss construction, with steel spiral rake blades and adjustable 20 gauge 304 stainless steel squeegees. The rake blades shall provide complete raking of the basin floor twice per revolution.
3. The rake blades shall consist of a minimum 3/16 inch thick steel plate. The blades shall be constructed to a logarithmic spiral curve with a constant 30 degree angle of attack. Blade depth shall vary as noted above. Each rake truss support arm shall be provided with the necessary outrigger bracing and other blade support structures, to ensure that the complete blade can be properly located and adjusted in the field.
4. The rake blades shall terminate at and directly attach to the rotating sludge collection drum.

5. The cage and rake arms shall be designed such that calculated stresses do not exceed the AISC allowable stress at the drive 100% rating.

E. Energy Dissipating Inlet (EDI)

1. The EDI shall be concentric with the center column and shall be supported, at a minimum, at four points, each 90° apart, from the center cage. It shall be made of 3/16" steel plate. Stiffener angles shall be included around the perimeter top and bottom, and along the sides of the influent well as required. Side stiffeners shall be provided where the individual center well sections are bolted together.
2. Top edge shall be approximately 6 inches above the water surface at average flow. Design shall be such as to diffuse influent into tank to greatest extent possible by use of energy-dissipating baffles with gates or other approved means. Energy dissipating inlet shall have closed bottom, which is sealed within 1 inch of the center column, and the tangential (clockwise) outlets shall also have bottoms. The EDI will cause a slow rotation of liquid near the feedwell and an open section of the skimmer is required to prevent trapping of the scum.
3. There shall be six openings 12.0 inches wide by 20 inches deep (water depth)
4. The openings shall extend at least 3 inches above the water surface to permit discharge of floating material.
5. Provide four 2x4 inch openings at the periphery in the bottom plate to prevent grit accumulation.

F. Feedwell

1. The feedwell shall be of welded steel construction and shall be concentric with center column, supported by center cage, and stiffened with top and bottom angles.
2. Top edges of the feedwell shall be set 6 inches above the average water surface elevation. The feedwell shall be made from 3/16-inch thick steel.
3. Four baffled slots shall be provided at liquid level to permit removal of floating material in the well. The ports shall be 8 inches long by 8 inches high and shall be set with the opening 3 inches below the average water surface elevation. The manufacturer shall note the peak water surface elevation also and verify that the height of the scum opening is adequate.

4. The feedwell shall include four scissor blades to force the scum in the well out into the clarified zone. Four spray nozzles shall be spaced to ensure that the scum is forced along the blade. Spray nozzles shall be in accordance with Section 15060.

G. Rotating Sludge Collection Drum

1. A rotating sludge collection drum shall be provided to collect settled solids raked to the center by the rotating spiral blades. The collected sludge shall be discharged from the tank by way of the RAS sludge pipe as shown on the Contract Drawings.
2. The sludge collection drum shall rotate with the center cage and shall be provided with sludge collection ports located directly in front of each rotating spiral rake blade. The ports shall be sized to collect thickened sludge from the bottom most dense sludge layer to maximize underflow solids concentration.
3. The rotating sludge drum shall be constructed of 1/4 inch steel plate. A stainless steel seals shall be provided to seal against the tank floor and against the center column.

H. Scum Removal Equipment

1. The clarifiers shall be equipped with two full radius skimmer assemblies that automatically push scum into a full radius trough cantilevered from the tank wall extending to the rotating feedwell.
2. The skimmer assemblies shall consist of a structural steel truss, structural steel channel or fabricated tube assembly cantilevered from the center cage over the feedwell with adequate stiffeners and connecting supports for full adjustment.
 - a. Tie rods shall be properly located to provide adjustments for horizontal forces.
 - b. Each skimmer structure shall be equipped with one hinge skimmer and neoprene skimmer blade design. Each skimmer arm shall be equipped with a 1/2" inch 60 durometer neoprene wiper blade extending the full length of the arm from the feedwell to the scum baffle. The neoprene blade shall be fastened to the arm with stainless steel fasteners with steel back-up bars.

- c. Each skimmer shall be capable of carrying scum, grease and floatable up the ramp and discharge them along the full edge of the trough.
3. The full radius scum troughs shall be fabricated from 1/4" steel plate and structural steel angles to form a self supported trough.
4. The approach ramp of the trough may be of radial design, having a tapered width and a variable slope that will enable the full length of the skimmer wiper to make simultaneous and continuous contact with the entire ramp along a radial line, at each revolution of the skimmer arm.
5. The clarifier equipment manufacturer shall furnish a flush valve assembly for automatic flushing of the scum box and scum pipe. The flush valve assembly shall be adjustable to allow 0 to 20 gallons of clarified effluent to enter the scum box as the skimmer assembly passes over the scum box. The assembly shall consist of a stainless steel lever, UHMW seal plate and neoprene diaphragm mounted to the scum box. The diaphragm shall be opened and closed by an easily adjustable, submerged actuation arm mounted to the rotating skimmer blade. The flush volume adjustment mechanism shall be above the water level.
6. The bottom of the trough shall be sloped to drain from the center to the end of the box at the perimeter of the tank.
7. Fabrication of the trough box shall be true and free of any warpage.
8. Located at the inner end of the trough shall be Schedule 40 stub pipe connector with dimensions as shown on the Drawings for field fitting of a flexible connector provided by the contractor.
 - a. Rigid pipe connection shall not be allowed.
9. The troughs shall be fully adjustable by providing a mid-adjustment leveling support and adjustable supports at the tank wall.
10. The clarifier manufacturer shall design the scum troughs and skimmer arms for the following loads.
 - a. The scum trough and support structure shall be designed for all dead loads plus a 200 lb. point load applied at the end closest to the stilling well with no permanent damage to the structure and no more than 1/2 inch deflection.

I. Walkways and Center Platform

1. Aluminum handrails and railings shall be furnished in accordance with Section 05521.
2. Aluminum grating shall be furnished in accordance with Section 05531. Grating shall span in the short direction across the walkways.
3. The walkway shall be supported at one end by the drive unit and supported at the other end by the tank wall. As a minimum the walkway shall be designed to safely withstand all dead loads plus a live load of 50 pounds per square foot with a maximum deflection of $1/360$, over the entire span. The walkway shall consist of structural steel beams, sufficiently braced to resist the specified design loads. The walkway decking shall be 1-1/2 inch aluminum I-bar grating.
4. Walkways and operating platforms shall be provided with aluminum handrail, skidproof aluminum grating, and toe plate on all sides.
5. Walkway shall not be less than 3 feet 6 inches wide between handrails; operating platform shall provide at least 3 feet clearance on all sides of the drive mechanism.
5. Removable grating sections above main drive mechanism shall be provided for drive access.
6. Provide Teflon or high-density polyethylene slide bearing for each clarifier bridge at the tank wall, plus at one end of the bridge between clarifiers
7. The top-of-grating elevation for the clarifier walkway bridges is as indicated on the structural drawings. Contractor and clarifier manufacturer to coordinate pocket at top of concrete support wall to accommodate walkway/bridge beam depth if needed. Clarifier manufacturer shall coordinate and provide swing gates, handrail opening and connection for stair, and handrail opening for access to top of precast concrete scum pumping station. Contractor shall coordinate and clarifier equipment manufacturer shall follow project standard details so that all project fabrications are of matching construction.
8. Walkway shall be provided with hot dipped galvanized steel electrical conduit support system. Conduit support system shall consist of angle brackets spaced at 8'-0" maximum intervals along the length of the walkway

as shown on the Contract Drawings. Conduit support system shall be designed and sized to carry the load of a minimum of four (4) 1" PVC coated galvanized rigid steel conduits along the clarifier walkway as indicated on the Contract Drawings.

9. Walkway/bridges shall each be a welded steel fabrication, hot dip galvanized after fabrication, and supplied with aluminum grating and aluminum handrail. Backpaint aluminum in contact with galvanized steel.

J. Anchor and Connecting Bolts, Nuts, and Washers

1. Attach all components for the entire secondary clarifier with stainless steel machine bolts, ANSI Type 316.
2. Bolt sizes and locations shall be as indicated on the Contract Drawings or as specified in this Section. Under any circumstances, minimum bolt diameter is 3/8 inch and minimum washer thickness is 1/8 inch.

K. Clarifier Fiberglass Accessories

1. Clarifier Fiberglass Accessories as specified Section 11288, including weir plates, scum baffles, density current baffles, and weir and launder covers, shall be furnished by others and installed by the Contractor. The Contractor shall coordinate between the Clarifier equipment manufacturer and the Clarifier Fiberglass Accessories manufacturer to ensure compatibility and coordination between the equipment and the installation of this equipment.

2.04 DRIVE UNIT

A. Design Parameters

1. The center drive assembly shall consist of an integral motor and gearmotor primary speed reducer coupled through roller chain and sprockets to a secondary worm/worm gear reducer driving the main gear through a pinion and shall have an integral overload protection system.
2. Gears and bearings shall be oil bath lubricated with the main bearing totally submerged in oil and the teeth of the main spur gear submerged at least 70 per cent in the oil bath. Oil pumps for lubrication or grease lubricated bearings are not considered appropriate for this application and will not be allowed. The oil reservoir for the main bearing and gear shall have a section of minimum depth 4.75 inches below the main bearing to positively prevent

contamination of the main bearing and gears with condensate or other contaminants. Gear and bearing housings must also be fitted with oil level sight glasses and condensate drains. Condensate must be allowed to drain from a low point of the housing. Condensate and contaminants will not be allowed to drain through the lower pinion bearing.

3. Drive components will be located via a machined, registered fit to preserve the alignment of key drive components under all load conditions. Manufacturers not named in the specification must submit reports of tests and certifications of material hardness prior to shipment to the job site.
4. Major drive components, main gears and bearings must be designed to allow for separate and individual replacement by plant personnel to facilitate quick and economical repairs.
5. The complete center drive assembly, including the overload protection device, shall be a regularly manufactured product of the clarifier manufacturer. The center drive assembly is a key element in a successful clarifier installation; therefore drive assemblies purchased from third party vendors will not be accepted.
6. The primary gear reducer shall be of worm/worm gear, helical or cycloidal design and shall be C-face or integrally mounted to the electric motor. The motor shall be minimum 3/4 horsepower and shall be totally enclosed, fan cooled, with a 1.15 service factor, and have bearings with a minimum B10 rating of 50,000 hours. Operating electric current will be 230/460 volt, 3 phase, and 60 hertz. Each motor will be NEMA Design B employing Class F insulation designed for an ambient temperature of 40 °C
7. The gearmotor primary speed reducer shall drive a secondary worm gear reducer through a #60 roller chain and steel sprockets enclosed in a galvanized 22 gauge steel guard. An integral-inverter motor shall drive the speed reducer. Sprockets and chain shall be designed for the connected horsepower of the drive with a minimum service factor of 4.0. Provision shall be made for adjustment of chain tension.
8. The main drive unit shall consist of a worm gear secondary reduction unit, pinion, and main spur gear assembly. The secondary reducer shall be a worm/worm gear reducer specifically designed for this application. The worm gear shall be centrifugally cast high strength manganese bronze. The worm shall be hardened alloy steel. A single piece pinion shall be keyed to the worm gear to transmit power from the worm gear to the spur gear. In order to maintain proper alignment between the pinion and the spur gear, the

pinion will be supported by bearings both above and below the spur gear. The bearings shall be fitted into precision machined bearing pilots to positively insure bearing and gear alignment.

9. The main spur gear material shall be high strength ductile iron per ASTM A536 grade 80-55-06 or equal. The gear shall have a nominal pitch diameter of 40 inches with a 6.0 inch face width or the equivalent nominal spur gear surface area of 754 square inches. Spur gear surface area is defined as the spur gear pitch diameter multiplied by the spur gear face width multiplied by 3.14.
10. The main gear shall rotate and be supported on a ball bearing assembly provided with four replaceable liner strips fitted into the main gear and turntable base. Liner strips shall be special vacuum degassed carbon corrected alloy steel hardened to a Rockwell hardness of at least 43 to 46 RC. The turntable base shall be a minimum 1 inch thick to insure adequate structural rigidity to properly support the drive bearing and gear.
11. The main gear and bearing shall be completely enclosed in an ASTM A-48 Class 30A cast iron housing provided with neoprene dust seals. In order to ensure the maximum possible base rigidity and vibration dampening, the gear housing shall be of full sidewall construction, integral with the base. Prior to assembly, the base shall be thoroughly inspected for seep holes or inclusions and given a hydrostatic test to insure no leaks are in the oil containment area.
12. The drive unit shall be equipped with an electro-mechanical torque overload control device actuated by thrust from the worm shaft. The pointer shall provide a visual reading of the relative main gear output torque on a 0 to 100 percent graduated scale. The 100 percent reading shall equal the 100 percent drive rating as specified in section 1.03. The control device shall also activate an alarm switch for warning of impending torque overload, a motor cutout switch for overload protection and a back-up safety motor cutout switch for back up overload protection. The respective switches in the overload control device shall be factory calibrated and set to the following settings:
 1. Alarm - 40% of scale
 2. Motor cutout - 85% of scale
 3. Back-up motor cutout - 100% of scale.
13. Overload control components shall be mounted in a weatherproof enclosure of epoxy coated aluminum construction with a gasket-sealed, removable cover. The pointer shall be covered with a clear plastic enclosure and shall be

above the walkway surface for visibility from the walkway. Amperage sensing devices are not acceptable for torque overload protection due to their inability to react quickly enough to prevent damage to the drive. Overload devices with exposed linkage connections will not be accepted due to possible corrosion problems. Devices which react to rotational movement of the secondary reduction unit will not be allowed due to possible misalignment of gearing created by the movement of the reduction unit.

14. The center drive unit shall be designed for the continuous torque rating as specified in section 1.03. The continuous torque shall be defined as the minimum torque at which the drive mechanism may operate continuously 24 hours per day, 365 days per year, for 20 years, at the specified sludge collector arm speed. Main gear and pinion calculations shall be based upon ANSI/AGMA 2001-C95 standards for rating the pitting resistance and bending strength of involute spur and helical gear teeth. Calculations shall clearly present the values used for the following design parameters:

- | | |
|-------------------------------------|-----------------------------|
| 1. Number of pinions | 6. Allowable bending stress |
| 2. Actual face width | 7. Pinion pitch diameter |
| 3. Tooth geometry (I and J factors) | 8. Hardness ratio factor |
| 4. Load distribution factor | 9. Elastic coefficient |
| 5. Allowable contact stress | 10. Life factor |

15. The load distribution factor shall be determined by the empirical method. For parameters which are material dependent, such as allowable contact stress, the calculations shall include a complete description of material and heat treatment used.
16. Worm gearing shall be designed and rated to equal or exceed the specified continuous torque and life. The basis for rating shall be ANSI/AGMA 6034-B92 standards for durability rating and design of worm gear reducers.
17. The continuous torque rating for the drive unit shall be the lowest value determined for the gearing.

B. Overload Protection

1. Four (4) primary drive alarm switches as follows:
 - a. High Torque alarm

- b. Motor cut-out.
- c. Fail-Safe Motor cut-out
- d. Spare

Each switch shall be provided with auxiliary contacts for connection to the alarm system provided at the MCC.

