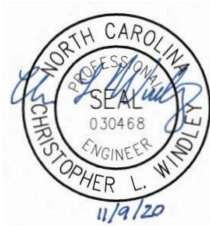


PROJECT MANUAL
FOR
NEUSE RIVER EAST PARALLEL INTERCEPTOR

City of Raleigh
Wake County, North Carolina
Hazen/CJS Project No. 32426/100-002

November 2020

FINAL DESIGN – ISSUED FOR BID



Chris L. Windley, P.E.



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ADVERTISEMENT FOR BIDS

POSTED: 11-09-2020

CITY BID NUMBER: 274-

WS-2016-10

Project: Neuse River East Parallel Interceptor

Owner: City of Raleigh, North Carolina
Raleigh Water
One Exchange Plaza, Suite 620, Raleigh, NC 27601
Contact: Dennis Lassiter, P.E.
919-996-3477
dennis.lassiter@raleighnc.gov

Engineer: CJS Conveyance, PLLC
320 S. Academy Street, Cary, NC 27511
Contact: Chris L. Windley, P.E.
919-890-3879
cwindley@cjsconveyance.com

Separate sealed Bids will be publicly opened and read aloud at **2:00 PM, Thursday, December 17, 2020**, at the Raleigh Water Operations Center (3304 Lake Woodard Drive, Raleigh, NC 27604) for the construction of the Neuse River East Parallel Interceptor project. Sealed bids may be dropped off at the office of the Engineer either the day of the Bid Opening until **11 AM**, or between the hours of **8 AM and 5 PM** in the days prior to the Bid Opening. Sealed bids may also be dropped off at the Raleigh Water Operations Center Bid Opening meeting location between **1 PM to 2 PM** on Bid Opening day. Immediately after bids are received, a meeting will be held outside the Raleigh Water Operations Center where bids will be publicly opened and read aloud. A map indicating the Bid Opening meeting location will be provided at the Pre-Bid meeting. As a precautionary measure due to COVID-19 and understanding that some businesses have chosen to suspend employee travel, the Bid Opening will also be held via a virtual meeting. Contractors and Vendors are strongly encouraged to attend the bid opening via virtual meeting. For those who wish to attend in person, all attendees will be required to adhere to the North Carolina and CDC social distancing and mask wearing guidelines. We also strongly recommend that each submitting firm only send one representative, if desiring to have an in-person presence, so that recommended social distancing can be accommodated. Invitations to the virtual meeting will be sent to those who attended the mandatory Pre-Bid Meeting. Others interested in attending shall contact the Engineer.

After Bids are opened, the Owner shall evaluate them in accordance with the methods and criteria set forth in the Instructions to Bidders. The Owner/City Council reserves the right to waive any informality or to reject any or all Bids. Unless all Bids are rejected, Award will be made to the lowest responsible and responsive Bidder, taking into consideration quality, performance and the time specified in the Bid Form for the performance of the Contract.

A **mandatory** Pre-Bid Meeting will be held via a virtual meeting at **2:00 PM, Thursday, November 19, 2020**. No onsite meeting will be held, and Contractors and Vendors should not come to the City expecting to attend in person. **Those who wish to attend the Pre-Bid Meeting must send an email to cwindley@cjsconveyance.com no later than 5:00 PM, Wednesday, November 18, 2020 to ensure an invite with the meeting link can be provided.** No guarantees shall be made for those who request to attend after the deadline specified herein.

Requirements for pre-bid submittals of an “or-equal” are required within 10 days of the issuance of the Advertisement for Bids and in accordance with Section 00200, Instructions to Bidders.

The Project consists generally of the following major items:

BASE BID:

- 26,000 LF of 84-inch and 96-inch gravity sewer interceptor and branch sewers
- 70 sanitary sewer manholes including precast concrete manholes and fiberglass pipe tee manholes
- A cast-in-place vortex drop structure and twin 66-inch inlet pipes and 72-inch outlet pipe
- Two trenchless NCDOT road crossings (Auburn-Knightdale Road and Poole Road) by hand excavation tunneling with liner plate
- Two open cut crossings of the Neuse River for installation of 72-inch gravity sewer interceptor
- Abandonment of two existing wastewater pumping stations (Neuse River Pump Station and Riverview Pump Station)

ALTERNATE BID:

- Install Precast Polymer Concrete Manholes in lieu of Standard Precast Concrete Manholes or Fiberglass Tee Manholes in the Base Bid

Bidding Documents may be examined at Engineer's office and online at: ConstructConnect, McGraw Hill Dodge Company, Construction Journal, and NC Institute of Minority Economic Development (a.k.a. The Institute).

Complete Bidding Documents are available in electronic or printed form and can be obtained from Duncan-Parnell via their bid room, <http://www.dpibidroom.com>. Registration with Duncan-Parnell is required to obtain the bid documents. A NON-REFUNDABLE FEE plus tax for a printed set, for a printed set with an electronic copy provided on a USB, or for a download is required. Bidders shall contact Duncan-Parnell for purchase of the documents. Neither Owner nor Engineer will be responsible for copies of the Bidding Documents obtained from sources other than from Duncan Parnell. For assistance with registration on <http://www.dpibidroom.com> or ordering bid documents please contact: Danielle Werner, raleigh@duncan-parnell.com or 919-833-4677.

With each request for Bidding Documents supply the following information: Company name, contact person, street address, phone number, and email address for Bidding point of contact; N. C. contractor's license with limitation and classification; indicate if the firm will be a Prime bidder, Supplier or Sub-Contractor.

Bidders will be required to show evidence that they are licensed to perform the work in the Bidding Documents as required by North Carolina General Statute, Chapter 87 and the Instruction to Bidders.

Bid Security in the amount of five percent (5%) of the Bid must accompany each Bid and shall be subject to the conditions provided in the Instruction to Bidders. **Only bids from the Prequalified General Contractors will be accepted. These contractors include the following:**

- Garney Companies, Inc.
- John D. Stephens, Inc.
- Kiewit Infrastructure South Co.
- Park Construction of NC, Inc.

- Ruby-Collins, Inc.

Pursuant to General Statutes of North Carolina Sections 143-128.2 and 143-131, and in accordance with City policy, the City of Raleigh encourages and provides equal opportunity for certified Minority and Woman-Owned Business Enterprise (MWBE) businesses to participate in all aspects of the City's contracting and procurement programs to include Professional Services; Goods and Other Services; and Construction. The prime contractor will be required to identify participation of MWBE businesses in their Bid, and how that participation will be achieved.

Furthermore, the City's goal is to contract or sub-contract fifteen percent (15%) of the contract amount to certified MWBEs on construction projects over \$300,000, or with contracts that include \$100,000 or more in state funding.

City of Raleigh

Mary-Ann Baldwin, Mayor

END OF DOCUMENT

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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 and which registers plan holders.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the Advertisement For Bids may be obtained by registering with the Issuing Office as identified in the advertisement.
- 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.
- 2.04 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents, or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as plan holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms, or for a Bidder's failure to obtain Addenda from a plan room.
- 2.05 *Electronic Documents*
- A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.
1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.
- B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.05.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 **The City of Raleigh has pre-qualified five (5) general contractors as listed in the Advertisement for Bids. Only these bidders will be permitted to submit bid proposals.** Bidders are notified that relevant Articles of Chapter 87 of the General Statutes of North Carolina, will be observed in receiving and awarding contracts. Bidders for this Project must be properly licensed for the Work.

- 3.02 To demonstrate Bidder's qualifications to perform the Work prior to award, within 5 days of Owner's request, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be called for below.
- A. Evidence of Bidder's authority to do business in the state where the Project is located.
 - B. Bidder's state contractor license number.
 - C. Official name of Bidder and length of time the organization has been in business under present name.
 - D. Address, phone and fax numbers of main place of business. Address and phone numbers of company office that will manage the Project if different than above.
 - E. Officers of the company. Name and resume of designated project manager and field superintendent. Number of regular employees of the organization.
 - F. Latest financial statement showing assets and liabilities of the company.
 - G. Name and home office address of the Surety proposed and the name and address of the responsible local claim agent.
 - H. Listing of completed projects of similar size and type in the last 5 years. Provide name and phone number of project owner representative.
 - I. Existing work commitments.
 - J. List of work to be subcontracted. Name and addresses of subcontractors.
 - K. Names and addresses of major material Suppliers.
 - L. Statement that bidder is capable of completing the project within the stated time.
 - M. Safety record of company for the last 5 years showing any violations, etc.
 - N. List of all claims/resolutions/final judgements for the last 10 years.
 - O. Failure or refusal to furnish information requested shall constitute a basis for disqualification of Bidder and the withholding of the Bid Bond.
- 3.03 The apparent Low Bidder shall submit within 72 hours of the Bid Date the following Affidavits:
- A. Affidavit C, Portion of the Work to be Performed by Certified MWBE Businesses.
 - B. Affidavit D, Good Faith Efforts.
 - C. Failure or refusal to furnish information requested shall constitute a basis for disqualification of Bidder and the withholding of the Bid Bond.

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

ARTICLE 4 – EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.01 *Subsurface and Physical Conditions*

A. The Supplementary Conditions identify:

1. Those reports known to Owner of explorations and tests of subsurface conditions at or contiguous 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).

B. Copies of reports and drawings referenced in Paragraph 4.01.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 5.03 of the General Conditions has been identified and established in Paragraph 5.03 of 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.

4.02 *Underground Facilities*

A. Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.

4.03 *Hazardous Environmental Condition*

A. The Supplementary Conditions identify any reports and drawings known to Owner relating to a Hazardous Environmental Condition identified at the Site.

B. Copies of reports and drawings referenced in Paragraph 4.03.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 5.06 of the General Conditions has been identified and established in Paragraph 5.06 of 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.

4.04 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.