- 2. The drive unit shall be equipped with an electro-mechanical overload control device actuated by thrust from the worm shaft. The pointer shall provide a visual reading of the relative main gear output torque on a 0 to 100 percent graduated scale. The 100 percent reading shall equal the 100 percent drive rating as specified.
- 3. The respective switches in the overload control device shall be factory calibrated and set to the following settings;
 - Alarm; 40% of scale.
 - Motor cutout; 85% of scale.
 - Back-up motor cutout; 100% of scale.
- 4. The control switches and electrical terminals shall be mounted in a local stainless steel NEMA 4X rated enclosure. The enclosures shall be sealed to prevent moisture from entering either the overload device or the drive unit. The pointer shall be covered with a plexi-glass enclosure and shall be above the walkway surface for visibility from the walkway. Amperage sensing devices are not acceptable for torque overload protection due to their inability to react quickly enough to prevent damage to the drive. Overload devices with exposed linkage connections will not be accepted due to possible corrosion problems. Devices which react to rotational movement of the secondary reduction unit will not be allowed due to possible misalignment of gearing created by the movement of the reduction unit.

C. Turntable

- 1. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29×10^6 psi. The center cage shall be fastened to and supported from the gear casing.
- 2. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be oil lubricated and protected by elastomer seals. Felt seals that allow the

entrance of moisture from outside the drive (i.e. rain water, condensate, etc.) will not be allowed.

2.06 FABRICATION REQUIREMENTS

- A. Surface preparation, shop painting and field painting and other pertinent detailed painting specifications shall be in accordance with Section 09900.
- B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- C. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.
- D. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- E. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.
- F. Welds shall be continuous unless noted otherwise.
- G. 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.
- H. Nameplates shall be provided in accordance with Section 15000.
 - 1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
 - 2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.
- I. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

2.07 SPARE PARTS

- A. Furnish the following spare parts in clearly identified dust-proof containers for the clarifiers:

1. Two sets of skimmer wiper blades of each type and size.
2. Two limit switches of each type.
3. Two sets of squeegees for all the scrapers.
4. Two spray nozzles.
5. For the drive unit, provide the following:
 - a. Two sets of gaskets and seals of each type
 - b. One gear motor
 - c. One set of internal rollers bearings (if provided)
 - d. One set of balls and strip liners (if provided)
 - e. Two of each of the sight glasses

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. The complete center drive mechanism shall be tested in the manufacturer's shop to assure quality, to calibrate the drive control, and to verify the drive is running properly prior to shipment.
 1. A complete shop inspection test report shall be sent to the Engineer verifying that the drive meets the quality assurance requirements of the manufacturer and Engineer. Report shall be signed by individual responsible for testing, and shall be submitted prior to shipping.

3.02 EQUIPMENT INSTALLATION

- A. Install the equipment and appurtenances in accordance with the manufacturer's recommendations.
- B. Manufacturer shall provide templates, certified drawings showing all anchors bolt locations and sizes as required for proper embedding in the concrete equipment support structure. The contractor shall provide all anchor bolts in accordance with the manufacturer's recommendations. Anchor bolts shall be 316 stainless steel.
- C. Tolerance on concrete work shall be in accordance with the equipment manufacturer's recommendations.
- D. Installation of the equipment shall not be attempted until the equipment manufacturer has provided detailed installation manuals to the Contractor and the Contractor and manufacturer have instructed key field personnel in detail regarding installation of the equipment.

- E. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences
- F. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.

3.03 LUBRICATION

- A. Lubricate the equipment in accordance with manufacturer's recommendation prior to startup and refill as necessary until the operation of the equipment is turned over to the Owner.
- B. Provide a list of recommended lubricants and a lubrication schedule in accordance with Division 15.
- C. Furnish one year's worth of all types of premium lubricants that the equipment requires.

3.04 PAINTING

- A. Shop primed parts of the equipment shall be finished in accordance with Division 9. All field touch-up painting shall be in accordance with Division 9.

3.05 FIELD TESTING AND INITIAL OPERATION

- A. Startup and initial operation shall be performed in accordance with Section 01650 and this specification section.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Final acceptance of the equipment will be made after the clarifier has been demonstrated in the field to meet the performance requirements stated in this specification under all normal operating conditions and verification that the motors are not overloaded in normal operating conditions.
- D. Perform tests as defined below.
 - 1. Static Torque Test
 - a. Perform a static torque test on each clarifier mechanism under the supervision of the manufacturer's field representative to verify the structural integrity of the mechanism and drive, calibrate the overload

settings, and verify that the alarms are functioning correctly.

- b. Conduct static torque tests after the pier base has been grouted and the unit has been fully assembled and leveled, but prior to grouting of the tank floor. Operate the mechanisms for at least two revolutions to lubricate bearings prior to conducting the test.
- c. Secure the rake arms with cables to temporary anchor bolts installed in the tank floor at locations recommended by the manufacturer and apply torque to the scraper arms by means of ratchet lever and hydraulic cylinder connected to the cable assembly. Do not apply loads by means of the drive motors. Use a dynamometer attached between the cable and the anchor bolts to measure the torque applied. Take and record torque readings at 75%, 100% and 120% of the minimum duty-rated torque values. The unit will pass this portion of the torque test if it had been loaded to the highest specified torque setting without damage.
- d. Using the same device, verify the alarm setpoints for the High Torque Alarm switch (pre-set to activate a remote alarm at a maximum of 85 % of the AGMA design torque) and the Torque Overload Shutdown switch (pre-set to stop the drive motor at 100% of the duty-rated torque). Adjust setpoints as necessary to match the torque reading calculated using the pressure shown on the dynamometer. Repeat the test procedure at least three times for each alarm setpoint verification. The unit will pass this portion of the torque test if the alarm indication points can be verified within 5% variation over three continuous test loadings.

2. Mechanical Performance Test

- a. Place each clarifier mechanism in initial operation in dry tank to demonstrate correct alignment, smooth operation, freedom from vibration, noise and overheating.
- b. Fill each clarifier with plant effluent water and place mechanism in operation. Adjust, as required, the drive mechanism, weirs, sludge and scum collector blades.
- c. With wastewater flow introduced to clarifier, Engineer shall periodically observe clarifier operation and performance during a fourteen corrective day test; in the event the mechanism or a component thereof fails to provide satisfactory performance, adjust,

repair or replace equipment as necessary; after which, the performance test shall be re-run.

- d. Make final adjustments to the equipment under the direction of the manufacturer's representative and to the satisfaction of the Engineer.

3. Operation Tests

- a. The mechanism shall be operated in a dry tank for a minimum of six continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same six-hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be replaced and the test re-run.
- b. Demonstrate proper operation of torque sensor and alarm system

- E. Adjust, repair, modify, or replace any components of the system that fail to meet all specified requirements.

END OF SECTION 11335

SECTION 11336

CLARIFIER BRUSH CLEANING SYSTEM

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SECTION 11336

BRUSH CLEANING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish, install, and test, a brush cleaning system for each secondary clarifier (SC-403 and SC-404), complete with an attachment sleeve mounted to the scum skimmer as directed by the clarifier manufacturer, a mainframe member, several telescopic brush arms, numerous brushes of various sizes, and an assortment of springs in different configurations to provide the biasing forces, and all necessary accessories, in compliance with these specifications and as shown on the Drawings.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification, and the Contractor shall be responsible for providing these sections to the equipment suppliers.
 - 1. Section 01300 – SUBMITTALS
 - 2. Section 01650 – STARTUP OF SYSTEMS
 - 3. Section 01740 – WARRANTIES AND BONDS
 - 4. Section 09900 – PAINTING

1.03 DESIGN REQUIREMENTS

- A. The brush cleaning system for algae and debris control shall be designed for a brush to make contact with each of the following surfaces:
 - 1. Inner Baffle
 - 2. Outer Baffle
 - 3. Inner Weir Surface
 - 4. Outer Weir Surface
 - 5. Top Spillway Surface
 - 6. Angled Spillway Surface
 - 7. Inner Launder Wall
 - 8. Launder Bottom
 - 9. Outer Launder Wall

- B. The brush cleaning system shall be designed to work off the power of the clarifier drive motor. The system shall be constructed to avoid any noticeable torque increases. The unit shall be capable of encountering an indefinite stall without incurring damage.
- C. The unit shall be designed with an engaged position for cleaning, and a disengaged position allowing the system to ride idle around the tank.

1.04 PERFORMANCE REQUIREMENTS

- A. The brush cleaning system shall be custom designed, constructed, for the removal of algae and debris and installed on a circular clarifier.

1.05 SUBMITTALS

- A. Submittals shall be in accordance with Sections 01300 and as specified herein. Submittals shall include as a minimum:
 - 1. Shop drawings.
 - 2. Manufacturer's operation and maintenance information.
 - 3. Manufacturer's installation certificate.
 - 4. Manufacturer's equipment warranty.

1.06 SPARE PARTS

- A. The following spare parts shall be provided in clearly identified dust-proof containers:
 - 1. A spare brush of each size for each clarifier.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The brush cleaning system specified herein shall be provided by, Ford Hall Company, Inc. (Lexington, KY), Or Equal
- B. In the case of an "or-equal", the Contractor shall demonstrate in writing, to the satisfaction of the Owner at the time of the shop drawing submittal that the manufacturer has produced the specified type and size of equipment for sanitary

wastewater service that has been in successful operation for a minimum period of five years prior to the bid date.

2.02 EQUIPMENT DESIGN

- A. Clarifiers shall be circular in design and be completely free of obstructions around the entire periphery of the tank.
- B. Design Requirements shall be based on the drawings.
- C. Specific problem areas must be avoided:
 - 1. Walkway support - Walkway should extend freely to the outer effluent launder wall or beyond and not be supported on the spillway surfaces.
 - 2. Water Supply Lines - The area must be kept free of all supply lines.
 - 3. Baffle Brackets - Brackets with webbing gussets must not be used to attach the baffle. An L-shaped bracket must be used to allow the free passage of the Brush cleaning system and to promote more efficient cleaning.
 - 4. Bolt Protrusions - Bolt protrusions should be minimized. Bolts/studs which attach the weir and baffle should protrude no more than 1/4 inch past the nuts.
 - 5. Skimmer arm shall be of a standard design (no "ducking" or submersible skimmers). Skimmer arm must remain at consistent elevation (plus or minus 1") around the entire periphery of the tank. Skimmer arm must be able to support addition of approximately 100 lbs. without inducing metal fatigue.
 - 6. Concrete surfaces should be finished as smoothly as possible. This will allow for maximum brush life and also increase the effectiveness of algae removal.
- D. Attachment Assembly
 - 1. The Attachment Assembly shall provide a means of attaching the brush cleaning system to the skimmer arm and or rake truss so as not to interfere with any other operations of the skimmer arm (such as the effective skimming of floatable solids or the operation of the skimmer blade assembly at the scum box).
 - 2. The Attachment Assembly shall be custom designed for each specific clarifier. It shall be constructed of 304 Stainless Steel.

E. Mainframe

1. The brush cleaning system Mainframe shall be constructed of Type 304 Stainless Steel and designed to slip easily into the Attachment Assembly and be tightened in position with the use of set screws.
2. The Mainframe shall be designed so that the Brush Arms can be positioned at any point on the Mainframe.

F. Brush Arms

1. All brush cleaning system Brush Arms shall be of Type 304 Stainless Steel and custom designed and installed. A supplier factory service technician will be on site to observe and advise the installation of the brush arms to allow for cleaning all aforementioned surfaces and allow for the following:
 - a. Flexibility to clean effluent surfaces within a plus or minus 4-inch radial variance (specifically: Clarifier walls, weirs, baffle).
 - b. To allow Brush Holder to be adjusted telescopically so that a maximum number of Brush Arm adjustments are possible.
 - c. To have opposite the Mainframe end, a Brush Holder attachment allowing for the insertion of a brush.
 - d. To have a means of biasing the arm to the Mainframe so as to provide sufficient force to remove algae and debris.

G. Brushes

1. Brushes shall be provided that slip easily into the Brush Holder and provide the cleaning means necessary to remove algae and debris from their respective surfaces.
2. Brush construction shall be as follows:
 - a. Brush backing shall be of durable plastic able to withstand continuous exposure to sunlight, seasonal temperature changes and the corrosive elements found in wastewater.

- b. Brush bristles shall be polypropylene with adequate trim length, density, and stiffness for extended continuous use.
- c. Brushes shall be cut and shaped appropriately so as to clean their respective surfaces without binding.

H. Brush Bridge

- 1. Provides the brush cleaning system Launder Brush Assembly a "Bridge" over the effluent hole on which to travel.
- 2. The Brush Bridge shall be constructed entirely out of Type 304 Stainless Steel.

2.03 FABRICATION

- A. The equipment shall be shop assembled and tested according to Sections 01300.
- B. Surface preparation, shop painting and field painting and other pertinent detailed painting specifications shall be in accordance with Section 09900.
- C. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- D. Backpaint metals in contact with concrete or masonry with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- E. Isolate dissimilar metals with dielectric using appropriate fasteners.
- F. Welds shall be continuous unless noted otherwise.
- G. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Not required.

3.02 EQUIPMENT INSTALLATION

- A. Furnish and install the equipment according to the Contract Documents and the manufacturer's on-site instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. Start-up and initial operation shall be performed in accordance with Section 01650 and this specification section.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Final acceptance of the equipment will be made after the Brush cleaning system has been demonstrated in the field to meet the performance requirements stated in this specification under all normal operating conditions.
- D. Adjust, repair, modify, or replace any components of the system that fail to meet all specified requirements.

3.04 TRAINING

- A. Operations and Maintenance Training
 - 1. The manufacturer shall furnish the services of a qualified, factory trained operations and maintenance serviceman to instruct and train plant personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:
 - a. Theory of operation.
 - b. Actual operation.
 - c. Mechanical maintenance.
 - d. Optimization of the system.
 - e. Safe operating and working practices and operation of safety devices.

2. Training shall be completed after the mechanical check-out and dry start of the units. Time, location, and duration of all training sessions shall be coordinated with plant personnel.
3. Training sessions will be held at the project site on weekdays only selected by the County. All training shall be conducted between the hours of 8:00 a.m. and 4:00 p.m.
4. One (1) training session is required.
5. Hands-on training and demonstrations shall use the installed equipment.
6. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of a qualified manufacturer's field representative to inspect the gates after installation, instruct plant personnel in maintenance of the gates for a minimum three 8 hour day excluding travel time as in accordance with Sections 01300 and 01650.
- B. Provide jointly to the Owner and the Engineer an installation certificate from the equipment manufacturer or their approved representative stating that the equipment has been properly installed and tested to their satisfaction and that all final adjustments required have been made.

3.06 EQUIPMENT WARRANTY

- A. The equipment manufacturer shall guarantee for a period of five years on parts (except brushes) and one year labor starting at the time of Substantial Completion that the equipment supplied is free from materials defects or workmanship and will meet the specified performance requirements when in operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

END OF SECTION 11336

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SECTION 11345
CHEMICAL FEED EQUIPMENT

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SECTION 11345

CHEMICAL FEED PUMPS

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the chemical feed equipment as specified herein and as shown on the drawings.