- 4.05 On request, Owner will provide Bidder access to the Site to conduct such examinations, investigations, explorations, tests, and studies as Bidder deems necessary for submission of a Bid. 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. Bidder shall comply with all applicable Laws and Regulations relative to excavation and utility locates.
- 4.06 Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work contemplated by these Bidding Documents. On request, Owner will provide to each Bidder for examination access to or copies of contract documents (other than portions thereof related to price) for such other work.
- 4.07 Paragraph 7.13.G of the General Conditions indicates that if an Owner safety program exists, it will be noted in the Supplementary Conditions.
- 4.08 It is the responsibility of each Bidder before submitting a Bid to:
- A. Examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents, including any Addenda;
 - B. Visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
 - C. Become familiar with and satisfy Bidder as to all federal, state, and local 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 contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Paragraph 5.03 of the Supplementary Conditions as containing reliable Technical Data, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Paragraph 5.06 of the Supplementary Conditions as containing reliable Technical Data;
 - E. Consider the information known to Bidder; 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, including applying any specific sequences of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;
 - F. Agree at the time of submitting its Bid that 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(s) 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; and
- I. Determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.
- J. The site shall be inspected only in the company of an authorized representative of the Owner with appointments made through the Owner's project representative. The representative's contact information for this project is Dennis Lassiter, P.E., (919) 996-3477, dennis.lassiter@raleighnc.gov.

4.09 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific sequences of construction that may be shown or indicated or expressly required by the Bidding Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Bidding Documents and the written resolutions thereof by Engineer are acceptable to Bidder, and that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

ARTICLE 5 – PRE-BID CONFERENCE

5.01 A mandatory Pre-Bid Conference (Virtual) will be held at 2:00 pm local time on Thursday November 19, 2020. Representatives of Owner CJS Conveyance will be present to discuss the Project. No onsite meeting will be held, and Contractors and Vendors should not come to the City expecting to attend in person. Those who wish to attend the Pre-Bid Meeting must send an email to cwindley@cjsconveyance.com no later than 5:00 PM, Wednesday, November 18, 2020 to ensure an invite with the meeting link can be provided. No guarantees shall be made for those who request to attend after the deadline specified herein. Bidders are required to attend and participate in the conference. 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 6 – SITE AND OTHER AREAS

6.01 The Site is identified in the Bidding Documents. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Bidding Documents. The Owner has obtained the temporary easements shown for construction and limited staging and laydown area as indicated on the Drawings; however, all additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor with agreements being in writing and a copy of the agreement provided to the City. All permits, regulatory approvals and fees associated with obtaining the additional area shall be the full responsibility of the Contractor.

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 only. Interpretations or clarifications considered necessary by Engineer, in response to such questions, will be issued by Addenda to all plan holders registered with the

Issuing Office. Questions received less than 7 working 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. Engineer's email address is cwindley@cjsconveyance.com.

- 7.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.
- 7.03 Submittal with questions shall include the project name, City Bid Number, the person's name submitting the question, firm, telephone number, and email address.
- 7.04 Addenda, when issued, will be on file at the offices of the Owner and Engineer and the NC Interactive Purchasing System (IPS) at least 24 hours before Bids are opened. It shall be the Bidder's responsibility to make inquiry as to the Addenda issued. All such Addenda shall become part of the Contract Documents and all Bidders shall be bound by such Addenda, whether or not received by the Bidders.

ARTICLE 8 – BID SECURITY

- 8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternatives) and in the form of a certified check, bank money order, or a Bid Bond (on the form attached) issued by a surety meeting the requirements of Paragraphs 6.01 of the General Conditions.
- 8.02 The Bid security of the Successful Bidder will be retained until 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 returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 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. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Agreement or the end of the Bid holding period, whereupon Bid security furnished by such Bidders will be returned.
- 8.03 Bid security of other Bidders whom Owner believes do not have a reasonable chance of receiving the award will be returned within 7 days after the Bid opening.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be substantially completed, ready for final payment, and Milestones (if any) are set forth in Section 00520, Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, are set forth in Section 00520, Agreement.

ARTICLE 11 – “OR-EQUAL” ITEMS

- 11.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, or those “or-equal” materials and equipment approved by Engineer and identified by Addendum. The materials and equipment described in the Bidding Documents

establish a standard of required type, function and quality to be met by any proposed “or-equal” item. No item of material or equipment will be considered by Engineer as an “or-equal” unless written request for approval has been submitted by Bidder and has been received by Engineer within 10 days of the issuance of the Advertisement for Bids or invitation to Bidders. Each such request shall conform to the requirements of Paragraph 7.05 and 7.06 of the General Conditions and related Supplementary 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 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.

Applications for review of “or-equals” materials or equipment shall be by Bidders only.

- 11.02 All prices that Bidder sets forth in its Bid will 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” requests are made at Bidder’s sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

- 12.01 If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. 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 a substitute, without an increase in the Bid.
- 12.02 If apparent Successful Bidder declines to make any such substitution, Owner may declare the Bid as non-responsive and award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not 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 revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 7.07 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 Supplementary Conditions 7.07.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents. Additional copies may be obtained from the Issuing Office. To bid the project the Bidder should be registered with the Issuing Office.

- 13.02 All blanks on the Bid Form shall be completed in ink 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 item listed therein. In the case of optional alternatives the words “No Bid,” “No Change,” or “Not Applicable” may be entered. Bid forms shall not be conditional, limited, or restricted in any way.
- 13.03 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.
- 13.04 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.
- 13.05 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.06 A Bid by an individual shall show the Bidder’s name and official address.
- 13.07 A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 13.08** All names shall be printed in ink below the signatures.
- 13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.10 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.11 The Bid shall contain evidence of Bidder’s authority and qualification to do business in the state where the Project is located. Bidder’s state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID; COMPARISON OF BIDS

14.01 Lump Sum

- A. When the Bid Form is set up for Lump Sum bidding, Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form.
- B. When the Bid Form includes Alternate(s), Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- C. In the comparison of Bids, alternatives will be applied in the same order of priority as listed in the Bid Form to the extent that project funds are available.

14.02 Unit Price

- A. Bidders shall submit a Bid on a unit price basis for each item of Work listed in the Bid schedule.
- B. The total of all estimated prices will be the sum of the products of the estimated quantity of each item and the corresponding unit price. 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.
- D. When the Bid Form includes Alternate(s), Bidder shall submit a Bid on a unit price basis for the base Bid and include a separate price for each alternate described in the Bidding Documents as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
- E. In the comparison of Bids, alternatives will be applied in the same order of priority as listed in the Bid Form to the extent that project funds are available.

14.03 Allowances

- A. When the Bid Form includes 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 The Owner, at the location and time indicated in the Advertisement for Bids, will receive sealed Bids. Bids received after the indicated time and date shall not be considered.
- 15.02 With each copy of the Bidding Documents, a Bidder may be furnished one separate unbound copy of the Bid Form and the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and all attachments as outlined in Article 8 of the Bid Form. The complete list of required bid documents can also be found in the attached Bidder's Checklist. The completed checklist shall be the first page of all bids submitted.
- 15.03 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement For Bids and shall be enclosed in a plainly marked package with the Project title, City Bid Number, and project name as applicable, the name and address of Bidder, 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."
- 15.04 The Bidder shall be fully responsible for timely delivery at the location designated for receipt of the Bids.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be modified or 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. Modifications shall indicate only the amount to be added to or deducted from the Bidder's Bid amount as submitted on the Bid Form.

16.02 No bid may be withdrawn after the Bid opening for a period of time as indicated in the Bid Form except in accordance with the provisions of N.C. General Statutes 143-129.1.

ARTICLE 17 – OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Advertisement For Bids 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 further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to not be responsible. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder when the lowest responsible Bid is in excess of the funds available.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 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 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.

19.05 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.

19.06 If the Contract is to be awarded, Owner will award the Contract to the Bidder whose Bid is in the best interests of the Project.

19.07 In determining the lowest responsible Bidder, Owner may take into consideration the past performance of Bidder on construction contracts with particular concern given to completion

times, quality of work, safety record, cooperation with other contractors, and cooperation with owner.

- 19.08 In determining the responsive Bidder, Owner shall take into consideration bidder's compliance with the requirements of G.S. 143-128.2(c). Failure of the low bidder to furnish affidavit(s) and documentation as required by the Bid Form for compliance with G.S. 143-128.2(c) may constitute a basis for disqualification of the Bid.
- 19.09 Owner reserves the right to reject Bid as non-responsible if the evidence submitted by, or investigation of, such Bidder fails to satisfy Owner that such Bidder is properly qualified to carry out the obligations of the Agreement and to complete the Work described therein.
- 19.10 Should the Owner adjudge that the apparent low Bidder is not the lowest responsible Bidder by virtue of the above information, said apparent low Bidder will be so notified and his Bid security shall be returned.
- 19.11 If the Contract is to be awarded, the Owner reserves the right to award contracts to the lowest responsive, responsible bidder in the manner described above.

ARTICLE 20 – CONTRACT SECURITY 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 executed Agreement to Owner, it shall be accompanied by such bonds.

ARTICLE 21 – SIGNING OF AGREEMENT

- 21.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement as attached thereto. Within 15 consecutive calendar days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within 90 consecutive calendar days thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

- 21.02 In case of failure of Owner to execute the Agreement in the appropriate time, Bidder shall have the right to withdraw bid.
- 21.03 In case of failure of Bidder to execute the Agreement, Owner may at his option consider the Bidder in default, in which case Bid security accompanying Bid shall be retained by the Owner.
- 21.04 Applicable laws, ordinances, and the rules and regulations of authorities having jurisdiction over construction of the Project shall apply to the contract throughout.

ARTICLE 22 – SALES AND USE TAX

- 22.01 The Owner is exempt from sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. Refer to Paragraph 7.10 of the Supplementary Conditions for additional information.

END OF DOCUMENT

BIDDER'S CHECKLIST

This checklist shall be included as the first page of the submitted bidding documents. As outlined in Article 7 of the Bid Form section, the following items shall be included with the fully executed Section 00410 Bid Form:

	A.	Required Bid security in the form of a Bid Bond (EJCDC No. C-430) or Certified Check (circle type of security provided); Bid Bond shall include an executed Power of Attorney.
	B.1.	Nondiscrimination Agreement
	B.2.	Communication of City of Raleigh Policy toward use of Minority and Women-Owned Business Enterprise Program/Contractors
	B.3.	Identification of Certified MWBE Participation
	B.4.	Affidavit A, Listing of Good Faith Effort; or Affidavit B, Intent to Perform Contract with Own Workforce
	C.	Contractor's Certificates, Affidavit of Organization and Authority of Sworn Statement
	D.	City of Raleigh – Contractor's Poor Performance Policy
	E.	Non-Collusive Affidavit
	F.	Notice to Contractor Regarding Intrusions Beyond Project Limits
	G.	Evidence of authority to do business in the state of the Project (i.e., copy of contractor's license)

BID FORM

PROJECT: Neuse River East Parallel Interceptor

CITY BID NO.: 274-WS-2016-10

BID FROM: _____

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BID RECIPIENT

This Bid is submitted to:

Dennis Lassiter P.E.
 City of Raleigh, Raleigh Water
 One Exchange Plaza, Suite 620
 Raleigh, North Carolina 27601

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.

By submitting a Bid, the Bidder acknowledges that the trenchless constructability of all tunnels shown on the Contract Drawings have been vetted by the Bidder and that the Bidder’s own design has been advanced to the extent necessary to establish, in the Bidder’s own opinion, the ability to safely construct by means of tunneling methods.

A Preliminary Tunnel Plan shall be developed by the Bidder, concurrent with the development of the Bid, to document the Bidder’s awareness and understanding of the quantity of, location of, and access to the portions of the Contract that are required to be built by trenchless means. The Preliminary Tunnel Plan is a conceptual plan establishing the capability to accomplish the tunnel construction

required by Contract. Following award of the Contract, the Contractor shall modify the Preliminary Tunnel Plan as needed to develop the most efficient construction plan of operation in accordance with Contract Documents. Requirements for submittal of and content of the Preliminary Tunnel Plan shall be in accordance with Section 05 below.

Apparent Low Bidder shall submit, no later than 24 hours after Bid Opening, a Preliminary Tunnel Work Plan as part of its Bid. The Preliminary Tunnel Work Plan shall consist of sketches, markups, and/or narrative explanations. Legible hand written notes on Bid Documents (e.g.: Bid Drawings) are acceptable. The Preliminary Tunnel Work Plan shall include the following:

- A. Indication of type, diameter, and material of initial tunnel support system for Tunnels 1 and 2.
- B. Indication of tunnel drive direction.
- C. Indication of basic tunnel equipment type, size, make, and model anticipated.
- D. Indication of conceptual understanding of all shaft locations, size (e.g.: diameter, length and width), orientation, anticipated conceptual method of support, staging/storage, and means of site access for each tunnel shaft as required for the Bidder's specific means and methods.
- E. Conceptual markup of plan, profile, or detail drawings of the following:
 - 1. groundwater removal process and safe discharge locations,
 - 2. spoil handling and storage,
 - 3. method of installation and blocking of carrier pipe, and
 - 4. annular space grouting.
- F. Preliminary indication all areas where potential ground modification strategies are anticipated or will be further explored by the Bidder upon award of the Contract.

The following documents are submitted with and made a condition of this Bid:

- G. Qualifications as required per Section 00201 – Bidder Qualifications.

BIDDER'S ACKNOWLEDGEMENTS

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 120 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

BIDDER'S REPRESENTATIONS

In submitting this bid, bidder represents that:

- H. Bidder has examined and carefully studied the Bidding Documents, other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

No. _____, dated _____

No. _____, dated _____

No. _____, dated _____

No. _____, dated _____

No. _____, dated _____

- I. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- J. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
- K. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Supplemental Conditions - 5.02 as containing reliable Technical Data, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-5.06 as containing reliable Technical Data.
- L. Bidder has considered the information known to Bidder; 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, including applying the specific sequences of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.
- M. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- N. 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.
- O. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.
- P. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

BIDDER'S CERTIFICATION

Bidder certifies that:

- Q. 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;
 - 1. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
 - 2. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
 - 3. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.A:

- a. "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;
- 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.

BASIS OF BID

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

- R. For Unit Price Work, an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of that item as indicated in the Bid Schedule below.