1.02 SHOP DRAWINGS

- A. Shop drawings for all equipment, materials, and appurtenances as specified herein, shall be submitted in accordance with **SECTION 01300, SUBMITTALS**. The Contractor shall include physical characteristics, parts and materials lists, electrical characteristics and installation requirements.
- B. Operations and Maintenance Manuals shall be submitted in accordance with the **SECTION 01300, SUBMITTALS**.
- C. Manufacturer's Certificate for equipment and installation shall be submitted in accordance to **SECTION 01300, SUBMITTALS**.

1.03 EQUIPMENT DESIGN

Equipment design, workmanship, testing and operation shall be as specified under section, **GENERAL MECHANICAL REQUIREMENTS**.

1.04 MANUFACTURER'S INSPECTION AND START-UP

The Contractor shall furnish the services of the peristaltic pump manufacturers' qualified field representatives and installing subcontractors to inspect the equipment after installation, instruct plant personnel in its operation and maintenance, and supervise its initial operation for the minimum duration's listed below and as specified under section, **GENERAL MECHANICAL REQUIREMENTS**. The training duration for the peristaltic pumps shall be no less than four (4) hours per pump.

1.05 MANUFACTURER'S CERTIFICATE

The Contractor shall furnish the Engineer with a Manufacturer's Certificate, as specified under **SECTION 01300, SUBMITTALS**, certifying that the peristaltic

pumps have been installed in a complete and satisfactory manner ready for operation.

PART 2 - PRODUCTS

2.01 SODIUM HYPOCHLORITE METERING PUMPS

- A. Pumps shall be positive displacement peristaltic type complete with spring-loaded pumphead, self-contained variable speed drive, and flexible extruded tube as specified.
- B. Each pump shall consist of an enclosed housing with clear cover and roller compressor mechanism designed for operation with hose. Hose shall be rigidly mounted to the pump body. The pump assembly shall consist of a standard pump head close-coupled to a commercial gearbox that is directly connected to a NEMA C-Face motor. The pumps shall be suitable for Sodium Hypochlorite @ 30% concentration. Pump flow range shall be capable of 0-50 gph with a pressure rating to exceed line pressure by 10 psi minimum. Sodium Hypochlorite metering pumps shall be a QDOSS as manufactured by Watson-Marlow/ Bredel, or approved equal.
- C. The housing shall be constructed of corrosion resistant material suitable for the chemical being pumped. Housing shall be capable of being mounted in a minimum of four (4) mounting positions. Removable cover for the housing shall be clear and of polycarbonate construction.
- D. Rotor shall be a corrosion resistant material, such as Delrin or comparable material, with selectable shaft positions suitable for a two (2) roller design. Shafts shall be 316 stainless steel. The rollers shall be constructed of the same material as the rotor. One roller shall at all times be fully engaged with hose providing complete compression to prevent back flow or siphoning.
- E. Inlet and outlet connections shall be 316 stainless steel MNPT. Radiator style hose clamps are not acceptable. The pump base shall be constructed of corrosion resistant material.
- F. The pump to gearbox connection shall be close coupled and self aligning. Flexible couplings shall not be required. External couplings shall not be acceptable. Gearbox shall be of the in-line helical design, with epoxy powder coated cast aluminum. Minimum service factor of 1.4 based on motor nameplate rating and an AGMA Class II continuous duty rating,

NEMA 56C input. Face of output flange shall be sealed from the wetted pump head by a corrosion resistant seal.

- G. Each pump shall be capable of self-priming when completely dry with a suction lift capability of up to 30 feet of water. The pump shall be capable of running dry without damaging effects to the pump, tube or hose. The pump shall use no check valves or diaphragms and shall not utilize any dynamic seals in contact with the chemical being pumped.
- G. Hose shall be installed as required by the application, shall be suitable for use with Sodium Hypochlorite and shall be designed specifically for use with peristaltic pumps and working pressures to 30 psi. Hose shall be constructed from the highest quality materials, and have an expected life of 6 months minimum, with a 64 Shore A durometer. Hose lubrication shall be food grade silicon grease.
- H. Motor
 - 1. Peristaltic pump motor shall be TENV, inverter-duty, wash-down capable with stainless steel shaft. Motor windings shall be epoxy impregnated, moisture resistant, and epoxy coated to provide corrosion resistance. The motor shall be rated for 460 Volt, 3-phase service. Motor shall be NEMA 56C with a minimum continuous turndown capability of 10:1 and shall meet NEMA MG-1 Parts 30 & 31.
 - 2. Pump motor to gearbox connection shall be close coupled and self-aligning. The motor and gearbox connection shall not require flexible couplings.
- I. Drives and Controls
 - 1. Sodium Hypochlorite metering pumps shall be variable speed. Drive shall be rated for continuous 24-hour operation at ambient temperature to 40 degrees C. Drive enclosure shall be NEMA 4X.
 - 2. Sodium Hypochlorite metering pump controls shall be as described in the Instrumentation Specifications and as shown on the Contract Drawings.

2.02 ACCESSORIES

A. Flexible Connections

Flexible connections shall be installed on the suction and discharge of chemical pumps where indicated on the drawings. Flexible connections shall be capable of absorbing pump vibration and shall incorporate a "Teflon" bellows suitable for chemical service at 125 psig and 120°F. Flexible connectors shall be capable of absorbing at least 2 inch of axial movement.

All flexible connections shall be Type T-2 Teflon Expansion Joints as manufactured by the Metraflex Company, Murcer Co., or equal.

B. Chemical Resistant Hose

Those systems listed in the proceeding schedule and where noted in chemical systems on the Contract Drawings as requiring "flexible hose" shall be PVC with spiral reinforcement, 8 inch bend radius, FDA approved manufacturers: Radial Flex flood processing hose of Darcy Rubber, Potomac Rubber Company, Inc., or equal. Fittings shall be stainless steel or AAI, grooved for mechanical locking couplings Victaulic Snap Joint style 78, or equal.

C. Flow Indicator shall meet the NSF standard requirement for a visual signal to determine that a pump is delivering a solution. The indicator shall be attached to the supply line or discharge line and shall utilize a ball for visual indication by its position in the indicator.

D. Spare Parts

1. Provide four spare tube elements.
2. Provide one spare pumphead assembly and rotor.

2.03 MODULAR SPILL CONTAINMENT DECK

A. Secondary spill containment decks shall be the modular design to configure any shape spill platform. Each module shall be connected to each other with "Bulkhead Fittings" allowing leaked chemical to flow from one platform to the next; and "T-strips shall be used to keep spilled chemical from draining between connected modules."

B. The secondary spill containment deck modules shall be 5 3/4" high, constructed of polyethylene and holds 1-500-gallon drum with minimum 100 gallons of containment. The module shall meet EPA and Uniform Fire code spill containment regulations.

- C. Contractor shall provide containment decks with bulkhead fittings, “T-Strips” and polyethylene spill deck ramps as shown on the contract drawing. The secondary spill containment decks shall be ultra-spilldecks as supplied by Lab Safety Supply, Inc., or approved equal.

2.04 CALIBRATION CYLINDER

- A. The suction line for each peristaltic metering pump shall have a calibration cylinder, sized as shown on the Contract Drawings.
- B. The cylinder shall be constructed of a transparent material suitable for use with the chemical system. The cylinder shall have a leak tight top with vent. The cylinder shall not discolor and the top shall be open to atmosphere.
- C. The cylinder shall have a minimum of graduated volume of 0.25 gallons and shall be graduated with distinct, legible, engraved graduations of suitable units for accurate flow measurement.

2.05 BACK PRESSURE/ANTISIPHON VALVES

- A. Metering pumps shall be provided with back pressure/anti siphon valves. The valves shall be located on the pump discharge line and as shown on the Contract Drawings.
- B. The back pressure/anti siphon valve shall be constructed of a material suitable for use with the chemical being pumped.
- C. The back pressure/anti siphon valve shall be able to supply a minimum back pressure as recommended by the pump manufacturer and a maximum pressure of 50 psi for transfer pumps and 110 psi for metering pumps. The valves shall be adjustable and shall be manufactured by RK Industries, Prominent, or equal.

2.06 PRESSURE RELIEF VALVES

- A. All metering pumps shall be provided with a pressure relief valve. The pressure relief valve shall be installed on the pump discharge line, in a location where it will not be subjected to high instantaneous pressures.
- B. The pressure relief valve shall be constructed of PVC body with Viton seals suitable for use with 12.5 percent sodium hypochlorite.

- C. The pressure relief valve shall be sized to relieve the chemical metering system of extreme pressure conditions and pressure surges. The relief valve setting shall be as follows:

Sodium Hypochlorite: 150 psig

Pressure relief valves shall be manufactured by RK Industries, Prominent, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install peristaltic pumps and appurtenances in accordance with manufacturer recommendations.

3.02 BALANCING AND TESTING

- A. After installation of each pump, operating tests shall be carried out to assure that the peristaltic pump installation operates properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted. Reports of all tests shall be submitted prior to final acceptance of the installation.
- B. Pumps shall be tested to demonstrate that the pumps are capable of operating without vibration or leakage. Testing shall be performed at the maximum design flow rate and at half the design flow rate. Testing shall be demonstrated while controlled and operated in all feasible modes with the pumps operated singly and in unison.
- C. Pump shall be tested by filling a portable calibrated standpipe furnished by the Contractor with chemical and measuring the outage, with all other equipment valved off. The time, volume and pumping pressures shall be recorded.
- D. Test pressure shall be carried out at 30 psig. Backpressure valves shall be manually controlled for this testing, and shall be reset as necessary after testing. The time to deliver a given quantity of chemical at a given stroke and speed setting shall be the same at all pressures.
- E. Pumps shall be tested to demonstrate zero gallons per minute flow at a zero stroke or speed setting. Failure to meet this test shall be cause for rejection.

END OF SECTION 11345

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SECTION 11371

POSITIVE DISPLACEMENT BLOWERS

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SECTION 11371

POSITIVE DISPLACEMENT BLOWERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. The Work in this section includes furnishing, installing, and testing two (2 duty) positive displacement blowers (PBB-B-624 and PBB-B-625) for supplying air to two aerated lagoons. The blowers shall include a sound attenuating enclosure, inlet filter, inlet/discharge silencers, V-belt driven motor, pressure gauge, pressure transducer, discharge temperature gauge with shut down switch, inlet filter differential pressure switch, check valve, pressure relief valve, automatic belt tensioning system, flexible discharge connector, as specified herein and shown on the Contract Drawings.

1.02 RELATED SECTIONS

- A. The specification sections listed below are an integral part of this equipment specification and the Contractor shall be responsible for providing these sections to the equipment suppliers:
 - 1. Section 01300 - SUBMITTALS
 - 2. Section 01650 – STARTUP OF SYSTEMS
 - 3. Section 01740 – WARRANTIES AND BONDS
 - 4. Section 15000 – GENERAL MECHANICAL REQUIREMENTS

1.03 REFERENCES

- A. Not Applicable.

1.04 PERFORMANCE REQUIREMENTS

- A. The positive displacement blowers (PBB-B-624 623) shall meet the following conditions:

Capacity per Blower (scfm)	2,200
Discharge pressure (psig).....	6.6
Site Elevation above MSL (ft)	28
Maximum Discharge temperature (degrees F).....	174
Maximum summer ambient air temp. (degrees F)	95
Ambient relative humidity (%)	70
Maximum Blower Speed (rpm)	2,520

Minimum safe operating speed (rpm)	760
Minimum Capacity at Minimum Speed (scfm)	600
Maximum Discharge Connection Size (inches)	10
Minimum volumetric efficiency	0.88
Maximum Motor Size (HP)	125
Type of cooling	Air cooled
Minimum air filter removal efficiency.....	95% - 5 microns
Maximum noise level with enclosure	79 dB(A)

- B. The maximum dimensions of each blower shall not exceed 73 inches in width, 85 inches in length, and 83 inches in height including sound attenuating enclosure. All blower components shall be inside an enclosure except for flexible connectors. Instrumentation and gauges shall be mounted on the enclosure and allow for remote monitoring when applicable.

1.05 SUBMITTALS

A. Shop Drawings

- 1. Submit shop drawings for equipment provided under this section. Format and content of the shop drawing submittal shall conform to requirements specified in Section 01300.
- 2. The shop drawing submittal shall include the following as a minimum:
 - a. Certified performance curves indicating the design point and the limits recommended for stable operation. Two curves shall be submitted, one curve will be for the maximum speed of the blower and the second curve for the minimum speed. The stable operating points shall be based on actual tests performed at the factory.
 - b. Technical proposal and data sheets.
 - c. Manufacturer's catalog information, descriptive literature, specifications, etc. for pumps, motors, silencers, inlet filter, and accessories, including pump seal assemblies and pressure gauges.
 - d. Manufacturer's certified installation drawings containing all critical dimensions, piping connection sizes, weights, etc. required for installation of the equipment.
 - e. Shop and field painting information.
 - f. Lubrication requirements and MSDS sheets for the lubrication.
 - g. Motor information conforming to the requirements specified in Section 15000.

- h. Manufacturer's written installation instructions, including any special requirements for shipping, handling, and storage of equipment prior to installation.
 - i. Warranty information.
- B. Shop Test Results - Submit shop test results, including certified blower curves for each blower provided, in accordance with the requirements of Sections 01650.
- C. Operation and Maintenance Manual
 - 1. Submit manufacturer's written instructions for proper operation and maintenance of pumps, motors, and accessories provided under this section.
 - 2. Format and content of the manufacturer's operation and maintenance instructions shall conform to requirements specified in Section 01300.
- D. Manufacturer's Certification of Equipment Compliance
 - 1. Submit written certification of proper equipment installation and satisfactory completion of preliminary field testing by authorized field service representative of the equipment manufacturer.
 - 2. Manufacturer's certification shall conform to requirements specified in Sections 01300.

1.06 SPARE PARTS

- A. The Contractor shall furnish the following spare parts in clearly identified dust-proof containers for each blower provided:
 - 1. One (1) flexible connector
 - 2. One (1) set of gaskets
 - 3. One (1) set of V-belts
 - 4. One (1) years supply of oil lubricant for gears and bearings
 - 5. One (1) set of filter elements

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. The process blower manufacturer and model and all accessories shall be the following or equal:
 - 1. Kaeser Model HB 950C/82P

- B. Dimensions and locations shown on drawings for the blower systems are based on the Kaeser model indicated above. Any change in the dimensions or location of equipment or accessories or the type of accessories required to accommodate alternate manufacturers and models shall be at the Contractor's expense.
- C. In the case of an "or-equal", the Contractor shall demonstrate in writing, to the satisfaction of the Owner at the time of the shop drawing submittal that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the bid date.