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UNIT PRICE BID SCHEDULE

BASE BID

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
A. Sanitary Sewer System					
1	Mobilization (max. 3% of total base bid)	LS	1	\$	\$
2	96" FRP SN 46 Sanitary Sewer				
	a. Depth 16 - 18'	LF	52	\$	\$
	b. Depth 18 - 20'	LF	138	\$	\$
	c. Depth 20 - 22'	LF	649	\$	\$
	d. Depth 22 - 24'	LF	920	\$	\$
	e. Depth 24 - 26'	LF	1533	\$	\$
	f. Depth 26 - 28'	LF	4258	\$	\$
	g. Depth 28 - 30'	LF	7104	\$	\$
	h. Depth 30 - 32'	LF	3622	\$	\$
	i. Depth 32 - 34'	LF	932	\$	\$
3A	84" FRP SN 46 Sanitary Sewer				
	a. Depth 16 - 18'	LF	10	\$	\$
	b. Depth 18 - 20'	LF	18	\$	\$
	c. Depth 20 - 22'	LF	358	\$	\$
	d. Depth 22 - 24'	LF	424	\$	\$
	e. Depth 24 - 26'	LF	1471	\$	\$
	f. Depth 26 - 28'	LF	2444	\$	\$
	g. Depth 28 - 30'	LF	530	\$	\$
	h. Depth 30 - 32'	LF	353	\$	\$
	i. Depth 32 - 34'	LF	200	\$	\$
3B	84" FRP SN 72 Sanitary Sewer				
	a. Depth 24 - 26'	LF	68	\$	\$
	b. Depth 26 - 28'	LF	210	\$	\$
4	72" FRP SN 72 Sanitary Sewer				
	a. Depth 8 - 10'	LF	70	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
4	72" FRP SN 72 Sanitary Sewer (Cont.)				
	b. Depth 10 - 12'	LF	200	\$	\$
	c. Depth 12 - 14'	LF	24	\$	\$
	d. Depth 14 - 16'	LF	24	\$	\$
	e. Depth 16 - 18'	LF	21	\$	\$
	f. Depth 18 - 20'	LF	21	\$	\$
	g. Depth 20 - 22'	LF	26	\$	\$
	h. Depth 22 - 24'	LF	160	\$	\$
	i. Depth 24 - 26'	LF	502	\$	\$
	j. Depth 26 - 28'	LF	20	\$	\$
	k. Depth 28 - 30'	LF	50	\$	\$
	l. Depth 30 - 32'	LF	10	\$	\$
	m. Depth 32 - 34'	LF	10	\$	\$
	n. Depth 34 - 36'	LF	5	\$	\$
	o. Depth 36 - 38'	LF	5	\$	\$
	p. Depth 38 - 40'	LF	50	\$	\$
	q. Depth >40'	LF	20	\$	\$
5	66" FRP SN 72 Sanitary Sewer				
	a. Depth 20 - 22'	LF	76	\$	\$
	b. Depth 22 - 24'	LF	219	\$	\$
	c. Depth 24 - 26'	LF	17	\$	\$
6	36" FRP SN 72 Sanitary Sewer				
	a. Depth 18 - 20'	LF	85	\$	\$
	b. Depth 20 - 22'	LF	80	\$	\$
	c. Depth 22 - 24'	LF	18	\$	\$
	b. Depth 24 - 26'	LF	12	\$	\$
7	18" FRP SN 72 Sanitary Sewer				
	a. Depth 8 - 10'	LF	5	\$	\$
	b. Depth 10 - 12'	LF	34	\$	\$
	c. Depth 12 - 14'	LF	34	\$	\$
	d. Depth 14 - 16'	LF	40	\$	\$
	e. Depth 16 - 18'	LF	40	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
7	18" FRP SN 72 Sanitary Sewer (Cont.)				
	f. Depth 18 - 20'	LF	120	\$	\$
	g. Depth 20 - 22'	LF	10	\$	\$
7A	12" Ductile Iron CL 350 Sanitary Sewer				
	a. Depth 20 - 22'	LF	23	\$	\$
	b. Depth 22 - 24'	LF	23	\$	\$
8	8" Ductile Iron CL 350 Sanitary Sewer				
	a. Depth 0 - 6'	LF	172	\$	\$
	b. Depth 6 - 8'	LF	70	\$	\$
	c. Depth 8' - 10'	LF	13	\$	\$
8A	8" PVC SDR-35 Sanitary Sewer				
	a. Depth 6 - 8'	LF	30	\$	\$
	b. Depth 8 - 10'	LF	257	\$	\$
	c. Depth 10 - 12'	LF	80	\$	\$
	d. Depth 12 - 14'	LF	10	\$	\$
9	Geotextile Fabric for Trench Backfill Stabilization	SY	50000	\$	\$
10	120" Steel Liner Plate with 96" FRP SN 46 Sanitary Sewer (by Hand Tunnel				
	a. Auburn-Knightdale Road Tunnel	LF	156	\$	\$
	b. Auburn-Knightdale Road Shafts	EA	2	\$	\$
	c. Poole Road Tunnel	LF	149	\$	\$
	d. Poole Road Tunnel Shafts	EA	2	\$	\$
11	Precast Concrete T-Base Manhole <u>or</u> Fiberglass Pipe Tee Manhole for 96" Sanitary Sewer				
	a. Depth 22' - < 24'	EA	1	\$	\$
	b. Depth 24' - < 26'	EA	2	\$	\$
	c. Depth 26' - < 28'	EA	1	\$	\$
	d. Depth 28' - < 30'	EA	11	\$	\$
	e. Depth 30' - < 32'	EA	13	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
11	Precast Concrete T-Base Manhole <u>or</u> Fiberglass Pipe Tee Manhole for 96" Sanitary Sewer (Cont.)				
	f. Depth 32' - < 34'	EA	9	\$	\$
	g. Depth 34' - < 36'	EA	2	\$	\$
11A	Fiberglass Pipe Tee Manhole for 96" Sanitary Sewer				
	a. Depth 30' - <32'	EA	2	\$	\$
12	Precast Concrete T-Base Manhole <u>or</u> Fiberglass Pipe Tee Manhole for 84" Sanitary Sewer				
	a. Depth 22' - <24'	EA	1	\$	\$
	b. Depth 24' - < 26'	EA	1	\$	\$
	c. Depth 26' - < 28'	EA	3	\$	\$
	d. Depth 28' - < 30'	EA	5	\$	\$
	e. Depth 32' - < 34'	EA	1	\$	\$
	f. Depth 34' - < 36'	EA	1	\$	\$
13	4' Inside Diameter Precast Concrete Manhole with Interior Coating				
	a. Depth 6' - < 8'	EA	1	\$	\$
	b. Depth 8' - <10'	EA	1	\$	\$
	c. Depth 10' - <12'	EA	1	\$	\$
14	Precast Polymer Manhole				
	a. MH-1 and MH-43 (30' - < 32' Depth) – 96" SS	EA	2	\$	\$
	b. MH-46, MH-47, MH-48 (28' - < 30' Depth) – 84" SS	EA	1	\$	\$
	c. MH-60, MH-61, MH-62 (26' - < 28' Depth) -84"/72" SS	EA	3	\$	\$
	d. MH-63 (20' - < 22' Depth) - 18" SS	EA	1	\$	\$
	e. MH-64 (10' - < 12' Depth) – 18" SS	EA	1	\$	\$
	f. MH-65 (22' - < 24' Depth) – 18" SS	EA	1	\$	\$
	g. MH-66 (14' - < 16' Depth) – 66" SS	EA	1	\$	\$
	h. MH-70 (24' - < 26' Depth) – 72" SS	EA	1	\$	\$
	i. MH-71 (30'-<32' Depth) – 72" SS	EA	1	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
14A	Stub Out Manholes (Polymer) including Sanitary Sewer	EA	10	\$	\$
15	Junction Boxes				
	a. MH-45 (Polymer Concrete)	EA	1	\$	\$
15A	Junction Boxes at Riverview Road including 66" DIP and All Electrical/SCADA/I&C (Complete Installation)	LS	1	\$	\$
16	Vortex Drop Shaft Structure including Bypass Pumping	LS	1	\$	\$
17	Connection of Sewer Lines to Existing Manholes including Inside/Outside Drops	EA	6	\$	\$
18	Manhole/Junction Box Vent				
	a. Standard Vent	EA	13	\$	\$
	b. Offset Vent	EA	63	\$	\$
19	Remove and Replace Existing Manholes	EA	1	\$	\$
20	Abandon Existing Sanitary Sewer				
	a. 18"	LF	175	\$	\$
	b. 36"	LF	215	\$	\$
	c. 66"	LF	130	\$	\$
21	CCTV Inspection of Existing Sewer Main	LF	2000	\$	\$
22	Neuse River Crossings				
	a. Poole Road	LS	1	\$	\$
	b. Anderson Point Park	LS	1	\$	\$
23	Permanent Stream and Wetland Crossings	EA	18	\$	\$
24	Anti-Seep Collars	EA	23	\$	\$
25	Concrete Encasement for Sanitary Sewer Pipe and Connections at Manholes (excludes river crossings)	CY	4000	\$	\$
26	Pond Dam and Restoration	LS	1	\$	\$
27	Abandonment of Existing Manhole/Structure In-Place	EA	3	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
28	Abandonment of Existing Pump Station				
	a. Poole Road (Riverview) Pump Station	LS	1	\$	\$
	b. Neuse River (Anderson Point Park) Pump Station	LS	1	\$	\$
29	Existing Inverted Siphon Abandonment	LS	1	\$	\$
30	Temporary Construction Access Roads				
	a. Access Road No. 1 (Maintenance)	LS	1	\$	\$
	b. Access Road No. 2	LS	1	\$	\$
	c. Access Road No. 3 (Limited)	LS	1	\$	\$
	d. Access Road No. 4	LS	1	\$	\$
	e. Access Road No. 5	LS	1	\$	\$
	f. Access Road No. 6 (Limited)	LS	1	\$	\$
	g. Access Road No. 7	LS	1	\$	\$
31	Permanent/Final Access Roads				
	a. Access Road No. 1	LS	1	\$	\$
	b. Access Road No. 2	LS	1	\$	\$
	c. Access Road No. 3	LS	1	\$	\$
	d. Access Road No. 5	LS	1	\$	\$
	e. Access Road No. 6	LS	1	\$	\$
	f. Access Road No. 7	LS	1	\$	\$
32	Temporary Laydown Areas				
	a. Laydown Area No. 1 – Auburn-Knightdale Road	LS	1	\$	\$
	b. Laydown Area No. 2 – Leonard Road	LS	1	\$	\$
	c. Laydown Area No. 3 – Hodge Road (South)	LS	1	\$	\$
	d. Laydown Area No. 4 – Hodge Road (North)	LS	1	\$	\$
33	Anderson Point Park Access – Traffic and Pedestrian Control	LS	1	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
34	Greenway (Pedestrian) and Traffic Control and Closures at Poole Road	LS	1	\$	\$
35	Trench Restoration in Asphalt Roadway	SY	100	\$	\$
36	Trench Restoration in Asphalt Driveway and Parking Lot	SY	56	\$	\$
37	Asphalt Removal and Replacement – Greenway 6” ABC and 2” Asphalt	SY	2200	\$	\$
38	Gravel Driveway Repair	SY	200	\$	\$
39	Temporary Construction Entrance	EA	2	\$	\$
40	Silt Fence	LF	1840	\$	\$
41	Super Silt Fence	LF	18540	\$	\$
42	Combination Silt/Tree Protection Fence	LF	27135	\$	\$
43	Tree Protection Fencing	LF	22140	\$	\$
44	Stone Relief Outlet	EA	183	\$	\$
45	Rock Check Dam	EA	2	\$	\$
46	Clean Water Diversion Ditch	LF	21380	\$	\$
47	Sediment Trench	LF	20585	\$	\$
48	Temporary Slope Drain and Dissipator Pad	EA	62	\$	\$
49	Pipe Outlet Protection	EA	4	\$	\$
50	Inlet Protection	EA	4	\$	\$
51	Rip Rap Protection				
	a. Class A	CY	2686	\$	\$
52	Ditch Liner and Stabilization Matting				
	a. Straw with Net Liner	SY	2500	\$	\$
	b. Coir Matting	SY	9335	\$	\$
53	Undercut of Unstable Pipe Foundation and Replacement with #67 Stone (Minimum price of \$30.00/CY)	CY	10000	\$	\$
54	Removal of Unsuitable Material and Replacement with Select Backfill (Minimum price of \$10.00/CY)	CY	20000	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
55	Rock Excavation by Blasting (Minimum price of \$40.00/CY)	CY	125000	\$	\$
56	Rock Excavation by Mechanical Methods (Minimum price of \$50.00/CY)	CY	20000	\$	\$
57	Topsoil (4" Depth)	SY	12500	\$	\$
58	Bypass Pumping – Sanitary Sewer and Manhole/Junction Boxes	LS	1	\$	\$
59	Cleanup and Seeding along Utility Pipelines (Min. 10% of Item No.'s (2 – 8A)	LF	29738	\$	\$
60	Temporary Construction Barrier/Security Fencing	LF	5000	\$	\$
61	Allowance for 3rd Party Vibration Monitoring and Soil compaction Testing		-		\$ 100,000.00
62	Stockpiling of Non-Hazardous Contaminated Soil (Non-Petroleum)	CY	400	\$	\$
63	Compliance with Health & Safety Plan	LS	1	\$	\$
64	Loading, Transport and Disposal of Non-Hazardous Petroleum Contaminated Material by Direct Load & Haul From Trench Excavation	TONS	1200	\$	\$
65	Loading, Transport and Disposal of Non-Hazardous Non-Petroleum Contaminated Material From Stockpile (Subtitle D Landfill)	TONS	600	\$	\$
66	Allowance for Third Party Environmental Monitoring & Analytical Testing		-		\$ 50,000.00
67	Pretreatment of Containerized Trench Dewatering Effluent Prior to Discharge to the Sanitary Sewer				
	a. Trench Dewatering Effluent Pretreatment Design For POTW Discharge	LS	1	\$	\$

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Extended Bid Price
	b. Allowance for Trench Dewatering Effluent Pretreatment System Operation Prior to Discharge to POTW		-		\$ 60,000.00
	c. Allowance for Setup & Tear Down of Effluent Pretreatment Prior to Discharge to POTW (All Locations)		-		\$ 10,000.00
68	Containerization, Sampling and Sanitary Sewer Discharge of Trench Dewatering Effluent				
	a. Trench Dewatering Permitting For POTW Discharge	LS	1	\$	\$
	b. Allowance for Setup & Tear Down of Trench Dewatering, Effluent Storage Equipment For POTW Discharge		-		\$ 10,000.00
	c. Allowance for Trench Dewatering, Effluent Storage, Monitoring & Discharge to POTW		-		\$ 65,000.00

TOTAL BASE BID PRICE (Sum of Items 1 through 68) \$ _____

Bidders shall identify whether they are going to furnish and install precast concrete manholes with interior coatings or fiberglass pipe tee manholes for the base bid items 11 and 12 below by circling which manhole type their bid price includes:

Circle One: Precast Concrete Manhole w/Interior Coating _____ or _____ Fiberglass Pipe Tee Manhole

ALTERNATE BIDS

Alternate Bid No. 1 – Polymer Manholes in Lieu of Precast Concrete or Fiberglass Pipe Tee Manholes

Bidder shall complete the Alternate Bid No. 1 Schedule below and provide a price reduction or addition for the net difference in cost to provide and install precast polymer concrete manholes or structures in lieu of standard precast concrete manholes or fiberglass pipe tee manholes in the Base Bid for the depth classes and sizes described in the Alternate Bid Schedule. The Bidder must complete the Alternate Bid Schedule in full for bid proposal to be acceptable and indicate if the prices are deducts (-) or adders (+).

ALTERNATE BID SCHEDULE

Alternate Bid No. 1

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price(-/+)	Extended Bid Price (-/+)
11A	Precast Polymer Concrete Manhole for 96" Sanitary Sewer				
	a. Depth 22' - < 24'	EA	1	\$	\$
	b. Depth 24' - < 26'	EA	2	\$	\$
	c. Depth 26' - < 28'	EA	1	\$	\$
	d. Depth 28' - < 30'	EA	11	\$	\$
	e. Depth 30' - < 32'	EA	13	\$	\$
	f. Depth 32' - < 34'	EA	9	\$	\$
	g. Depth 34' - < 36'	EA	2	\$	\$
12A	Precast Polymer Concrete Manhole for 84" Sanitary Sewer				
	a. Depth 22' - < 24'	EA	1	\$	\$
	b. Depth 24' - < 26'	EA	1	\$	\$
	c. Depth 26' - < 28'	EA	3	\$	\$
	d. Depth 28' - < 30'	EA	5	\$	\$
	e. Depth 32' - < 34'	EA	1	\$	\$
	f. Depth 34' - < 36'	EA	1	\$	\$

TOTAL ALTERNATE BID PRICE (Sum of Items 11A and 12A - Total Adder or Deduct to be Applied To Total Base Bid) \$ _____

Alternate Bid No. 2 – Provide Composite Manhole Frame and Covers in lieu of Cast Iron Frame and Covers

Bidder shall complete the Alternate Bid No. 2 Schedule below and provide a price reduction or addition for the net difference in cost to provide and install composite manhole frame and covers in lieu of cast iron frame and covers on applicable structures including precast concrete and polymer manholes/structures. The Owner may select which structures require composite manhole frame and covers at their sole discretion.