2.02 EQUIPMENT DESIGN

- A. The blower shall be a rotary tri-lobe design, positive displacement pulsation cancellation, with a V-belt driven inverter-rated motor suitable for outdoor service, corrosion resistant, and continuous operation 24 hours per day. Contractor shall be responsible for installing a local on/off disconnect switch for each blower.
- D. Casing
 - 1. Blower casing shall be of high strength, close-grained cast iron conforming to ASTM A 48. The casing shall provide reinforcement ribs to prevent distortion and be designed to facilitate cooling of the motor and be the vertical style.
 - 2. Casing shall be able to withstand a minimum of 15 psig.
- C. Rotors
 - 1. Two three-lobe rotors of one piece construction fabricated from ductile iron shall convey air from the inlet side to the discharge side of the blower. The two rotors shall intermesh but neither rub nor require lubrication.
 - 2. Hollow rotors are capped, dust tight. Open rotors are not acceptable.
 - 3. Blower rotors are to be balanced according to ISO 1940 class Q2.5/ANSI S2.19 G6.3.
- D. Timing Gears
 - 1. The rotation of each rotor shall be controlled a precision ground timing gear consisting of either helical or spur teeth which are accurately machined, and constructed of heat treated hardened alloy steel. The timing gear material

shall meet AGMA Grade 11 quality with a minimum service factor of 1.7 at maximum operating point.

E. Bearings and Lubrication

1. The drive end and gear end bearings shall be oil splashed lubricated. Grease lubricated bearings are not acceptable.
2. The timing gears and gear end bearings shall be splash oil lubricated.
3. All bearings shall be high standard cylindrical roller bearings.
4. All bearings shall have an L-10 life of at least 40,000 hours at maximum speed and maximum pressure differential.
5. The rotor and shaft assemblies shall be supported by heavy-duty anti-friction bearings with thrust control rated for a minimum B-10 life of 160,000 hours.

F. Seals

1. Positive oil seals shall be provided at each bearing and shall be designed to prevent lubricant from leaking into the air stream.
2. Labyrinth shaft or lip type seals shall be provided where shaft passes through headplate. The rotor side of the oil seal shall be vented to eliminate any possible carryover of lubricant into the air stream.
3. Provisions for venting to the atmosphere between the oil and air-side seals shall be included.

G. Baseplate

1. Blower, drive, and motor shall be mounted on a common fabricated steel baseplate.
2. The base shall be an elevated, rigid, fabricated steel design with a solid sub-base. The blower shall be mounted horizontally for a compact frame.
3. To prevent transmission of vibration and noise, as well as secure the package to the foundation, the base shall include vibration isolators made of rubber in a steel footing equipped with mounting holes for anchoring purposes.

H. Inlet and Discharge Silencers – Both inlet and discharge silencers shall be of multi-chambered design, with an arrangement of ported tubes and chambers which

attenuate the blower noise. Silencers shall be of welded steel construction. Silencers shall have flanged connections for direct bolting to the silencers.

1. Inlet Silencer – Each blower shall be provided with an inlet silencer. Inlet silencer shall be of the absorptive type, directly connected to the inlet port of the blower.
 2. Discharge Silencer – Each new blower shall be provided with a discharge silencer. The silencer shall minimize noise and prevent pipe resonance.
- I. Each blower shall have an inlet filter that is integral to the inlet silencer and conforms to the following:
1. The filter media efficiency must meet the requirements of ASHRAE 52.2 MERV7 50-70% @3-10 microns.
 2. Filter and silencer performance losses shall be included by the blower vendor in the blower performance calculation.
 3. Filter shall include a washable and reusable polyester element for minimal pressure drop.
- J. Frame Support
1. The frame support shall be provided with a swing-type belt tensioning system. Motor slide bases shall not be accepted.
 2. Discharge silencer shall be an integral part of the frame support and shall be located underneath of the motor slide base.
 3. Blower, motor, and all other accessories shall be factory mounted to the support frame and shipped as one unit.
- K. Flexible Discharge Connector
1. Each blower shall include an elastomeric ANSI/DIN flanged arch-type expansion joint at the discharge connection to prevent transmission of forces and movements from the piping to the blower casing and reduce structure-borne noise.
 2. The expansion joint shall be made from reinforced rubber rated for a minimum working temperature of 300 degrees F.
 3. The connector on the discharge must be restrained in the axial direction.

- L. Oil drains from the blower drive-end and gear-end lubricating oil sumps shall be piped to the front of the base for ease of maintenance, if not easily accessible at the edge of the blower package already. The drain valves shall be a ball valve with a fully retained and gasketed threaded cap. Each blower must come equipped with a sight glass to monitor fluid levels.

2.03 MOTOR AND DRIVE

A. Motor

1. Drive motor for the blower shall be provided by the equipment manufacturer designed for specific use with the process equipment being served. Motors shall be provided with operating characteristics as specified herein and be of premium efficiency or Efficiency One per IEC.
2. Motor shall be capable of withstanding all forces which may be imposed during the course of normal operation.
3. Motor shall be of cast iron construction (ASTM A-48, Class 30), fully guarded, self-ventilated with approved number of adequate size openings to provide ventilation throughout. Motors shall be provided with removable access covers, oil reservoirs, seals, lifting eyes, hollow steel machined and polished shaft, oversized motor terminal box, auxiliary control connection boxes and engraved stainless steel nameplates.
4. Thrust bearing shall be grease or oil lubricated, spherical, anti-friction type. The thrust bearing shall be adequate for all thrust loads. Radial guide bearing shall also be oil lubricated ball bearing type. Shaft stray current insulation shall be provided at the thrust and radial bearings to prevent current flow through the bearing surfaces. All bearings shall be designed to have a minimum of B-10 life of 100,000 hours under rated load and speed.
5. Motors shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation.

6. Blower Motor Parameters

PARAMETERS	PBB-B-624 AND 625
Motor horsepower	125 HP
Motor type	Horizontal
Maximum motor speed	3600
Design	NEMA
Duty	Continuous
Insulation	Class F (utilized to Class B temp rise)
Voltage	460V, 3 phase, 60 Hertz
Service factor	1.15
Motor enclosure	TEFC, cast iron construction
Protection	Motor winding thermistor (minimum 1 per phase winding)

7. The electric drive motor shall be mounted on a swing-type motor base of heavy-duty cast iron or fabricated steel construction. The motor base shall be adjustable to allow field adjustment of belt tension without disturbing the belt guard or belt alignment.
8. Motor shall be furnished with winding overheat protection in the form of Positive Temperature Coefficient (PTC) thermistors. One thermistor shall be embedded in each of the motor's windings and wired in series. The control panel supplier shall include a suitable PTC Thermistor relay to integrate the thermistor terminals in the motor junction box to the control panel. The thermistor terminals are rated for a maximum 2.5 volts. The control logic shall shutdown the motor when any one of the thermistors detects a overheat condition.
9. Motor shall be supplied with oversized terminal box and power distribution block.
10. Motor shall be suitable for use with variable frequency drive.
11. Motor shall include isolated motor bearings to prevent Eddy currents (shaft voltage) and the electric discharge machining (pitting) of the motor bearings inherent to VFD driven electric motors. The control panel supplier/installer shall take all necessary precautions to ensure a proper VFD installation, including proper grounding and recommended EMC guidelines such as shielded cabling and separate conduit for control, input, and output conductors.

B. Belt Drive

1. Blower shall be driven by a variable speed, high capacity type, oil and heat resistant V-belt drive assembly, equipped with integral electric drive motor and motor support.
2. The drive assembly shall employ a belt transmission consisting of two pulleys that are connected to a V-belt. Belt tensioning shall be automatic.
3. Output speed of the drive shall be capable of being changed by replacement of the pulleys.
4. All rotating surfaces shall be enclosed by a removable OSHA-approved safety guard.
5. The drive assembly shall have a minimum service factor of 1.4.
6. The PTC motor winding over temperature protection contacts will be identified inside the blower package's main drive motor conduit connection box and there will be two wires/terminals (labeled T1 and T2) connected to a 110V PTC thermistor control module relay type device.

2.04 WINDING OVERHEAT PROTECTION

- A. Contacts shall be identified inside the main drive motor conduit connection box.
- B. Two terminals shall be provided and shall connect to a control module relay device supplier by the control system supplier.
- C. The motor winding heater shall be suitable for 115V/1Ph/60h Hz power supply.

2.05 CONTROLS

- A. Controls for the blowers specified in this section shall be furnished by the Biological Treatment System Manufacturer. See specification sections 11500.

2.06 FABRICATION REQUIREMENTS

- A. The equipment shall be shop assembled and tested according to Sections 01300 and 01650.
- B. Surface preparation, shop painting and field painting and other pertinent detailed painting specifications shall be in accordance with Section 09900.
- C. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

- D. Backpaint metals in contact with concrete or masonry with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- E. Isolate dissimilar metals with dielectric using appropriate fasteners.
- F. Welds shall be continuous unless noted otherwise.
- G. 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.
- H. A nameplate shall be provided for each piece of equipment.
 - 1. Equipment nameplates shall be fastened to the equipment in an accessible location.
 - 2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.
- I. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

2.07 ACCESSORIES

- A. Sound Attenuating Enclosure:
 - 1. Each blower shall be provided with a weatherproof sound attenuating enclosure.
 - 2. The sound enclosure shall have acoustic foam insulation and shall provide sound attenuation of at least 15 dB(A).
 - 3. Ventilation - Each enclosure shall be provided with a dome-type roof mounted exhaust fan capable of five to six air changes per minute. Make-up air shall be introduced through an acoustical plenum panel that is located in the rear of the enclosure. The intake and discharge openings in the plenum panel shall be sized so that there is at least four times the height of the opening, between the bottom of the intake and the top of the discharge. The intake opening shall be covered with a grill. The fan motor shall be provided in accordance with Section 15000 and shall be provided with integral motor overload protection. Where motors do not include integral motor overload protection, the control panel supplier shall provide manual motor starter with

motor overload protection. The ventilation fan motor shall be wired to run whenever the blower package's main drive motor is energized. A timer relay may be incorporated to allow the ventilation fan to continue running 10 – 15 minutes after the blower package's main drive motor has been de-energized to help remove residual heat from the blower package and improve thermal conditions within the enclosure. Electrical requirements shall be 120 VAC/ 1 phase/ 60 Hz. Fan motor shall be pre-wired at the factory and the fan motor shall be interlocked with blower operation to shut down the blower in the event of ventilation failure.

4. Frame - Frames shall be provided for bottom caps, doorjambs, bi-part seams, top caps, and all openings.
5. Panel - Enclosure shall be fabricated with a powder-coated steel exterior skin. The enclosure shall cover the complete blower assembly including blower, motor, belt drive, and inlet and discharge silencers.
6. Doors - Access must be provided for maintenance and service.
7. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.

B. Pressure Relief Valve

1. A spring loaded, factory set, pressure relief valve shall be provided with each blower.
2. Relief valve shall be set to protect the blower from over-pressurization based on specified conditions of service and shall be sized to pass the full design capacity of the blower.
3. The relief valve exhaust shall be piped out of the enclosure.
4. The relief valve shall be capable of being adjusted in the field.

C. Check Valve

1. The check valve internal to the blower shall be of the full-bore low pressure-drop, flapper or wafer-type design mounted on the discharge of each blower. The blower manufacturer shall include the pressure losses produced by the check valve in the required discharge pressure for the blower. The check valve shall be factory installed and tested with the blower.

2. Check valve shall be of steel or cast aluminum, stainless steel spring, and EPDM or silicone sealing material.
 3. Seals shall be rated for at least 300 degrees Fahrenheit.
- D. Discharge Pressure Gauge
1. Blower shall be equipped with a discharge pressure gauge.
 2. Discharge pressure gauge shall be pre-piped and panel mounted on the sound enclosure.
 3. Pressure gauges shall have a minimum 2.5-inch liquid filled dial face.
 4. Minimum range of pressure gauge shall be 0 to 25 psig.
 5. Accuracy of pressure gauge shall be 3 percent of full scale.
- E. Discharge Temperature Gauge with Shut Down Switch
1. Blower shall be equipped with a temperature gauge with adjustable switch with available volt-free contacts for general alarm or warning signal.
 2. Range of temperature gauge switch shall be 120 to 400 degrees F.
 3. The cutout point shall be adjustable.
 4. Shall accept a 120V, 60 Hz, 5A power supply.
 5. Discharge pressure gauge shall be panel mounted on the sound enclosure.
 6. Accuracy of temperature gauge shall be 1 percent of full scale.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Shop testing shall be conducted for each blower prior to shipment to demonstrate that the blower can deliver the specified flow rates and pressure using PTC9 type test or ISO equal. Shop tests shall be in accordance with Section 01650 and this section.
1. At minimum, testing shall include:

- a. Design point.
 - b. Secondary design point (if applicable).
 - c. Design point with motor speed reduction at specified percentage (if applicable).
2. Deviation of actual data from specified performance criteria shall not exceed +/- 5%.
 3. Develop curve for each blower type using at least 10 actual data points.
 4. Development of at least 5 blower curves at different speeds for units specified to be operated with a VFD.
 5. Record motor amperage and brake horsepower and efficiency at each data point at the pump curve.
- B. Engineer shall be informed of factory blower testing date a minimum of 14 days in advance.
- C. Results of factory testing shall be made available to the engineer for review prior to shipment of units.
- D. Include results of factory testing in the O&M Manual.

3.02 EQUIPMENT INSTALLATION

- A. Furnish and install the equipment according to the Contract Documents and the manufacturer's instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. Startup and initial operation shall be performed in accordance with Section 01650 and this specification section.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.

-
- C. Final acceptance of the equipment will be made after the blower has been demonstrated in the field to meet the performance requirements stated in this specification under all normal operating conditions and verification that the motors are not overloaded in normal operating conditions.
1. Demonstrate that the blower has been properly installed and aligned.
 2. Start the blower and operate for a period not less than one hour.
 - a. Verify that unit operates without overheating or overloading motor and without objectionable vibration.
 - b. Verify that the blower can deliver the specified flow rates and pressure using certified factory PTC9 type or ISO equal tests reports compared to measured blower speeds.
 - c. Demonstrate specified maximum noise levels can be met in free-field conditions.
 - d. Obtain concurrent readings, showing motor voltage, amperage, and discharge head.
 - e. Check power leads to the motor for proper current balance.
 - f. Determine bearing temperatures by a contact-type thermometer. A blower running time of at least 20 minutes shall be maintained for the test.
 - g. Adjust blower motor operating frequency (Hz) with the VFD to demonstrate a 50 percent turndown in the motor operating frequency without overheating the motors.
 - h. Test blowers over the entire range (50 to 100 percent) of VFD operation.
 - i. The blowers must operate below a vibration speed of 0.5 inches/second measured at the bearing housing per VDI standard 2056 or equal.
- D. Contractor shall adjust, repair, modify, or replace any components of the system which fail to meet all specified requirements.

3.04 TRAINING

A. Operations and Maintenance Training

1. The manufacturer shall furnish the services of a qualified, factory trained operations and maintenance serviceman to instruct and train plant personnel in the proper care, operation and maintenance of the equipment. The training shall include, but not be limited to, the following:
 - a. Theory of operation.
 - b. Actual operation.
 - c. Mechanical maintenance.
 - d. Optimization of the system.
 - e. Safe operating and working practices and operation of safety devices.
2. Training shall be completed after the mechanical check-out and dry start of the units. Time, location, and duration of all training sessions shall be coordinated with plant personnel.
3. Training sessions will be held at the project site on weekdays only selected by the County. All training shall be conducted between the hours of 8:00 a.m. and 4:00 p.m.
4. One (1) training session is required.
5. Hands-on training and demonstrations shall use the installed equipment.
6. Supplier shall provide all materials for training and shall provide training manuals to all personnel being trained.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of a qualified manufacturer's field representative to inspect the gates after installation, instruct plan personnel in maintenance of the gates for a minimum two 8 hour days excluding travel time as in accordance with Sections 01300 and 01650.
- B. Provide jointly to the Owner and the Engineer an installation certificate from the equipment manufacturer or their approved representative stating that the equipment has been properly installed and tested to their satisfaction and that all final required adjustments have been made.

3.06 EQUIPMENT WARRANTY

- A. The equipment manufacturer shall guarantee for a period of three-years starting at the time of equipment delivery to the job site or one-year starting at the time of Substantial Completion (whichever is shorter) that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

END OF SECTION 11371

SECTION 11385

Floating Mixers and Aeration Equipment

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SECTION 11385
FLOATING MIXERS AND AERATION EQUIPMENT

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Furnishing floating mixers and aeration equipment for two identical waste sludge holding lagoons, complete with all necessary accessories in accordance with the Contract Documents.

1.02. DEFINITIONS

- A. Floating Mixer and Aerator Equipment Supplier: The single Supplier that delivers all Goods included in this Contract to Buyer and acts as the single source of responsibility to Buyer for all Goods and warranties required by this Contract.

1.03. PERFORMANCE REQUIREMENTS

- A. Mixing and aeration system shall be capable of meeting the performance requirements for two identical waste sludge holding lagoons at the high water level with the following characteristics:
 - 1. Approximate Lagoon Dimensions (each)
 - a. Length: 193 feet
 - b. Width: 150 feet
 - c. Total Depth: 14 feet
 - d. Minimum Operating Sidewater Depth: 6 feet
 - e. Maximum Operating Sidewater Depth: 12 feet
 - f. Side Slope: 2:1 (Horizontal : Vertical)
 - 2. Sludge Characteristics
 - a. Upstream Treatment: Extended Aeration
 - b. Sludge Type: Waste Activated Sludge
 - c. Sludge Concentration: 6,000 mg/L – 12,000 mg/L (range for mixers)
 - d. Sludge Loading: 2,240 lbs/day
 - 3. Fluid temperature
 - a. Maximum temperature: 24°C
 - b. Minimum temperature: 12°C
- B. Performance Requirements:
 - 1. Minimum VSS Reduction: 38% to achieve Class B biosolids
 - 2. Maximum combined HP Per lagoon: 125
 - 3. Maintain complete suspension of sludge solids at all locations in each waste sludge holding lagoon.

1.04. SUBMITTALS

- A. Submittals shall be in accordance with Sections 01300, Submittals, and Section 01640, Equipment – General, as supplemented herein. Submittals shall include as a minimum:
 - 1. Shop Drawings:
 - a. Calculations showing aeration needed to achieve required VSS reduction.
 - b. Calculations showing unit can meet the oxygen demand shown in the VSS reduction calculations.
 - c. Calculations showing mixing requirements can be met.
 - d. Maximum loads imparted to support base under all operating conditions.
 - e. Clean Water Testing Reports – including oxygen transfer rates
 - f. Layout of equipment including cable assembly and junction box locations.
 - 2. Special Guarantee
 - 3. Operations and Maintenance Manuals.

1.05. SPECIAL GUARANTEE

- A. Floating Mixer and Aerator Equipment Supplier shall provide Sussex County with a written extended Supplier’s warranty covering the following:
 - 1. For a period of two (2) years from delivery or one (1) year following equipment Startup (whichever is shorter), that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when stored and operated in accordance with the Supplier’s recommendations. The Supplier shall correct any breach in this warranty at their expense. The warranty shall specifically exclude replacement of normal wear items. Supplier shall provide at no additional cost to the owner, goods and services, not to exceed the Limitation of Liability.
 - a. Limitation of Liability – Notwithstanding anything else to the contrary, Supplier shall not be liable for any consequential, incidental, special, punitive, or other indirect damages. Supplier’s total liability arising in any manner under this process warranty and mechanical warranty shall not exceed 100% of purchase price.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Aeration Industries;
- B. Aqua-Aerobics;
- C. Or Equal.

2.02. EQUIPMENT DESIGN

- A. General:
 - 1. Flootation:
 - a. Each unit shall be equipped with a modular float constructed of low density polyethylene or heavy duty fiber-reinforced polyester skin (FRP) filled with closed cell polyurethane foam.

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- b. Modular float shall have connection rings/hooks compatible with Supplier's guide rails to ensure float can travel smoothly up and down float rises and sinks with varying water level. Compatible hooks shall be Type 304 stainless steel.
 - c. The float shall have reserve buoyancy to ensure float assembly has no unequal water displacement while mixers and aerators are in operation under maximum speed and demand.
- B. Mixers:
- 1. Mixer Motor Drive:
 - a. Each motor shall have a rain cap constructed of cast iron or non-corrosive Type 304 stainless steel. Painted or plated carbon steel rain caps will not be acceptable.
 - 2. Motor Bearings:
 - a. Motor bearings shall be regreaseable. Sealed bearings will not be acceptable. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open.
 - b. The top and bottom motor bearings shall be of the combined radial and axial thrust type.
 - c. The lower motor bearing inner race shall be locked to the motor shaft via a special washer and locking nut arrangement
 - 3. Motor Shaft:
 - a. The mixer motor shall have a one piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the impeller.
 - b. The mixer motor shaft shall be a minimum of 2.75-inches in diameter and manufactured from 17-4 PH stainless steel. The maximum allowable full

length shaft run out shall be limited to 0.006 inches total indicator reading (TIR).

- c. The mixer motor shaft shall operate freely without contacting any bearings or bushings other than the motor bearings.

4. Motor Base Assembly:

- a. The motor shall be securely mounted onto a solid Type 304 stainless steel base that is integral with the motor base extension. All submerged wetted motor mounting base components shall be constructed of Type 304 stainless steel.
- b. The motor base shall contain a machined recess to permit the use of a free running, anti-deflection insert. The anti-deflection insert shall not require lubrication. The provision for this insert shall be located in the lower extremity of the motor base extension immediately above the impeller.
- c. The journal insert shall be machined from molded moly-filled urethane, or equal, and shall be a minimum of .0600-inches in diameter or larger through the bore than the diameter of the motor shaft.
- d. The motor end bell alignment pilot on the motor base shall be machined concentric with the machined recess that houses the free running, anti-deflection insert.
- e. The upper portion of the motor mounting base, immediately below the lower motor bearing, shall include two independent acting air seals. These two seals shall be capable of sealing off the flow of air from the suction action of the pumped flow and prevent back flow of liquid during impeller reversal. The lower end of the motor base extension shall be provided with a rotating backflow seal that will prevent grit from being introduced into the anti-deflection insert reservoir, but shall allow liquid to contact the shaft. The backflow seal shall not require scheduled lubrication or maintenance.

5. Impeller:

- a. The impeller shall be a two-blade marine type, minimum 16.5-inches in diameter and be a precision casting of Type 316 stainless steel.
- b. The impeller shall be designed to pump the liquid from near the surface and direct it down toward the vessel/basin bottom.
- c. The impeller shall be streamlined to prevent cavitation and reduce drag and shall have 180° trailback blades to insure non-clog operation.
- d. The impeller shall be capable of being reversed to cause back flow liquid movement without causing damage to the mixer chassis and without causing upflow liquid damage to the motor bearing and windings.
- e. The impeller shall be securely attached to the motor shaft in such a manner so that reversal operation for liquid backflushing will not loosen its connection. Impellers requiring the threading of the shaft for attachment will not be allowed.

- f. The impeller shall be "pitch balanced" to insure equalization of load under full flow operation. Each blade's pitch and rake shall not vary more than 2.0 percent from the other.
 - g. No liquid spray or other liquid leakage upward onto the surface of the motor support surface or flotation chassis will be allowed at any time.
6. Intake Volute Assembly:
- a. The impeller shall operate in a volute made of Type 304 stainless steel plate with a minimum volute diameter of 17-inches.
 - b. No plastic, fiberglass, carbon steel or cast iron materials will be allowed.
 - c. The volute shall be welded to and aligned concentrically with the motor base and float without shims or external adjustment.
 - d. The center structure of the float shall be integral to the float cover and shall transmit all mooring stress from one mooring line to another.
 - e. The center structure shall also contain rigid vertical support gussets that connect the top and bottom alignment flanges that support and connect the motor support base and the submerged impeller volute assembly.
 - f. All connecting bolts shall be Type 316 stainless steel, have drilled heads, and shall be wired in place with stainless steel safety wire.
 - g. No shoulder bolt connection, spacer sleeves, or other type point load connections in tension or compression will be allowed.
- C. Aerators:
1. Aerator Motor Drive:
- a. Each motor shall have a rain cap constructed of cast iron or non-corrosive Type 304 stainless steel. Painted or plated carbon steel rain caps will not be allowed.
2. Motor Bearings:
- a. Motor bearings shall be regreasable. Sealed bearings will not be allowed. Top bearing shall be shielded on the bottom side only. Bottom bearing shall be open.
 - b. The top and bottom motor bearings shall be of the combined radial and axial thrust type.
 - c. The lower motor bearing inner race shall be locked to the motor shaft via a special washer and locking nut arrangement.
3. Motor Shaft:
- a. The aerator motor shall have a one piece motor shaft continuous from the top motor bearing, through the lower bearing and down to and through the impeller.

- b. The aerator motor shaft shall be a minimum of 1.75-inches in diameter and manufactured from 17-4 PH stainless steel. The maximum allowable full length shaft run out shall be limited to 0.006 inches total indicator reading (TIR).
- c. The aerator motor shaft shall operate freely without contacting any bearings or bushings other than the motor bearings.

4. Diffusion Head:

- a. The design of the diffusion head shall be such that the liquid spray will discharge at angle of 90° to the motor shaft, and over a 360° pattern in the horizontal plane, and shall be a stainless steel monolithic casting.
- b. The diffusion head casting shall act as a base for the aerator motor, and alignment of the motor to this base shall be controlled by machined index fittings that engage the P-base of the motor. Diffusion head/motor arrangements that are dependent upon boltholes only for alignment will not be allowed. All diffusion head hardware shall be Type 304 stainless steel and safety wired.
- c. The diffusion head casting shall act as a thrust block to deflect the high velocity, pumped volume of the aerator from the vertical to the horizontal direction. In order to minimize vibration, and to provide adequate strength, the diffusion head casting shall weigh no less than 85 lbs. The bottom side of this casting shall have a 90° radiused transition to effect the hydraulic change in direction with a minimum of head loss.
- d. The diffusion head shall absorb all normal and shock loads encountered by the propeller and transmitted to the diffusion head via the motor shaft and lower motor end-bell. The diffusion head shall distribute these forces into the float via webs that terminate in a flange or ring that is an integral part of the diffusion head. This flange shall mate with a similar flange that is an integral part of the float/volute to spread the stresses generated by the propeller uniformly around the float so that no point loading of the float is allowed. These flanges shall be machined flat to provide proper bearing surfaces. The alignment of the diffusion head flange to the float/volute shall be by use of a 360° index pilot.
- e. Specifically, diffusion head designs that employ studs and spacers, shoulder bolts or fiberglass are not allowed. Load bearing, machined flat, flange-to-flange connections will be mandatory.
- f. The diffusion head shall contain an anti-deflection journal insert to limit the radial deflection of the motor shaft.
- g. This anti-deflection journal insert shall be located in the lower extremity of the diffusion head, approximately one-half the distance between the motor base and the lower end of the shaft.
- h. The journal insert shall be machined from molded moly-filled urethane or equal and shall be a minimum of 0.060" diameter or larger through the bore than the diameter of the motor shaft.
- i. Units featuring a one-piece unsupported shaft will not be allowed.

- j. There shall be a fluid deflector located on the motor shaft immediately below the anti-deflection journal, which shall cover completely the anti-deflection journal insert and the lower portion of the diffusion head.
 - k. This fluid deflector shall be molded from black neoprene and shall be press fit onto the motor shaft.
5. Propeller:
- a. The propeller shall be a two-blade, left-handed, marine type precision casting of Type 316 stainless steel, 11.5-inches diameter, and shall be specifically designed for the application intended. It shall be a self-cleaning type that will not accumulate fibers, rags, stringy materials, etc. The propeller shall have a diameter not allowing a greater clearance with the volute of 0.25 inches.
 - b. Each propeller blade shall be pitched so that the pitch angle and rake angle are within ± 2 percent of the other blade(s).
 - c. The propeller shall be pitches so that the drive motor is loaded between 88 percent and 94 percent of the full load nameplate horsepower.
 - d. Units using inclined screw impellers will not be allowed.
 - e. The propeller must be attached to the motor shaft with a hardened stainless steel pin and set screw. No tapered, threaded shafts with nut fasteners will be allowed.
6. Volute:
- a. The propeller shall operate in a volute made of Type 304 stainless steel and shall be a minimum of 12-inches in diameter. It shall be round and true so that propeller blade tip clearance is uniform within the volute as it rotates. The volute shall have a minimum of 0.188-inch wall thickness, and a minimum of four full-length stainless steel gussets shall be welded on a 90° spacing around the circumference of the volute between the top and bottom flanges.
 - b. The volute shall have a large machined flange at its top extremity that completely encircles the volute, and this flange shall match a similar flange on the bottom of the diffusion head to provide for a bolted, machined flange-to-flange fit to provide uniform distribution of the dynamic loads generated by the propeller and the static weight of the motor and drive. A 360° machined index in the upper flange shall provide concentric alignment of the propeller in the volute by engaging the inside diameter of the mating flange on the diffusion head. Bolt holes alone will not be allowed to locate alignment of the propeller.
 - c. Fiberglass volutes, or carbon steel volutes that are fiberglass, steel or stainless steel lined will not be allowed.
7. Intake Cone:
- a. The intake cone shall be fabricated from 0.070-inch Type 304 stainless steel having a gradually expanding opening outward to the intake end. The length and inlet diameter shall be sufficient to provide uniform inlet hydraulics so that no increase in vibration is caused due to its shape or size. The minimum

acceptable length is 8 inches and the minimum allowable inlet diameter is 16.25 inches.

- b. The material used to fabricate the intake cone shall be structurally sufficient to support the weight of the entire aerator assembly when the aerator is freestanding on dry ground.
- c. For maximum in-depth mixing efficiency, the intake cone shall be designed so that the suction lift from the aerator propeller is vertical from the liquid depth below the aerator. Unless specifically required for anti-erosion requirements, side or angle entry suction inlets will not be approved. Fiberglass intake cones are not allowed. All aerators 20 hp and larger must provide anti-vortex crosses welded inside the cones.
- d. Anti-erosion devices, if required, must be welded to the crosses.

D. Aerator/Mixers:

1. Motor:

- a. The motor terminal box shall be firmly bolted to the motor frame at four points.
- b. The terminal box shall be drilled and tapped to receive one compression watertight fitting to accommodate the appropriate electrical service cables.