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price(-/+)	Extended Bid Price (-/+)
13A	Composite Manhole Frame and Covers	-	EA	\$	\$

Bidders are hereby notified that GS 143-128(d), requires all bidders on single prime projects to identify on their Bid form the contractors they have selected for the subdivisions for branches of work for (1) HVAC, (2) Plumbing, (3) Electrical, and (4) General. Accordingly, bidder shall list below applicable selected contractors for the following branches of work (write "N/A" if not applicable or self-performed).

HVAC	_____	_____
	Name	License No.
Plumbing	_____	_____
	Name	License No.
Electrical	_____	_____
	Name	License No.
General	_____	_____
	Name	License No.

Material Supplier List: (*List must be completely filled out for bid proposal to be acceptable)

Material	Supplier
1. Fiberglass Reinforced Sewer Pipe	_____
2. Ductile Iron Pipe	_____
3. Precast Manholes/Structures	
a. Standard Precast Concrete Manholes	_____
b. Fiberglass Tee and Riser Manholes	_____
c. Polymer Manholes/Structures	_____
4. Gates and Valves	_____

- S. Unit Prices have been computed in accordance with Paragraph 13.03.B of the General Conditions.
- T. Bidder acknowledges that 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.
- U. Bidder acknowledges that the rights of the Owner and the recommendations of the Engineer are not to be questioned in the Award of Contracts.
- V. Bidder acknowledges that it is the intention of the Mayor and City Council to let contracts on a basis of the Bids received in accordance with GS 143-129 and in such manner as they deem to be for the best interests of the Owner.

- W. Bidder acknowledges that the Owner reserves the right to accept or reject any or all bids and to waive any informalities in the bidding.
- X. Bidder acknowledges that should the total bid exceed the funds available to construct the project, the Owner reserves the right to reduce the scope of work from the project by deleting certain lump sum or unit price bid items prior to awarding the contract to bring the project within the funds available.
- Y. Bidder acknowledges that if this contract is awarded, Bidder must, with every pay request, furnish to the Public Utilities Director of the City of Raleigh an accurate itemized statement of North Carolina Sales Taxes paid on materials, supplies, equipment, and other items charged to this contract, and otherwise fully comply with the "Procedure for Reporting North Carolina Sales Tax Expenditures.". A sales tax form must be submitted even if there is no sales tax incurred.
- Z. Bidder agrees to begin work within 10 days from the date of the Notice to Proceed.
- AA. Bidder agrees that should the Owner reduce the scope of work by 25% or less of the Total Bid price prior to award of the contract, the lump sum and the unit price on all bid items shall remain unchanged.
- BB. Bidder agrees that in the case of failure on his part to execute the said Contract and the Bonds within 15 consecutive calendar days after written notice being given of the award of the Contract, the check, cash or Bid Bond accompanying this Bid shall be paid into the funds of the Owner's Account set aside for this Project, as liquidated damages for such failure; otherwise the check, cash or Bid Bond accompanying this Bid shall be returned to the Bidder.
- CC. Bidder agrees to provide all necessary tools, machinery, equipment, apparatus, and all other means necessary to do all the work and will furnish all labor, materials and all else required to complete such Contract as may be entered into, in the manner prescribed in and in accordance with the terms of the Specifications and Contract and in accordance with the true intent and meaning thereof, and in accordance with the Plans and/or Drawings and the requirements of the Engineers under them, in a first class manner.

TIME OF COMPLETION

Bidder agrees that the Base Bid Work will be substantially complete within **seven hundred and thirty (730) consecutive calendar days** after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and will be completed and ready for final payment in accordance with Paragraph 15.06.B of the General Conditions within **seven hundred and ninety (790) consecutive calendar days** after the date when the Contract Times commence to run. No additional contract time will be granted if Owner awards Alternate Bid.

Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times. This amount is agreed upon as the proper measure of liquidated damages the Owner will sustain, per day, by the failure of the undersigned to complete the work, within the stipulated time, and it is not to be construed, in any sense, as a penalty.

Milestone Dates

- A. The following principal events shall be completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within days indicated below after the date when the Contract Time commences to run. In accordance with paragraph 3.2 above as liquidated damages for delay (but not as penalty) Contractor shall pay Owner the amounts indicated below for each day that expires after the time specified below for completion and readiness for final payment.

Milestone Event	Consecutive Calendar Days	Liquidated Damages
Substantial Completion	730	\$500/day
Final Completion	790	\$1,000/day

ATTACHMENTS TO THIS BID

The following documents are submitted with and made a condition of this Bid:

- A. Required Bid security in the form of a Bid Bond or Certified Check (Section 00430);
- B. In accordance with GS 143-128.2(c), Bidder shall identify on its bid the minority businesses that it will use on the project and the total dollar value of the bid that will be performed by the minority businesses and list the good faith efforts (Affidavit A) made to solicit participation. A Bidder that will perform all of the work with its own workforce may submit an Affidavit B to that effect in lieu of the affidavit A required above.
 - 1. Nondiscrimination Agreement (Section 00440);
 - 2. Use of MWBE Businesses (Section 00440);
 - 3. Identification of Minority Business Participation (Section 00440), and;
 - 4. Affidavit A, Listing of Good Faith Effort, or Affidavit B, Intent to Perform Contract with Own Workforce (Section 00440).
- C. Contractor’s Certificates, Affidavit of Organization and Authority of Sworn Statement (Section 00441);
- D. City of Raleigh – Contractor’s Poor Performance Policy (Section 00442);
- E. Non-Collusive Affidavit (Section 00443);
- F. Notice to Contractor Regarding Intrusions Beyond Project Limits (Section 00444);
- G. Evidence of authority to do business in the state of the Project (i.e., copy of contractor’s license);

Submit the Bidder’s Checklist as provided in the bidding documents with the bid submittal. The Checklist shall be completed and included as the first page of the submittal.

After the bid opening the Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low Bidder, the Bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

- A. An Affidavit (C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the goal established by the Owner and indicated in the Instruction to Bidders, paragraph Minority Participation Goals. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort; or,
- B. Affidavit (D) of its good faith effort to meet the goal. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

Bidder understands that if this Bid is accepted by the Owner, Bidder shall not substitute for the subcontractors named in the Bid Documents except as allowed in the Supplementary Conditions.

DEFINED TERMS

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.

BID SUBMITTAL

Bidder's License

- A. Number: _____
- B. Classification: _____
- C. Limitation: _____
- D. Employer's Tax ID No.: _____
- E. Business Address: _____
- F. Phone No.: _____ Fax No.: _____
- G. Contact Person: _____ E-mail Address: _____
- H. Phone No. w/ Ext.: _____

This Bid is submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____

(Individual's signature)

Doing business as: _____

A Partnership

Partnership Name: _____

The Organization and Internal Affairs of the Partnership are governed by the laws of the State of: _____

By: _____

(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): _____

Title (typed or printed): _____

Attest: _____

(Signature of Corporate Secretary)

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General Business, Professional, Service, Limited Liability): _____

By: _____

(Signature -- attach evidence of authority to sign)

Name (typed or printed): _____

Title (typed or printed): _____

(CORPORATE SEAL)

Attest: _____

(Signature of Corporate Secretary)

Date of Qualification to do business in North Carolina is ____/____/____.

Limited Liability Company - LLC

Name of LLC: _____

Name of State under whose Laws the Limited Liability Company was formed:

By: _____

(Signature of Manager)

Name (typed or printed): _____

Title (typed or printed): _____

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

BID

Bid Due Date:

Description *(Project Name and Include Location)*:

BOND

Bond Number:

Date *(Not earlier than Bid due date)*:

Penal sum _____ \$ _____
(Words) (Figures)

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

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal) Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Minority and Women-owned Business Enterprise Program (MWBE)



Explanation of Affidavit A

A Listing of the Good Faith Effort

Company has made a good faith effort to recruit minority businesses in accordance with N.C. Gen. Stat. § 143-128.2 and represents that it has performed the following (**check all that apply; note that a minimum of fifty (50) points must be achieved**):

A well-crafted email solicitation to individual mwbe's may provide documentation of 6 (criteria 1,2,3,6,8,10) of the items below. Examples are given beneath each criteria of ways to satisfy requirements:

- ❑ 1. (10 points) Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
 - ***Newspaper/trade ads don't count for notification***
 - ***Produce list of potential bidders contacted by contractor***
 - ***Subtract 10 days from bid date then add 1 day to determine latest time to notify***

- ❑ 2. (10 points) Made the construction plans, specifications and requirements available for review by prospective minority businesses, or provided these documents to them at least 10 days before the bids are due.
 - ***Newspaper/trade ads don't count for notification***
 - ***Notice shall state available in own office or provide mwbe's the documents***
 - ***Subtract 10 days from bid date then add 1 day to determine latest time to notify***

- ❑ 3. (15 points) Broke down or combined elements of work into economically feasible units to facilitate minority participation.
 - ***Show that work is broken down into small components (eg: for mechanical contractor- break down to insulation, controls, and air balance)***
 - ***Indicate in solicitation that mwbe's can bid work for this project in any areas that they are qualified***

- ❑ 4. (10 points) Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
 - ***Obtain letter or other documentation from one of these organizations indicating that you are working with them in the recruitment of minority businesses – NCMWBE Coordinators Network, The Institute or NCIEDI or HCAC.***

- 5. (10 points) Attended pre-bid meetings scheduled by the public owner.
 - **Owner/architect is keeping list of attendees (make sure you sign-in)**
- 6. (20 points) Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
 - **Document, or indicate in solicitation to notified subs, that bonds aren't required, or that bonds aren't required in certain divisions, or that bonds aren't required below certain contract amounts, or that will assist in procuring bonds or insurance**
- 7. (15 points) Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
 - **Document that no mwbe's were low - Document that you accepted all low mwbe's - Document written reasons for rejection of any low mwbe's**
- 8. (25 points) Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
 - **Document recent history of doing joint pay agreements such as "in the recent past, we have done joint pay agreements (lines of credit, waiving of credit, etc.) with the following mwbe's (x company, y company, z company) and intend to offer the same on this project for qualified mwbe's"**
 - **Produce letter from vendor/supplier indicating that they will give the same pricing to mwbe's quoting to you as vendor/supplier gives directly to you**
 - **Indicate in solicitation that joint pay agreements, etc. are available for qualified mwbe's.**
- 9. (20 points) Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible. **self explanatory**
- 10. (20 points) Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash flow demands.
 - **Document recent history of doing quick pay agreements such as "in the recent past, we have done quick pay agreements with the following mwbe's (x company, y company, z company) and intend to offer the same on this project for qualified mwbe's"**
 - **Indicate in solicitation that quick pay agreements are available for qualified mwbe's**

INFORMATION FOR BIDDERS REGARDING COMPLIANCE WITH THE CITY OF RALEIGH'S MINORITY AND WOMEN-OWNED BUSINESS ENTERPRISE (MWBE) PROGRAM

Contractor Responsibilities

The bidders agree to use their best efforts to comply with the City of Raleigh's Minority and Women Business Enterprise (MWBE) Program through the award of subcontracts to Certified Minority and Women-Owned Business Enterprises and utilization of certified minority and women-owned business suppliers to the fullest extent consistent with the efficient performance of this contract.