2. Blower:

- a. The equipment shall include a high efficiency regenerative blower sized to provide sufficient airflow to yield the rated oxygen transfer capacity. Each blower includes the following features:
 - 1) Maintenance free operation
 - 2) Aluminum alloy construction
 - 3) Inlet and outlet sound attenuating silencers to minimize noise
 - 4) Inlet filters with epoxy-coated wire mesh media rated for 70 microns or better
- b. The blowers shall be tropicalized for corrosion resistance. Blower motors shall be wired separately.

3. Mounting flange shall be stainless steel.

4. Shaft/Universal Joint Coupling:

- a. The shaft shall be stainless steel full-welded to a forged carbon steel universal joint coupling. The shaft must be hollow to promote maximum airflow and oxygen transfer. Units with solid shafts will not be allowed.
- b. The shaft shall be dynamically balanced.

- c. The universal joint coupling shall include standard grease fitting for maintenance lubrication. Units that utilize flexible couplings to attach to the shaft of the motor will not be allowed.
 - d. The shaft shall be stabilized by replaceable water lubricated bearing located within one inch from the propeller hub. The area of the shaft supported by the bearing shall be fitted with a replaceable hardened non-metallic sleeve.
 - e. Units supplied with couplings that require alignment will not be allowed.
5. Housing shall be stainless steel and flanged for mounting to the unit. The housing shall form a guard around the hollow shaft and support a field replaceable, water-lubricated bearing press-fitted into the housing lower end. Water lubrication holes shall penetrate the housing in the area surrounding the bearing.
6. Bearings:
- a. The unit shall be supplied with a field replaceable water lubricated lower support bearing. The bearing shall be press-fitted into the housing to allow ease of replacement.
 - b. Units utilizing a cantilever design without a lower support bearing or regreaseable tapered roller bearings will not be allowed.
7. Propellers:
- a. Bronze mixing propeller shall be stainless steel specifically designed to maximize oxygen transfer and mixing characteristics. Propellers shall be self-tightening such that the propeller threads tighten on the shaft threads during normal operation. The entire flow of air shall pass through the propeller shaft via the hollow drive shaft along the axis of the propeller hub. Aluminum and standard marine type propellers will not be allowed.
 - b. The propeller shall be designed to allow easy removal and replacement in the field.
8. Diffuser:
- a. Aerator shall be equipped with a stainless steel, self-tightening, diffuser threaded to the drive shaft. The aspirated air shall flow through the diffuser in one direction parallel with the axis of the diffuser. The entire flow of aspirated air shall exit at the diffuser opening. The air will be dispersed as fine bubbles, as defined by U.S. EPA-6000/2-82-003.
9. A vortex shield shall be furnished with each mounting assembly to eliminate the formation of vortices, maximize shaft airflow and prevent damage to the propeller during operation. Units without vortex shields will not be allowed.

2.03. ACCESSORIES

1. Supplier shall provide Type 304 stainless steel guiderails that include low water level supports to stop float from passing below safe minimum operating water level. Minimum number of guiderails shall be three per aerator, mixer, and/or aerator/mixer unit.
 - a. Provide anchor sleeves with slide pipes.

2. Supplier shall provide one NEMA 3R type “NF” junction box for each unit. Cord length for each unit shall be sufficient to reach each junction box, plus an additional 10 feet. Supplier shall allow cord length to ensure junction box may be placed at closest shore of lagoon to unit.
3. Electrical Service Cable: Supplier shall provide sufficient length of electrical service cord to reach all units.
 - a. #12 AWG-four conductor UL-62 type ST retractable power cable assembly shall be provided. Each conductor shall be insulated including ground. Conductors shall have Class K stranding per ASTM B-174 and B-172.
 - b. Cable system shall be supplied with a retractable cord unit to ensure no slack or pull on the cord takes place as the equipment rises and falls with changes in water level.
 - c. Shall be of continuous length to each unit.
 - d. Each conductor shall be insulated with a nonhygroscopic filler material, including ground, encapsulated in an outer jacket of CPE, PVC, TPE.
 - e. Cable shall be CSA and UL approved for severe environments, suitable for underwater service.
 - f. Cable shall be resistant to oil, sunlight, ozone, grease, acids, abrasions, and impact.
 - g. Supplier shall provide electrical cable float buoys for 5 foot intervals to support cables or mooring span cable with provisions to attach power cable.

2.04. MOTORS AND DRIVES

- A. All Motors shall have the following requirements at a minimum:
 1. The motor shall be wired for 460 volt, 60 cycle, three phase service.
 2. The motor shall be vertical P base design, totally enclosed, fan cooled (TEFC.), and rated for severe duty.
 3. The motor shall in all cases equal or exceed standard NEMA specifications.
 4. The motor winding insulation shall in all cases equal or exceed NEMA class F design and shall be nonhygroscopic.
- B. Motors and drives shall be furnished by the equipment supplier and shall be designed specifically for use with the equipment provided.

2.05. CONTROLS

- A. By Others.

2.06. FABRICATION REQUIREMENTS

- A. Shop coat per Supplier’s standard finish system and color.

- B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- C. Welds shall be continuous unless noted otherwise.
- D. 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.
- E. Furnish nameplates for piece of each unit.
 - 1. Stainless steel nameplates shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
 - 2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

PART 3 EXECUTION

3.01. DELIVERY

- A. Goods shall be delivered in suitable containers for long term storage in a covered unheated storage facility. Storage containers shall provide for easy access for required maintenance activities.
- B. Supplier shall instruct Owner in required maintenance activities to maintain goods in operating condition during long term storage.

3.02. EQUIPMENT INSTALLATION

- A. Goods furnished under this section will be installed at a later date by a construction contractor separately procured by the Owner.
- B. Seller shall provide detailed written installation instructions at the time of delivery.

3.03. STARTUP AND PERFORMANCE TESTING

- A. Construction contractor will procure equipment Startup and testing services from equipment Supplier under a separate negotiated contract.
- B. Performance testing shall be conducted after Startup of the Mixing and Aeration System.
- C. Prior to the initiation of the performance test, initial operation of the equipment shall be completed to the mixer/aeration equipment Supplier's satisfaction. The mixer/aeration equipment Supplier shall give written notice when they feel the equipment is ready for performance testing.
- D. Test procedures shall be as follows:
 - 1. For each test run, a representative of the Owner or construction contractor, as directed by the Owner, shall record the lagoon conditions and take samples. A representative shall label each sample with required analysis. The samples will be tested for those properties required by the Specifications by a certified laboratory, as specified herein. Performance testing shall be after Startup to demonstrate the following:

- a. VSS Reduction Test – Test must show that specified VSS reduction is met over a period of 60 days. Test shall use sample from WAS holding lagoon influent (Secondary Clarifier effluent) and compare VSS with sample taken from holding lagoon 60 days after influent sample was taken.
 - b. Complete Mixing Test – Three samples taken at Engineer and specified locations shall have suspended solids within 10% of each other.
2. A representative of the aeration and mixer Supplier shall be notified prior to each test and shall be allowed to oversee the testing process.
- E. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial certified laboratory accepted by the Engineer unless otherwise noted.
- F. In the event that the Floating Mixer and Aeration System does not meet the requirements of the Specifications during the performance test, the Mixer and Aeration Equipment Supplier will be permitted to make changes to the equipment and methods of operation at its own expense. The adjustments shall be made as soon as practicable within a period not to exceed 30 days. Following the adjustments, the Mixer and Aeration Equipment Supplier shall make a second test run similar to the first. All costs for the second test run shall be borne by the Mixer and Aeration Equipment Supplier. Additional testing of equipment that has been repaired, modified, or replaced shall be conducted in accordance with the procedure original testing requirements included in the Contract Documents. Conformance with the performance requirements must be achieved before the system will be deemed acceptable.

3.04. TRAINING

- A. Construction contractor will procure operator training services from equipment Supplier under a separate negotiated contract.

END OF SECTION

SECTION 11399
WASTEWATER SAMPLER
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SECTION 11399

WASTEWATER SAMPLER

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all coordination, labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the equipment as shown or specified and in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Furnish detailed shop drawings for all items specified herein in accordance with Division 1.
- B. Furnish detailed Operation and Maintenance manual for all items specified herein in accordance with Division 1.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.
- B. Electrical and Instrumentation equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Division 16 and 17.

1.04 QUALITY CONTROL

- A. The equipment manufacturer shall have a minimum of 10 years experience in manufacturing equipment similar, equal or larger size, to that specified.
- B. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience

requirements. Installation information shall include, but not be limited to, the following:

1. Name and location of the installation.
 2. Name of person in direct responsible charge for the equipment.
 3. Address and phone number of person in direct responsible charge.
 4. Month and year the equipment was placed in operation.
 5. Capacity of Equipment
- C. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.06 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein to meet the Function and Component Tests requirements of Section 00110 – Special Instructions. Services shall be provided as required to ensure complete and operational equipment for one (1) eight (8) hour day.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.07 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be provided by as required to ensure Owner's personnel understanding of equipment and shall follow the general outline training requirements specified in Section 00110 – Special Instructions for a minimum of two (2) hours.

1.08 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective in accordance with Article 38 of the Standard Contract Requirements for (2) two years from the date the system is placed in operation which shall be upon completion of operation tests.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

The wastewater sampler shall be Teledyne Isco Model 6712FR, or equal.

2.02 SAMPLER

- A. The composite sampling unit shall be located as shown on the Contract Drawings. The unit shall be capable of sequential or composite sampling programming. Sampler shall be weatherproof, constructed of corrosion resistant materials and sealed with protective coatings. The exterior shell shall be fiberglass construction.
- B. The unit shall be capable of maintaining a temperature under adverse conditions. Temperature control shall be through three electronic sensors, accurate to 1 deg C, monitoring interior air temperature, ambient air temperature, and evaporator plate temperature. The unit shall built-in heaters to control internal temperature and eliminate freezing problems.
- C. The sample pump shall be a peristaltic type with controls in a NEMA 4X enclosure. The sample pump shall be capable 60 ml/sec at 3 feet vertical lift. Repeatable sample volumes shall be ensured by a non-contacting liquid presence detector which automatically compensate for changes in head. The sample shall be drawn through a 3/8 inch I.D. suction tube of a

length to suit. Sample shall be capable of being collected in (24) – 1000 ml and (4) – 3 gallon polyethylene containers. A sample strainer shall be provided.

- D. The composite sampler unit shall have an automatic liquid volume measurement system in conjunction with microprocessor to insure accurate and time-cycled sampling. Flow proportional sampling shall be achievable through 4-20 mA interface with a remote flow measuring device. The controller shall incorporate a program tamper-proof and display program feedback and cycle complete prompts on a 24-character alpha numeric LCD display. The controller shall have complete diagnostic mode and store minimum of (3) programs. Automatic features shall include rinse cycles, inlet purge, three (3) sample retries if sample is not obtained and automatic shut down. Power requirements shall be 115 volt, 1 phase, 60 Hz. The controller shall be equipped with an internal lithium battery to maintain internal logic and user-selected settings.

2.04 SPARE PARTS

- A. Furnish the following spare parts for equipment to be provided in this section:
1. Four round 10-liter polyethylene sample bottles
 2. Ninety-nine (99) feet of 3/8-inch ID clear vinyl suction tubing
 3. Two polypropylene sample strainers

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Furnish and install equipment in accordance with the Contract Drawings and manufacturer's instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) required for initial operation and testing.

END OF SECTION

SECTION 11500

BIOLOGICAL TREATMENT SYSTEM

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BIOLOGICAL TREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Furnish, install, and test, two (2) cyclic aerated lagoon biological treatment systems complete with all necessary accessories and controls in compliance with the following specifications and as shown on the drawings.
- B. All major process components of the cyclic aerated lagoon biological treatment systems shall be provided by a single equipment supplier, who shall have complete system responsibility for the proper coordination and functioning of the entire system, regardless of the source of individual components.
- C. Equipment furnished by the cyclic aerated lagoon biological treatment systems supplier shall include, but not be limited to:
 - 1. Sixteen (16) floating aeration chains and diffuser assemblies.
 - 2. Eighteen (18) electric motor operated aeration chain butterfly valves (AL-MBFV-230 through 238; AL-MBFV-240 through 248).
 - 3. Two (2) positive displacement blowers (specified in Section 11371) supplied by the biological treatment system manufacturer for supplying air to the cyclic aeration basins
 - 4. Two (2) dissolved oxygen analyzers and two (2) dissolved oxygen transmitters, one per basin, (AL-DO-901, 902).
 - 5. Two (2) mass air flow meters (AL-FE-243, 244), one per basin.
 - 6. One (1) control panel
 - 7. All fittings to connect the supplied equipment to the piping shown on the Drawings.
 - 8. All spare parts listed in this section and in Section 11371.
 - 9. Concrete, pipe bollards, pipe supports, lagoon liner, earthwork, and anchor bolts will be provided by the Contractor.

1.03 PERFORMANCE REQUIREMENTS

A. Fine bubble aeration equipment shall be installed in Aeration Lagoons No. 3 and No. 4. Overall dimensions of the lagoons are approximately 193 feet by 150 feet (measured at the top of berm) with a 2:1 side slope. Bottom of berm dimensions are approximately 137 feet by 94 feet. The total depth of the lagoons is approximately 14.2 feet. The sidewater depth of the lagoons is 12.0 feet at design average flow and 12.7 feet at design peak flow. All elevations are in respect to the bottom of the lagoon.

B. Influent Parameters

The biological wastewater treatment system comprised of two cyclic aeration lagoons shall be designed to meet the effluent criteria stated in 1.03.C. based on an influent wastewater composition consisting of the following parameters shown below.

Table 1

Influent Wastewater Characteristics

	Average Month		Maximum Month	
Flow	1.9 mgd		2.1 mgd	
Minimum Influent Temperature	12°C		12°C	
Maximum Influent Temperature	24°C		24°C	
BOD ₅	190 mg/L	3,000 lbs/day	247 mg/L	4,300 lbs/day
TSS	220 mg/L	3,500 lbs/day	286 mg/L	4,900 lbs/day
TKN	40 mg/L	600 lbs/day	52 mg/L	900 lbs/day
NH ₃ – N	25 mg/L	400 lbs/day	33 mg/L	600 lbs/day
TP	7 mg/L	110 lbs/day	9 mg/L	200 lbs/day
Alkalinity	251 mg/L	4,000 lbs/day	326 mg/L	5,600 lbs/day

C. Effluent Performance Requirements

When operated according to the manufacturer's instructions by a certified operator, in the absence of toxic compounds, the treatment system will produce a secondary effluent quality (following clarification) equal to or less than shown in Table 2 under influent loading rates equal to or less

than those shown in Table 1 without supplemental chemical addition when operated with a mixed liquor suspended solids (MLSS) concentration not to exceed 3,500 mg/L:

Table 2

Influent Wastewater Characteristics		
	Daily Maximum	Monthly Average
BOD ₅	30 mg/L	15 mg/L
TSS	30 mg/L	15 mg/L
TN	N/A	10 mg/L

D. Oxygen Transfer Requirements

The aeration system shall maintain an aerobic environment in the Aerated Lagoons assuming a MLSS concentration of 800 to 5,000 mg/L. Table 11500-3 outlines the quantities of air required based on standard rate conditions of 20°C and 0 mg/L dissolved oxygen in tap water.