As used herein, the term "minority and women business" shall mean a company that is 51% or more owned and controlled by minority group members or women. For the purpose of this definition, minority group members are Black Americans, Hispanic Americans, American Indians, Female Americans, Asian Americans, socially and economically disadvantaged individuals, and Disabled. The law defines socially disadvantaged individuals as "those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities." The term "economically disadvantaged individuals" shall mean those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business that are not socially disadvantaged." The successful bidder will be expected to provide minority participation not less than the expected goals for this project shown herein. All bidders that bid as prime contractor must utilize their best efforts to meet participation goals through award of subcontracts to minority and women business enterprises.

The Identification of Minority Participation Form and Affidavit "A" Listing of Good Faith Efforts should be properly completed as defined in the document specifications and submitted with your bid documents.

The Identification of Minority Participation form must include, at a minimum, the names of all minority contractors who will be construction contractors, subcontractors, vendors, or suppliers on this project. Additional contact information such as business addresses, phone numbers, work types, and minority categories is important and useful. In accordance with N.C.G.S. 143-128.2(c) each bidder shall identify on its bid the MWBE businesses to be used on this project and pursuant to subsection (f) of this statute provide the total dollar value of the bid that will be performed by the minority businesses. This information shall be listed on the **Identification of Certified Minority Participation Form**.

The **Affidavit A, Listing of Good Faith Efforts**, as applicable, must be properly executed and submitted with the bid providing evidence that the prime contractor has complied with the good faith efforts measures before bidding to solicit MWBEs and to meet the goals. The **Affidavit B Intent to Perform Contract with Own Workforce form** must be executed with the bid only if the prime contractor intends to perform 100% of the work required for the contract without the use of subcontractors.

The apparent low bidder must submit an Affidavit C or D depending on its adherence to the goals. The apparent low bidder who has met or surpassed the expected goals must provide **Affidavit C Portion of Work to be performed by Minority Firms** within seventy-two hours (72) after being notified by City Staff. The apparent low bidder who does not meet the expected goals must submit **Affidavit D Good Faith Efforts** within seventy-two hours (72) after being notified by City Staff. The bidder shall satisfy the City that he/she has made a good faith effort to solicit MWBE participation. Good faith efforts can be demonstrated using, among other factors, the following:

(a) Attending pre-solicitation or pre-bid meetings that are scheduled by the City to inform MWBE firms of contracting, subcontracting, and supply opportunities.

(b) Advertising in general circulation, trade association, or minority-focus media concerning subcontracting opportunities.

- (c) Providing written notice, to a reasonable number of specific MWBE firms that their interest in the contract is being solicited, at least 10 days before bids are due, to allow MWBE firms time to participate.
- (d) Following up initial solicitation of interest by contacting MWBE firms to determine with certainty whether the MWBE firms are interested.
- (e) Identifying and selecting portions of the work to be performed by MWBE firms in order to increase the likelihood of MWBE participation (including where appropriate, breaking down contracts into economically feasible units to facilitate MWBE participation).
- (f) Providing interested MWBE firms with equal access to plans, specifications, and requirements of the contract.
- (g) Negotiating fairly with interested MWBE firms, not rejecting MWBE firms as unqualified without sound reasons based on a thorough investigation of their capabilities.
- (h) Using the services of the City of Raleigh's MWBE office; available minority community organizations; minority contractors' groups; local, state, and federal minority business offices; and other organizations that provide assistance in the recruitment and placement of MWBE firms.
- (i) Assisting interested MWBE firms in need of equipment, loan capital, lines of credit or joint pay agreements to secure loans, supplies or letters of credit, including waiving credit that is ordinarily required.
- (j) Assisting interested MWBE firms in obtaining bonding, insurance, or providing alternatives to bonding or insurance for subcontractors.
- (k) Negotiating joint venture and partnership arrangements with minority businesses to increase the opportunities for minority participation when possible.
- (l) Provide for quick pay agreements and policies to enable minority contractors and suppliers to meet cash flow demands.

The MWBE Coordinator shall evaluate the good faith efforts of each bidder and determine if the requirements of this program have been met.

During the course of the contract the successful bidder will be required to submit **Certified Subcontractor Payment Form**. Payments from the City will be held until contractor submits the Certified Subcontractor Payment Form.

During the construction of a project, if it becomes necessary to replace an MWBE subcontractor, the prime contractor shall advise the owner by submitting to the project manager and MWBE Coordinator the **Request to Change a Certified MWBE Subcontractor**. No MWBE subcontractor may be replaced with a different subcontractor except (1) if the subcontractor's bid is later determined by the prime contractor or construction manager to be nonresponsible or nonresponsive, or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work (2) with the approval of City Council for good cause. Good faith efforts as set forth in N.C.G.S 143-131(b) shall apply to the selection of a substitute subcontractor. Prior to substituting a subcontractor, the contractor shall identify the substitute subcontractor and inform the project manager or its designee of its good faith efforts pursuant to N.C.G.S

NONDISCRIMINATION AGREEMENT

4/16

This agreement is made and executed this ____ day of _____, 20____, by and between the undersigned.

To the extent permitted by North Carolina law, the parties hereto for themselves, their agents, officials, employees and servants agree not to discriminate in any manner on the basis of race, color, creed, national origin, sex, age, handicap, or sexual orientation with reference to the subject matter of this Contract. The parties further agree, to the extent permitted by law, to conform with the provisions and intent of City of Raleigh Ordinance 1969-889, as amended. This provision is hereby incorporated into this Contract for the benefit of the City of Raleigh and its residents, and may be enforced by action for specific performance, injunctive relief, or other remedy as provided by law. This provision shall be binding on the successors and assigns of the parties with reference to the subject matter of this Contract.

This agreement shall be binding on the successors and assigns of the parties with reference to the subject matter of this contract.

(Use the following form for signatures by a CORPORATION):

(Corporate Name)

ATTEST:

(Assistant) Secretary

By: _____
(Vice) President

(AFFIX CORPORATE SEAL)

(Use the following form for signatures by an INDIVIDUAL):

By: _____ (SEAL)

WITNESS:

USE OF CERTIFIED MWBE BUSINESSES

The City's policy is to encourage Bidders to use Certified MWBE businesses as subcontractors. A presentation of that policy is made at the pre-bid conference. All construction Bid documents include the listing of the businesses in the construction-related fields that have been certified by the City is included following the Supplementary Conditions.

Formal Bid Process

The City requires all Bidders to submit a list of their subcontractors with their Bid and to identify all Certified Minority & Women-Owned Businesses (MWBE). After the Bid opening, the City will attempt to verify if those listed by the low Bidder are Certified MWBE businesses and that those listed have had contact with the low Bidder relative to constructing a portion of the Project. It is understood that this information will be provided to the City Council in the agenda packet with the Bid tabulation on the Project. It is further understood that the Contract Documents include a provision that the City will be notified of any changes in subcontractors. The low Bidder will be informed of that responsibility prior to signing the Contract.

I have read and understand the City of Raleigh's policy as stated above.

Signature

Printed Name

Title

Date

AFFIDAVIT A
Listing of Good Faith Effort
****SUBMIT WITH BID, if subcontracting****

County of _____
Affidavit of _____

(Name of Bidder)

I have made a good faith effort to comply under the following areas checked:

(A minimum of 50 points must be obtained in order to have achieved a "good faith effort")

- 1-** Contacted Certified MWBE businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
Value= 10 points.
- 2-** Made the construction plans, specifications and requirements available for review by prospective Certified MWBE businesses, or providing these documents to them at least 10 days before the bids are due. **Value=10 points.**
- 3-** Broken down or combined elements of work into economically feasible units to facilitate Certified MWBE business participation.
Value = 15 points.
- 4-** Worked with Certified MWBE businesses trade, community, or contractor organizations identified by the MWBE Program and included in the bid documents that provide assistance in recruitment of Certified MWBE businesses.
Value=10 points.
- 5-** Attended pre-bid meetings schedule by the public owner.
Value=10 points.
- 6-** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
Value=20 points.
- 7-** Negotiated in good faith with interested Certified MWBE businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a Certified MWBE business based on lack of qualification should have the reasons documented in writing.
Value =15 points.
- 8-** Provided assistance to an otherwise Certified MWBE businesses in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted Certified MWBE businesses in obtaining the same unit pricing with the bidder's suppliers in order to help Certified MWBE businesses in establishing credit.
Value=25 points.
- 9-** Negotiated joint venture and partnership arrangements with Certified MWBE businesses in order to increase opportunities for Certified MWBE businesses participation on a public construction or repair project when possible.
Value =20 points.

10-Provided quick pay agreements and policies to enable Certified MWBE business contractors and suppliers to meet cash flow demands.

Value=20 points.

TOTAL POINTS OBTAINED _____.

In accordance with GS143-128.2 (d) the undersigned will enter into a formal agreement with the firms listed on the Identification of Certified MWBE Participation schedule conditional upon execution of a contract with the Owner. Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the MWBE Program commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____

Signature: _____

Title: _____

State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 20__

Notary Public _____ My commission expires _____

SEAL

AFFIDAVIT B

Intent to Perform Contract with Own Workforce

****SUBMIT WITH BID – If Self-performing, don't submit Affidavit A ****

County of _____

Affidavit of _____

(Name of Bidder)

I hereby certify that it is our intent to perform 100 % of the work required for the _____ Contract. **Total Project Bid \$** _____ **Bid Date** _____

(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of work on this project with his/her own current work forces; and

The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: _____

Name of Authorized Officer: _____

Signature: _____

Title: _____

State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 20__

Notary Public _____ my commission expires _____

SEAL

AFFIDAVIT C

Portion of the work to be performed by Certified MWBE Businesses

This form is to be submitted only by the apparent lowest responsible, responsive bidder

County of _____

If the portion of the work to be executed by Certified MWBE Businesses as defined in GS 143-128.2 (g) **is equal to or greater than 15%** of the bidder's total contract price, then the bidder must complete this affidavit. *This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.*

Affidavit of _____ I do hereby certify that on the

 (Name of Bidder)
 _____ Total Project Bid \$ _____ Bid Date _____
 (Project Name)

Total dollar value of Certified MWBE businesses is \$_____ for a total of _____% of this contract. The Certified MWBE Businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. Attach additional sheets if required.

Business Name, Phone #, Email	Work Type	*MWBE	CERTIFIED NCHUB/NCDOT-DBE	Dollar Value	%

***Certified MWBE Business Program Categories:**

American Indian (AI), Asian American (AA), Black, African American (B), Hispanic (H), Non-minority female (NMF) Socially and Economically Disadvantaged (D)

Pursuant to GS 143-128.2 (d), the undersigned will enter into a formal agreement with Certified MWBE Business Program Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

Bidder must submit the Certified Subcontractor Payment with each payment request and final payment to the Project Manager.

Bidder must submit a Request to Change a Certified MWBE Subcontractor form to the Project Manager if necessary to replace/discontinue a MWBE Subcontractor.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____

Name of Authorized Officer: _____

Signature: _____

Title: _____

State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____ my commission expires _____

SEAL

**AFFIDAVIT D
Good Faith Efforts**

This form is to be submitted only by the apparent lowest responsible, responsive bidder with GFE Documents

County of _____

If the goal of 15% participation by Certified MWBE Businesses **is not** achieved, the Bidder shall provide the following documentation to the Owner of his Good Faith Efforts:

Affidavit of _____ I do hereby certify that the attached documentation is true
(Name of Bidder) and accurate presentation of my good faith efforts.

_____ Total Project Bid \$ _____ Bid Date _____
(Project Name)

Total dollar value of Certified MWBE businesses is \$ _____ for a total of _____% of this contract. The Certified MWBE Businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. Attach additional sheets if required.

(Attach additional sheets if required)

Business Name, Phone #, Email	Work Type	*MWBE	CERTIFIED NCHUB/NCDOT-DBE	Dollar Value	%

*Certified MWBE Business Program Categories:

American Indian (**AI**), Asian American (**AA**), Black, African American (**B**), Hispanic (**H**), Non-minority female (**NMF**) Socially and Economically Disadvantaged (**D**)

Documentation of the Bidder's Good Faith Efforts to meet the goals set forth in these provisions. Examples of documentation include, but are not limited to, the following evidence:

- A. Copies of solicitations for quotes to at least three (3) Certified MWBE businesses from the source list provide by the City of Raleigh for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be

subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contract, and location, date and time when quotes must be received.

- B. Copies of quotes or responses received from each firm responding to the solicitation.
- C. A telephone log of follow-up calls to each firm sent a solicitation.
- D. For subcontracts where a Certified MWBE business is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- E. Documentation of any contacts or correspondence to Certified MWBE business. Community or contractor organizations in an attempt to meet the goal.
- F. Copy of the pre-bid letter.
- G. Letter documenting efforts to provide assistance in obtaining required bonding or insurance for Certified MWBE business.
- H. Letter detailing reasons for rejections of Certified MWBE business due to lack of qualification.
- I. Letter documenting proposed assistance offered to Certified MWBE business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

Bidder must submit the Certified Subcontractor Payment with each payment request and final payment to the Project Manager.

Bidder must submit a Request to Change a Certified MWBE Subcontractor form to the Project Manager if necessary to replace/discontinue a MWBE Subcontractor.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: _____ Name of Authorized Officer: _____
Signature: _____
Title: _____

State of North Carolina, County of _____

Subscribed and sworn to before me this _____ day of _____ 20____

Notary Public _____ My commission expires _____

SEAL

REQUEST TO CHANGE A CERTIFIED MWBE SUBCONTRACTOR

Project Name: _____

Prime Contractor: _____ Contact Name: _____

Phone #: _____ Email Address: _____

Project Manager Name: _____ Division: _____

Will this request change the dollar amount of the contract? Yes ___ No ___ If yes,
Original total contract amount \$ _____ and proposed total contract: \$ _____

The proposed request will do the following to overall MWBE participation (please check one):

Increase ___ Decrease ___ No Change ___

Name current MWBE subcontractor: _____

Service provided: _____

Proposed Action:

___ Replace MWBE subcontractor

___ Perform work in-house

You must provide one of the following reasons (Please check applicable reason):

___ The listed MWBE, after having had a reasonable opportunity to do so, fails or refuses to execute a written contract.

___ The listed MWBE is bankrupt or insolvent.

___ The listed MWBE fails or refuses to perform his/her subcontract or furnish the listed materials.

___ The work performed by the listed subcontractor is unsatisfactory according to industry standards and is not in accordance with the plans and specifications; or the subcontractor is substantially delaying or disrupting the progress of the work.

___ Other. Explain on company letter head.

Name of replacement subcontractor: _____

Is the subcontractor a certified MWBE? ___ Yes ___ No

If no, please attach documentation of outreach efforts employed by the firm to utilize an MWBE.

Dollar amount of amended subcontractor \$ _____ MWBE _____ %

Printed Name

Title

Date

Interoffice Use Only:

Approval Yes No

Date _____

Signature _____



Minority and Women-Owned Business Enterprise Program (MWBE) Forms

BID FORMS	
DOCUMENT	SUBMISSION REQUIREMENTS
Acknowledgment of City MWBE Policy	Due with Bid
Identification of MWBE Participation <ul style="list-style-type: none"> List all MWBE firms intended to be used 	Due with Bid Complete Applicable Form: Formal, Informal, Professional
Affidavit A <i>Listing of Good Faith Efforts (GFE)</i> <ul style="list-style-type: none"> Earn at least 50 points 	Due with Bid (If self-performing, submit Affidavit B instead)
Affidavit B <i>Intent to Perform Contract with Own Workforce</i> <ul style="list-style-type: none"> Use only if you are self-performing 100% 	Due with Bid <ul style="list-style-type: none"> If using any subs or suppliers submit Affidavit A instead Affidavits C and D not required
Affidavit C <i>MWBE Subcontractor Utilization Commitment</i> <ul style="list-style-type: none"> Bidder meets the 15% MWBE Goal List all MWBE firms to be utilized 	Due within <u>3 business days</u> of notice of being apparent LRRB.
Affidavit D <i>Good Faith Efforts (GFE) & Statement of Compliance</i> <ul style="list-style-type: none"> Bidder does not meet the 15% MWBE Goal Documentation of GFE to be provided Minimum of 50 points 	Due within <u>3 business days</u> of notice of being apparent LRRB.
REPORT FORMS	
DOCUMENT	SUBMISSION REQUIREMENTS
Affidavit E <i>Subcontractor Payment Form</i>	Each invoice and final payment request
Request to Change MWBE Subcontractor <ul style="list-style-type: none"> Firm may replace MWBE subcontractor For cause and with approval of the City Good Faith Efforts apply. 	Due throughout entire contract period Anytime MWBE subcontractor changed

Maria A. Torres
 MWBE Coordinator
maria.a.torres@raleighnc.gov
 919-996-4271

Cheryl D. Sutton
 MWBE Program Manager
cheryl.sutton@raleighnc.gov
 919-996-6934

Lekesha R. Shaw
 MWBE Coordinator
lekeshasha@raleighnc.gov
 919-996-6958

www.raleighnc.gov

REQUEST TO CHANGE MWBE PARTICIPATION

Project Name: _____
Prime Contractor: _____ Contact Name: _____
Phone #: _____ Email Address: _____
Project Manager Name: _____ Division: _____

Will this request change the dollar amount of the contract? Yes ___ No ___ If yes,
Original total contract amount \$ _____ and proposed total contract: \$ _____

The proposed request will do the following to overall MWBE participation (please check one):

Increase ___ Decrease ___ No Change ___

Name current MWBE subcontractor: _____

Service provided: _____

Proposed Action:

___ Replace MWBE subcontractor

___ Perform work in-house

You must provide one of the following reasons (Please check applicable reason):

___ The listed MWBE, after having had a reasonable opportunity to do so, fails or refuses to execute a written contract.

___ The listed MWBE is bankrupt or insolvent.

___ The listed MWBE fails or refuses to perform his/her subcontract or furnish the listed materials.

___ The work performed by the listed subcontractor is unsatisfactory according to industry standards and is not in accordance with the plans and specifications; or the subcontractor is substantially delaying or disrupting the progress of the work.

___ Other – Explain in company letter head.

Name of replacement subcontractor: _____ Is
the subcontractor a certified MWBE? ___ Yes ___ No

If no, please attach documentation of outreach efforts employed by the firm to utilize an MWBE.

Dollar amount of amended subcontractor \$ _____ MWBE _____%

Effective Date: _____

Printed Name

Title

Date

Interoffice Use Only:

Date Received: _____

Approved: ___ Yes ___ No

Signature: _____

CONTRACTOR'S CERTIFICATES
AFFIDAVIT OF ORGANIZATION AND AUTHORITY
AND
SWORN STATEMENT

STATE OF _____)

COUNTY _____)
OF _____

_____ being the first duly sworn on oath deposes and says that the Bidder on the attached Bid is organized as indicated below and that all statements herein made are made on behalf of such Bidder and that this deponent is authorized to make them.

(Fill Out Applicable Paragraph)

1. CORPORATION:

The Bidder is a Corporation organized and existing under the laws of the State of _____ and its President is _____ ; its Secretary is _____ , and it does have a corporate seal. The President is authorized to sign construction contracts and bids for the Company by action of its Board of Directors taken _____ a certified copy of which is hereto attached. (Strike out last sentence if not applicable.)