Table 11500-3

Air Flow Requirements			
	AOR per Lagoon (lbs/day)	SOR per Lagoon (lbs/day)	Air (scfm)
Maximum Month	5,103	9,816	2,178
Average Month	3,964	6,216	1,381

Notes:

1. Temperature air required: 68°F
2. SOTE = 18.15% at diffuser submergence of 11.0 feet
3. Alpha = 0.70; Beta = 0.95; Fouling Coefficient = 0.90

E. Mixing Requirements

The system shall be capable of maintaining complete suspension of the solids in Aerated Lagoons No. 1 and No. 2 assuming a MLSS concentration of 800 to 5,000 mg/L with no sludge formation on the basin bottom throughout the length of the treatment basins.

F. Flexibility

Air and mixing rates shall be variable over the range necessary for oxygen transfer and mixing outlined above in Table 11500-3. The variation in air

flow rates shall be attainable by altering the blower outputs and cycling the valves.

G. Maximum Air Pressure

The maximum air pressure at the top of the drop pipe shall not exceed 6.26 psig at peak air flow and peak wastewater flow.

H. Check Valve Performance

Each diffuser shall have a check valve feature which prevents entry of liquid into the diffuser when the air supply is shut off.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 and as specified herein. Submittals shall include as a minimum:

1. Manufacturer's experience and qualifications (waived for named manufacturers).
2. Shop drawings
3. Certified design calculations.
4. Written performance guarantee
5. Control panel wiring diagrams
6. Certified performance curves for each blower
7. Shop test results.
8. Manufacturer's operation and maintenance manuals.
9. Manufacturer's installation certificate.
10. Manufacturer's equipment warranty.

B. Control System Shop Drawings shall include the following:

1. Bill of Material including all hardware, software, and spare parts.
2. Manufacturer's catalog information for all equipment, instrumentation, control components and accessories.

3. Control Panel Submittals shall include the following:
 - (1) Submittals shall contain the NEMA type designation and manufacturer data describing the enclosures and showing its compliance with specifications and associated standards.
 - (2) Control panel assembly drawings detailing panel cut-out locations and sizes, back panel and device layout and locations.
 - (3) Submit list of control panel and control station nameplate titles.
4. Provide electrical point to point wiring diagrams showing detailed internal wiring and wiring to field devices. Device tag numbers shall be indicated where shown on the Contract Drawings. Terminal blocks and wiring numbers shall be identified on the wiring diagrams. Wiring diagrams shall be specific for this project. All non-applicable information shall be crossed out.
5. Plant Process Control System Coordination: The system manufacturer shall submit the following information within 45 days after receiving an approved shop drawing submittal for the equipment.
 - (1) Input/Output matrix for all programmed registers and corresponding system parameters which shall be made available through the Ethernet/IP communications network.
 - (2) Submit HMI/Operator Interface graphic displays (screen shots) for each HMI graphic display for the completed program. Submit (4) sets of color screen shots.
 - (3) PLC program – Complete written and electronic form of PLC program, for coordination with plant process control system.
6. Submit a detailed “sequence of operation” controls narrative which completely describes the operation of the control system. Written narrative shall be provided with sufficient detail to demonstrate complete operation of the system. Controls narrative shall be specific to this project. (Generic descriptions from catalog and/or O&M data is not acceptable) Controls narrative shall include the following as a minimum:

- (1) System Manual Operation
- (2) System Automatic Operation
- (3) Control Sequencing
- (4) Instrumentation Loop Controls
- (5) Alternation and Failover Sequencing
- (6) System Alarm Monitoring
- (7) System Alarm/Acknowledge/Reset Procedures
- (8) Power Outage Shutdown and Power Restoration Sequencing
- (9) System Diagnostics

1.04 SPARE PARTS

- A. Provide the following spare parts for the Owner's inventory:
1. Five (5) each of the following: hose and tubing connectors, fittings, and clamps.
 2. Ten (10) plugs for blank diffuser mounts (including all required gaskets and accessory equipment).
 3. Fifty (50) diffuser membranes (packaged for long-term storage).
 4. Ten (10) complete Biofuser assemblies (packaged for long-term storage).
 5. Two (2) spare electric motor operated aeration chain butterfly valves.
 6. Control panel spare parts as follows:

- a. Provide one spare indicating light (full assembly) for each color provided.
 - b. Provide five spare fuses of each type and size used.
 - c. Provide two spare control relays of each type used.
- B. Package spare parts in moisture-proof containers, labeled with the part name and Manufacturer's part/stock number. Submit, in writing, storage procedures for spare parts to ensure adequate protection after delivery.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. The biological treatment system shall be a Biolac® Wave-Oxidation® system furnished by the Parkson Corporation or approved equal.
- B. Dimensions and locations shown on Drawings for equipment and accessories are based on the Biolac® Wave-Oxidation® system furnished by the Parkson Corporation. Any change in the dimensions or location of equipment or accessories or type of accessories required to accommodate alternate manufacturers and models shall be at the Contractor's expense.
- C. The equipment manufacturer shall have 15 years of manufacturing experience and provide a list of at least 25 installations where equipment identical to that proposed to be furnished has been in successful operation. In lieu of said experience, the equipment manufacturer shall provide an extended warranty and cash bond equal to 150% of the equipment price and valid for five (5) years from the start-up of the equipment.

2.02. EQUIPMENT DESIGN

- A. General
 1. The fine bubble aeration system shall provide biological treatment using moving aeration chains, aeration chain control valves, and controls for the operation of the aeration system.
 2. It is the intent of this specification that the manufacturer provides a complete aeration system including all equipment and hardware required for the in-basin components in addition to the process air blowers specified in Section 11371.

3. All concrete required for support or installation of any equipment supplied as part of the system shall be provided as shown on the plans and as required by the manufacturer. All concrete will be provided by the Contractor.

B. Moving Aeration Chain System

1. The aeration system shall be designed so that there are no anchors or points of attachment to the basin bottom. The aeration system must be completely suspended above the basin bottom and not be supported or resting on the bottom. The aeration system must be easily accessible for service and maintenance without basin dewatering or a complete aeration system shutdown.
2. The aeration chain system shall be self-propelled and move back and forth systematically in the wastewater to provide mixing of basin contents. The aeration chains shall have the flexibility and length required move 6 feet in each direction from their starting position. This capability is critical to allow turndown flexibility in the operation of the aeration system while maintaining a completely mixed system. The mixing energy air requirement shall not exceed 40 percent of that required to provide the design SOR.
3. Each aeration chain will be fed air from one side and connect to the air main through individual branches with butterfly valves. The butterfly valve will provide individual control or isolation of the airflow to each chain. An adjustable tension line consisting of stainless steel cable will connect near the last aeration assembly at each end of the aeration chain and securely attach to an anchor post at the side of the basin as shown on the drawings.

C. Moving Aeration Header Assembly

1. The moving aeration chain shall be constructed of a single continuous polyethylene header. All header piping will be manufactured by continuous extrusion process of high density, high molecular weight resin defined by ASTM D1248 Type III, Class C, Category 5, Grade P34. Each header will be field assembled using butt fusion welds.
2. Aeration chain piping shall be SDR 17 for 4" diameter with a minimal wall thickness of 0.265 inches. End caps and adaptors for hose feed end shall be SDR 11 minimum.

D. Air Feed Hose & Connections

1. The connecting hose between each moving aeration header and the butterfly valve shall be EPDM rubber and suitable for high temperature service. The hose shall provide adequate flexibility for the required chain movement and be the same diameter as the moving header. The hose will be attached to the butterfly valve by a stainless steel adapter and to the moving header by a machined polyethylene adapter.
2. The stainless steel adapter will incorporate a $\frac{3}{4}$ " additional valved outlet. Galvanized metal or non-metallic adapters to the butterfly valve shall not be acceptable.
3. The polyethylene adapter shall have a minimum wall thickness equal to SDR 11. Metallic adapters to the polyethylene header shall not be acceptable.
4. The connecting hose shall be held in place by not less than two band-type clamps at each end. Clamps shall be constant torque-type for the connection to the stainless steel adapter and standard band clamps at the polyethylene header. All clamp components will be 304 S.S., minimum. Working clamp rating shall not be less than 40 inch pounds. Rigid pipe connections will not be accepted.

E. Aeration Force Main Butterfly Valve

1. The valve shall be lever operated, capable of bi-directional, drop tight service to 100 psi. The body shall be lug style, cast iron and meet ANSI class 125/150 flange standards. The seat shall be EPDM molded into the valve body and shall ensure drop tight, bi-directional shut off. The disc shall be aluminum bronze with the edges polished to a 32 AARH finish to reduce frictional torque. The stem shall be one piece, 416 stainless steel. The valve shall have bronze upper and lower bearings and polyester upper stem support bushings.
2. For aeration control, the valve shall have an electric motorized actuator mounted directly to the valve and shall have a manual handwheel override. The actuator shall have internal travel limit switches, adjustable mechanical travel stops, external position indicator and anti-condensation heater. The actuator shall be 480 V AC, three phase. Each actuator shall include position limit switches for remote indication of the valve "full open" and "full close" status.

F. Aeration Header Butterfly Valve

1. The valve shall be lever operated, capable of bi-directional, drop tight service to 100 psi. The body shall be lug style, cast iron and meet ANSI class 125/150 flange standards. The seat shall be EPDM molded into the valve body and shall ensure drop tight, bi-directional shut off. The disc shall be aluminum bronze with the edges polished to a 32 AARH finish to reduce frictional torque. The stem shall be one piece, 416 stainless steel. The valve shall have bronze upper and lower bearings and polyester upper stem support bushings.
2. For Wave Oxidation denitrification control, the valve shall have an electric motorized actuator mounted directly to the valve and shall have a manual handwheel override. The actuator shall have internal travel limit switches, adjustable mechanical travel stops, external position indicator and anti-condensation heater. The actuator shall be 110 V AC, single phase. Each actuator shall include position limit switches for remote indication of the valve “full open” and “full close” status.

G. Thermal Mass Air Flow Meters and Transmitters

1. The flow metering equipment manufacturer and model shall be Fluid Components International (FCI) – model ST50; or equal.
2. Flow Sensor
 - a. The sensor shall include a pair of platinum resistance temperature detectors (RTDs). One element shall be heated above the gas ambient temperature and the other shall serve as the gas ambient temperature reference element. System shall determine mass flow rate past the sensing point by measuring the energy required to maintain the heated sensor a given amount above the ambient sensor reference element. Flow elements shall produce a 4-20 mA output linear to gas mass flow rate.
 - b. The flow sensing element shall be of insertion type.
 - c. The sensing element shall be 316 stainless steel, all welded. The sensing element shall be comprised of a “Dry Sensor” technology, with the Velocity sensor being constructed of a

Platinum-Iridium tip section swaged onto a 316SS section. There shall be no organic heat transfer compounds internal to the velocity sensor.

- d. Process connection shall be 1" NPT stainless steel compression fitting with adjustable Teflon ferrule.
- e. Flow sensing element shall be designed for process operating temperatures of -40 to +177°C (-40 to +350F).

3. Flow Transmitters

- a. Transmitter shall be integral to sensor assembly and be a NEMA 4X enclosure.
- b. Unit shall include integral diagnostics to alarm out of range verification.
- c. The electronics shall be designed for operation on 120 VAC ± 10 percent, 60 Hz ± 5 percent.
- d. The signal output shall be 4 to 20mA DC into 750 ohms.
- e. Flow transmitter shall be designed for ambient operating temperatures of -20 to +50°C (-5 to +140F).
- f. The unit shall have an integral LCD display, indicating flowrate and process temperature in degrees F and scfm.
- g. General Purpose CE, FM, CSA, UL Listed.

4. Performance Requirements

- a. Accuracy: $\pm 2\%$ of reading from 10 to 100% of calibrated range.
- b. Repeatability: $\pm 0.5\%$ of full scale below 10% of calibrated range.
- c. Drift: $\pm 0.2\%$ of full-scale range.
- d. Temperature Effect: Less than 0.1% of span for six-month period; Less than 0.01% per one degree F of span from 0 to 150F.

H. BioFuser Oxygen Transfer and Mixing Unit

1. The BioFuser suspended air diffuser assembly will consist of a fully functioning unit capable of housing five (5) diffuser tubes total. The design of the unit must allow for the addition and/or removal of diffuser tubes by the owner without disturbing its stability or air distribution characteristics. For designs where less than five tubes are used, the unused connections will be sealed with airtight, removable plugs. The plugs shall provide easy removal after extended use for the addition of diffuser tubes for future capacity increases. The installed tubes will be supplied at each end by an air supply manifold and secured by means of sealed connection held by a threaded flow-thru bolt and nut.
2. All diffuser tubes will be constructed with a complete, internal flow-through design in order to minimize buoyancy and reduce counterweight/ballast requirements. A maximum ballast weight of 30 pounds will be allowed to insure ease of maintenance over the life of the unit. Ballast in excess of this weight will not be approved. Ballasts must be designed to allow locating the diffuser centerline within 12" of the basin bottom while maintaining not less than 8" clearance for variations in the basin bottom and liner. Rubberized or coated carbon steel ballast assemblies may experience coating failure and are not acceptable. Ballast assemblies not contained within rigid, corrosion-proof enclosures must be supplied using stainless steel materials equivalent to type 304.

I. Diffuser Frame

1. The diffuser frame shall be formed from an extruded polypropylene compound of sufficient strength to prevent warping or deflection. The end connections of each frame shall be sealed using mechanical welding procedures providing a connection stronger than the unwelded tube. Simple solvent welding will not be acceptable.

J. Diffuser Sheath

1. The diffuser sheath shall be composed of a urethane special soft thermo plastic material. This soft urethane sheath shall be held in place by stainless steel clamps. Clamps shall be reusable. The sheath material shall not require any plasticizers or other volatile additives. No softeners will be allowed. Sheaths which require softening additives will not be approved. Rigid, micro porous,

ceramic or rubber-based (EPDM) diffuser membrane materials are not acceptable. To maximize membrane life expectancy, the diffuser design airflow rate shall not exceed 1.5 SCFM/active ft. of diffuser length at the design loading specified.

K. BioFuser Connection

1. The Biofuser will be connected to the moving aeration chain by EPDM hose. The point of connection will be formed by an insert type nozzle fitting with 1" \varnothing ID. Fittings shall be injection molded from polyamide resin with 33% glass filled content for strength and durability. Fittings without this reinforcement will not be approved. Fittings will be made airtight using BUNA-N gaskets. Fittings will be factory molded and field installed.

2.03 DISSOLVED OXYGEN CONTROL SYSTEM

A. General

1. The aeration blowers will be controlled using an on-line dissolved oxygen analyzer and sensor. The analyzer and sensor will be located in the lagoons as shown on the plans.
 - a. All instrument probes shall be UL listed for installation in Class I, Group D, Division 2 Hazardous Locations.
 - b. 120VAC power supplies for field instrumentation equipment shall be derived from the main system control panel. Power supplies for instrumentation shall be provided with transient voltage surge protection equipment.
2. Dissolved Oxygen Sensor: Provide two (2) dissolved oxygen sensors, one per lagoon (AL-DO-901,902). Dissolved Oxygen Sensors shall be Hach, LDO Probe and Sensor, or equal.

B. Equipment Design:

1. Probe shall utilize a blue LED to excite luminescent material on the sensor cap, use a photo cell to measure the delay from when the blue light was energized to when the luminescent material releases red light, and correlate the time delay to the concentration of oxygen present in the process fluid outside the sensor cap. Probe shall utilize a red LED as an internal reference.

2. Maintenance shall be limited to periodic wiping of the sensor cap to remove biological growth and annual replacement of the sensor cap.
3. Measurement range shall be 0 to 20.0 mg/L.
4. Accuracy shall DO reading be +/-0.2-percent of span. Temperature accuracy shall be +/-0.2°C.
5. Repeatability shall be +/-5-percent of span.
6. 90-percent response time shall be less than 40 seconds.
7. Resolution shall be +/-0.01 mg/L for DO concentrations less than 10.0 mg/L and +/-0.1 mg/L for concentrations greater than 10 mg/L.
8. Operating temperature range 0 to 50°C (32 to 122°F).
9. Wetted parts shall be suitable for immersion in the processes listed in Table 17610-1.
10. Digital communication to the transmitter to display dissolved oxygen concentration and temperature.
11. Certifications – Class I, Div.2
12. Probe Stand: The dissolved oxygen sensor will be mounted from a stand as shown on the plans. The stand shall be constructed of Schedule 80 PVC construction with Type 304 stainless steel hardware. The design shall position the probe properly in the basin according to the supplier's instructions.

C. Transmitter/Digital Controller

1. Each Dissolved Oxygen probe listed in shall be connected to a digital controller. It shall be acceptable for more than one probe to share a controller.
 - a. Operating Voltage shall be 120 VAC.
 - b. Enclosure – NEMA 4X suitable for outdoor mounting. Each transmitter shall be mounted within an NEMA 4X instrument enclosure as shown on the Contract Drawings.

- c. Support one, two, and three-point buffer methods of pH sensor calibration.
- d. Signal Inputs – Accept up to two digital sensor inputs simultaneously.
- e. Signal Outputs – Two isolated 4-20 mA analog outputs and three (3) SPDT user-configurable contacts rated 100 to 230 VAC at 5 Amps.
- f. LCD display with LED backlighting. 0.5-inch high reading
- g. The transmitter shall be capable of sending its output signal into a maximum load of 500 ohms.
- h. Certifications - Class I Div 2.

D. Accessories

- 1. Mounting hardware – Provide stainless steel mounting hardware as necessary to mount equipment in locations as described in the Contract Documents.
- 2. Cabling – Provide power, and signal, cable and conduit to locate equipment in locations shown on the Drawings and the Contact Documents according to Section 17000. Provide sufficient length abling to connect the electrode to the analyzer.
- 3. Sensor Cabling – Provide manufacturer supplied cabling in contiguous lengths between each sensor and the associated transmitter. Splices are not acceptable unless otherwise specified on the Contract Drawings.
- 4. Provide an enclosure to contain the digital controller as specified on the Contract Drawings.
- 5. Lightning and Surge Protection – Provide lightning and surge protection for the equipment listed in accordance with Section 17000.
- 6. Provide handrail boom mounting hardware for each sensor. Boom angle of immersion shall be adjustable and constructed as indicated on the Contact Drawings.
- 7. Provide one (1) set of special tools and/or instruments and test

standards, required for calibration and maintenance of the units.

2.04 CONTROLS

A. General

1. The biological treatment system supplier shall provide PLC based electrical control panel with a Human Machine Interface (HMI) to control the operation of the positive displacement blowers, the motor actuated aeration chain valves and the DO control system for the positive displacement blowers. The PLC based control panel shall be pre-wired and tested prior to shipping and only require mounting and connection of external wiring in the field by the Contractor.
2. The PLC based control panel shall be housed in a NEMA 12 painted carbon steel enclosure located in the Pump and Blower Building Electrical Room. The enclosure shall include a single flange mounted disconnecting means operating handle for the control panel main circuit breaker. Provide a means of locking the disconnect in the closed or off position. The HMI shall be located on the panel door and allow for control of all equipment associated with the system.
3. The panel shall be a Square D M-340 PLC. Controls for the equipment shall include the following and be accessible and from the HMI:
 - a. System power indicator light
 - b. H-O-A selection switch for each blower
 - c. Red run light for each blower
 - d. Amber fail light for each blower
 - e. Potentiometer for each blower with speed displayed on the HMI for each blower
 - f. Adjustable dissolved oxygen (DO) control set-point
 - g. Automatic addition of new blower in case of blower failure
 - h. Elapsed runtime meter for each blower
 - i. Wave-Ox time selection
 - j. Chain configuration for Wave-Ox
 - k. Graphic and numerical display of DO
 - l. Graphic status display of all devices
 - m. Alarm clearing function

B. Starters:

1. All motor starters provided will be IEC type with Solid State overloads. Allen-Bradley or equal will be used.

C. Protective Devices:

1. The panel(s) shall be protected using circuit breaker and/or motor circuit protectors as permissible in the NEC and UL. Single phase wiring less than 250VAC/VDC shall be protected using fuses.
2. Breakers will be Cutler-Hammer, or equivalent.
3. A three-phase power monitor will monitor the incoming power to the panels(s). The unit will disconnect the control voltage in the event of loss of voltage on one or more phases.
4. Phase Monitor will be Diversified Electronics SLA Series, or equivalent.

D. Terminal Blocks:

1. Terminal blocks will be of a spring loaded, pressure plate design. Blocks will not use screws as tension devices.
2. Terminal blocks will be Weidmuller Z series or equivalent.

E. Pushbuttons, Switches, Indicator lights.

1. Where needed, these devices will be by Allen-Bradley 800H series or equivalent. Devices will be NEMA 4/4x. Color and configuration of the devices will be as reflected on the drawings. All indicator lights will be transformer type.

F. Relays:

1. General purpose control relays will be of DPDT or 3PDT. Contacts will be 10 Amp or greater. Relays will be socket mountable. Relays will be MSD or equivalent.
2. Latching relays, will be Allen-Bradley Bull 700 Series or equivalent.

G. Control Power Transformer:

1. The Control Power Transformer will be sized as needed. Manufacturer shall be Acme, or equivalent.

H. Operator Interface:

1. Shall have sufficient capabilities to control all system devices.
2. Should have a multi-level menu system that requires no PLC programming knowledge.
3. Operator interface should also be compatible with M-340 PLC.

2.05 FABRICATION REQUIREMENTS

- A. Surface preparation, shop painting and field painting and other pertinent detailed painting specifications shall be in accordance with Section 09900.
- B. All bolts, nuts, washers, and other fasteners shall be Type 304 stainless steel unless otherwise noted.
- C. Backpaint metals in contact with concrete or masonry with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- D. Isolate dissimilar metals with dielectric using appropriate fasteners.
- E. Welds shall be continuous unless noted otherwise.
- 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. Nameplates shall be provided in accordance with Section 15000.
 1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
 2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.
- H. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

PART 3 - EXECUTION

3.01 SHOP TESTING

- A. Conduct shop testing of Blowers per Section 11371.

3.02 EQUIPMENT INSTALLATION

- A. Furnish and install the equipment according to the Contract Documents and the manufacturer's instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for initial operation and testing.
- D. Prior to installation, store gear reducers and motors in buildings or trailers that have a concrete or wooden floor, a roof and fully closed walls on all sides. Protect the equipment from being contaminated by dust, dirt, vibration and moisture. Temporarily connect equipment with built in space heaters to a power source and keep heaters in operation. Rotate all shafts that have bearings on at least a monthly basis.
- E. Check alignment of all aeration equipment prior to initial operation per Section 11371.

3.03 FIELD TESTING AND INITIAL OPERATION

- A. Startup and initial operation shall be performed in accordance with Section 01650 and this specification section.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Final acceptance of the equipment will be made after the biological treatment system has been demonstrated in the field to meet the performance requirements stated in this specification under all normal operating conditions and verification that the motors are not overloaded in normal operating conditions.
- D. Adjust repair, modify, or replace any components of the system that fail to meet all specified requirements.
- E. Notify the Owner, Engineer and manufacturer in writing when the installation is ready for inspection. Notification must be given a minimum of 10 days prior to inspection date.

- F. System supplier shall supply personnel to be present at final equipment installation/inspection and provide start-up assistance for a minimum of 6 man-days.
- G. After inspection, any adjustment or corrections deemed necessary for the correct operation of the system shall be detailed by the supplier and performed by the Contractor.

3.04 TRAINING

- A. All training shall be in accordance with Section 01650.

3.05 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall furnish the services of a qualified manufacturer's field representative to inspect the gates after installation, instruct plant personnel in maintenance of the gates for a minimum five 8 hour days excluding travel time as in accordance with Sections 01300 and 01650.
- B. Provide jointly to the Owner and the Engineer an installation certificate from the equipment manufacturer or their approved representative stating that the equipment has been properly installed and tested to their satisfaction and that all final adjustments required have been made.
- C. In addition to start-up and training services, manufacturer's factory representative shall visit the site at 30 and 90 days following initial equipment start-up to observe system performance, suggest equipment and control settings modifications to plant staff, and conduct additional training as requested by the plant staff.

3.06 EQUIPMENT WARRANTY

- A. The equipment manufacturer shall guarantee for a period of three-years starting at the time of equipment delivery to the job site or one-year starting at the time of Substantial Completion (whichever is shorter), that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.
- B. At the time of initial shop drawing submittal, the equipment manufacturer shall provide a written guarantee certifying that effluent quality shall meet all of the performance requirements specified in this specification under influent loading rates and operating conditions which are at or below the maximum specified values shown in the design requirements.

- C. Should effluent quality fail to meet specified performance requirements during initial performance testing or within the first twelve (12) months following Substantial Completion, the Manufacturer shall provide on-site services of a factory trained technician and any necessary additional parts, equipment, instrumentation, or control modifications necessary meet effluent quality requirements on a continuous basis.

END OF SECTION 11500

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SECTION 11900
ALGAE CONTROL EQUIPMENT
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SECTION 11900

WASTEWATER SAMPLER

PART 1 - GENERAL

1.01 DESCRIPTION

Provide all coordination, labor, materials, equipment and services necessary for and incidental to, the complete and satisfactory installation of the equipment as shown or specified and in accordance with the requirements of the Contract Documents.

1.02 SUBMITTALS

- A. Furnish detailed shop drawings for all items specified herein in accordance with Division 1.
- B. Furnish detailed Operation and Maintenance manual for all items specified herein in accordance with Division 1.

1.03 EQUIPMENT DESIGN

- A. Mechanical equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Section 15000, General Mechanical Requirements.
- B. Electrical and Instrumentation equipment design, workmanship, testing and operation shall be as specified herein and in accordance with Division 16 and 17.

1.04 QUALITY CONTROL

- A. The Equipment Manufacturer shall provide a list of at least 10 exclusively different U.S. installations where equipment identical to that proposed to be provided has been in successful operation. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as 1 installation toward meeting the experience requirements. Installation information shall include, but not be limited to, the following:

1. Name and location of the installation.
 2. Name of person in direct responsible charge for the equipment.
 3. Address and phone number of person in direct responsible charge.
 4. Month and year the equipment was placed in operation.
 5. Capacity of Equipment
- B. The equipment provided shall conform to all applicable requirements of the governing bodies listed in Section 15000 General Mechanical Requirements.

1.05 DELIVERY, STORAGE AND HANDLING

- A. The equipment shall be packaged to minimize possible damage from moisture, temperature variations and impact due to shipping conditions. Exposed threads shall be protected with tape or caps, openings shall be closed by caps or plugs. Detailed installation instructions shall accompany the equipment.
- B. The Contractor shall inspect the equipment when it is delivered to ensure that it is not damaged. Store the equipment in a dry location and maintain the equipment per Manufacturer's recommendations.
- C. Dispose of packing materials in accordance with state and federal regulations.
- D. Delivery, storage and handling shall be in accordance with Division 1.

1.06 MANUFACTURER'S INSPECTION AND START-UP

- A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein. Services shall be provided as required to ensure complete and operational equipment for one (1) eight (8) hour day.
- B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.07 TRAINING

Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be provided by as required to ensure Owner's personnel understanding of equipment and shall follow the general outline training requirements specified in Section 00110 – Special Instructions for a minimum of two (2) hours.

1.08 WARRANTY AND GUARANTEE

Contractor shall warrant and guarantee to the Owner that all work will be in accordance with the Contract Documents and that the equipment, material, workmanship, performance and installation will not be defective in accordance with Article 38 of the Standard Contract Requirements for (2) two years from the date the system is placed in operation which shall be upon completion of operation tests.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

The algae control equipment shall be LG Sonic MPC-Bouy, or equal.

2.02 WATER QUALITY MONITORING

- A. The system shall provide a complete overview of the water quality by collecting the following parameters every 10 minutes: Chlorophyll α (green algae), Phycocyanin (blue-green algae), pH, Turbidity, Dissolved Oxygen, and Temperature.
- B. The equipment shall be equipped with a set of sensors that monitor important parameters of water quality in real time. The basic set of sensors are:
1. Chlorophyll a (Algae)
 2. Phycocyanin (Blue-green algae)
 3. Dissolved Oxygen
 4. Turbidity
 5. Temperature
 6. pH
 7. Redox

2.03 ULTRASONIC TREATMENT

The equipment shall have a minimum of 4 ultrasonic transmitters for 360-degree algae control. Each transmitter shall have ultrasonic treatment range of 500m/1600ft in diameter. Based on the measured water quality data, the system shall remotely activate the right ultrasonic program using web-based software allowing users to visually track the water quality and the progress of the ultrasonic treatment.

2.04 POWER SUPPLY

The equipment shall have three (3) solar panels of 195 Wp and one (1) 24 Volt, 40-amp lithium batteries for autonomous power supply with an HDPE enclosure. The device shall have a power consumption of 5-20 Watts. The device shall operate year-round using energy saving modes when necessary.

2.05 CONSTRUCTION

The system shall consist of three unsinkable floats that carry the weight of the system in the water. The aluminum powder coated frame is both UV and corrosion resistant. An anchor system shall be included with required accessories to hold the system in place.

2.06 SPARE PARTS

A. Furnish the following spare parts for equipment to be provided in this section:

1. One (1) Transmitter and aquawiper
2. One (1) Regulator
3. One (1) Ultrasonic box
4. One (1) Datalogger box
5. One (1) USB cable
6. One (1) Antenna
7. One (1) cable regulator/datalogger box
8. One (1) cable datalogger box/ Ultrasonic Box
9. Four (4) solar extension cables
10. One (1) transmitter arm left
11. One (1) transmitter arm right
12. Bolts and nuts

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Furnish and install equipment in accordance with the Contract Drawings and manufacturer's instructions.
- B. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences.
- C. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) required for initial operation and testing.

END OF SECTION



WHITMAN, REQUARDT & ASSOCIATES, LLP