2. PARTNERSHIP:

The Bidder is a partnership consisting of _____ and _____ , partners doing business under the name of: _____

3. SOLE TRADER:

The Bidder is an individual and if operating under a trade name, such trade name is as follows: _____

4. ADDRESS:

The business address of the Bidder is as follows: _____

Its phone number is _____

Bidder
By: _____

Subscribed and sworn to before me this _____ day of _____, 20 ____ .
Co.

Notary Public

My Commission Expires:

CITY OF RALEIGH
CONTRACTOR'S POOR PERFORMANCE POLICY

RESOLUTION NO. (1992) 790

A RESOLUTION TO REGULATE THE PARTICIPATION IN CITY CONSTRUCTION PROJECTS BY CONTRACTORS WHO MAY NOT BE CAPABLE OF TIMELY AND PROPER COMPLETION OF CITY PROJECTS.

WHEREAS, the City of Raleigh wishes to minimize cost and inconvenience to the citizenry caused by the failure of contractors to complete projects in a timely manner in accordance with approved project schedules; and

WHEREAS, North Carolina law allows cities to award bids to responsible bidders and the inability to complete work on time is one indication of a lack of responsibility.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF RALEIGH:

Section 1. That the City Manager may disqualify bidders from participation in bidding and award of contracts for city construction projects based on the following conditions existing simultaneously:

- A. The dollar value of the work completed is less than the dollar value of the work which should have been completed on the basis of the contractor's approved progress schedule by more than twenty percent of the current contract amount. The dollar amount of the work completed will be the total estimate to date shown in the latest partial pay estimate. The current contract amount will be the contract estimate plus accumulated overruns and less accumulated underruns shown in the latest partial pay estimate.
- B. The percentage of the work completed is less than the percentage of contract time elapsed on the work by more than twenty percent. The percentage of work completed will be the dollar value of the work completed as defined above divided by the current contract amount as defined above. The percentage of contract time elapsed will be the number of calendar days elapsed as shown in the latest partial pay estimate divided by the total contract time in calendar days.

Section 2. The City Manager shall not include any late days which are caused by the City in any of his calculations directed at determining bid status.

Section 3. All City construction project specifications shall contain a specific provision clearly outlining the policies set out in this Resolution, including the criteria for determining whether a contractor is behind schedule, and the specifications shall clearly state the City's intent to enforce the provisions of this Resolution.

Section 4. The terms of this Resolution shall apply only to contracts for which the specifications for bidders are issued after the effective date of this Resolution.

Section 5. Any contractor who wishes to contest the decision of the City Manager declaring ineligibility may appeal to the City Council by delivering a notice of appeal to the City Clerk no later than ten days after receipt of the City Manager's decision. The notice of appeal shall clearly set out the reasons why the Contractor believes that the terms of this Resolution have been inappropriately applied or the equitable arguments for not applying this Resolution's terms. When considering an appeal the City Council shall consider, among other things, the report of the City manager, the notice of appeal, and the contractor's current status on any other current City contracts and its performance on any other contracts to which the contractor and the City have been parties to within the two calendar years immediately preceding the filing of the notice of appeal.

Section 6. Bidders so disqualified shall remain disqualified for any period in which they are still in conflict with the schedule provisions of this section.

Section 7. This Resolution is effective upon adoption.

ADOPTED: 10/6/92

EFFECTIVE: 10/6/92

I have read and understand the City of Raleigh's policy as stated above.

Signature

Printed Name

Title

Date

NON-COLLUSIVE AFFIDAVIT

State of _____)
)ss.
County of _____)

First being duly sworn deposes and says that:

- (1) He is the _____
(Owner, Partner, Officer, Representative or Agent)
of _____ the Bidder that has submitted the attached Bid;
- (2) He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
- (3) Such Bid is genuine and is not a collusive or sham Bid;
- (4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, have in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm, or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted; or to refrain from bidding in connection with such Contract; or have in any manner, directly or indirectly, sought by agreement or collusion, or communication, or conference with any Bidder, firm, or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit, or cost elements of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against (Recipient), or any person interested in the proposed Contract;
- (5) The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any other of its agents, representatives, owners, employees or parties in interest, including this affidavit.

BY _____

PRINTED OR TYPED NAME _____

ITS _____
(Title)

Subscribed and sworn to before me this _____ day of _____, 20_____.

Notary Public My commission expires _____

END OF AFFIDAVIT

NOTICE TO CONTRACTOR REGARDING INTRUSIONS BEYOND PROJECT LIMITS

The Contractor and Owner hereby acknowledge that the Owner has acquired permanent and temporary easements on private property for the construction of the Project (the "Easements"), and that the Easements, together with public street rights-of-way (and previously acquired easements) comprise the sole areas where the Contractor is allowed to work on the Project, or to use for mobilization, access, staging, storage, and other purposes associated with the Project.

ANY OCCUPANCY OF OR INTRUSIONS ONTO PRIVATE PROPERTY OUTSIDE THE EASEMENTS OR RIGHTS-OF-WAY OWNED OR CONTROLLED BY THE CITY WILL CONSTITUTE A TRESPASS UPON PRIVATE PROPERTY AND MAY RESULT IN SERIOUS LEGAL CONSEQUENCES FOR THE CITY OF RALEIGH.

The Contractor shall be solely responsible for any intrusions onto private property outside the Easements or rights-of-way owned or controlled by the City. The Contractor hereby agrees to save, defend, hold harmless, and indemnify the City from all actions, claims, and liabilities, arising from such actions including, but not limited to, the payment of attorney's fees.

The only exception to the above stated limitations on the Contractor's work area will be in those instances where the Contractor has independently negotiated and secured agreements for temporary work and/or access privileges from Property Owners. These independently negotiated agreements must be in writing, and a copy of any such agreement shall be provided to the City in advance of any use or occupancy of private property pursuant to the agreement. The terms of any independently negotiated agreement shall clearly express to the Property Owner that the Contractor is seeking such use, occupancy, or access independently from the City of Raleigh and its Contract with the City of Raleigh, and that the Contractor shall be solely responsible for activities carried out on such areas.

I have read and understand the City of Raleigh's policy as stated above.

Signature

Printed Name

Title

Date

NEUSE RIVER EAST PARALLEL INTERCEPTOR

**CITY OF RALEIGH
RALEIGH, NORTH CAROLINA**

SUBJECT: ADDENDUM NO.

DATE:

To the Plans and Specifications for:
Neuse River East Parallel Interceptor
Raleigh, N.C.

To: PROSPECTIVE BIDDERS AND OTHER CONCERNED PARTIES

This ADDENDUM forms a part of the Contract Documents and modifies the original Bidding Documents as noted below. Bidders shall acknowledge receipt of the ADDENDUM in the space provided on the Bid Form. Failure to do so may subject the Bidder to Disqualification.

- A. Previous Addenda Requirements
 - 1. Addendum ****Number****, ****Date Issued****
 - a. ****Change****

- B. Bidding Requirements
 - 1. Document ****Number****, ****Title****
 - a. ****Change****

- C. Contracting Requirements
 - 1. Document ****Number****, ****Title****
 - a. ****Change****

- D. Technical Specification Requirements
 - 1. Section ****Number****, ****Title****
 - a. ****Change****

- E. Drawing Requirements
 - 1. Drawing No. Number, Title
 - a. ****Change****

Bids will be received until ****Time of Bid****, ****Date of Bid****

FOR THE OWNER
****Engineering Company****

BY_ ****Engineer's Name****, P.E.

END OF DOCUMENT

NOTICE OF AWARD

Date of Issuance:

Owner: City of Raleigh Owner’s Project No.:

Engineer: CJS Conveyance, PLLC Engineer’s Project No.:

Project: Neuse River East Parallel Interceptor

Contract Name:

Bidder:

Bidder’s Address:

You are notified that Owner has accepted your Bid dated **[date]** for the above Contract, and that you are the Successful Bidder and are awarded a Contract for: **[Describe Work, alternates, or sections of Work awarded]**

The Contract Price of the awarded Contract is **[\$[Contract Price]**. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

[Number of copies sent] unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically.

Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner **[number of copies sent]** counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any): **[Describe other conditions that require Successful Bidder’s compliance]**

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within **[90]** days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: **City of Raleigh**

By (signature): _____

Name (printed): _____

Title: _____

Copy: Engineer

AGREEMENT

INSTRUCTIONS TO CONTRACTORS AND REQUIREMENTS AS TO FORM FOR CITY OF RALEIGH, NC AGREEMENTS

DO NOT REMOVE FROM AGREEMENT

Please observe the following in executing the attached Contract:

1. The Owner may enter into an Agreement with three types of legal entities.
 - (a) If the Agreement is with an individual, that individual should sign the Agreement exactly as his name is set out. If the Agreement is with an individually-owned business, the Agreement should be with the individual owner, and not the named business.
 - (b) Execution on behalf of a corporation should be by an authorized corporate officer, with a second corporate officer signing to attest, with the corporate seal affixed. An official other than a corporate officer should attach documentation of their authority to execute and bind the company.
 - (c) If the Agreement is with a partnership, a general partner may execute unless an authorized partner is designated to execute. Documentation of such authorization should be attached.
2. After signing the Agreement, the appropriate notary's acknowledgement, either in the corporate form or individual/partnership form should be completed.
3. The Performance and Payment Bonds should be attached to the Agreement package. They should be signed by the Agree mentor, and his signature should be acknowledged with the appropriate acknowledge form. Next, the Bonds, in approved form, must be signed by the authorized agent of the Surety Company issuing the Bonds, and an executed Power of Attorney document authorizing the agent to sign must accompany the Bond Documents.
4. The Agreement should not be dated, except by the last person executing the Agreement, normally the City Clerk.
5. The Bid Form and all other documents submitted with the Bid shall be included with the Agreement and as noted in Article 9.
6. Page 00510 -1: Complete the Acceptance of Notice section on this page.
7. Pages 00520-3 through 00520-13: Complete in entirety.
8. Section 00610, 00615, 00616, 00617, and 00618: Complete in entirety.

9. Section 00618: Certificate of Insurance, Article 5 of the General and Supplementary Conditions requires the Certificate of Insurance to have those named as Additional Insured in each policy issued.
10. Most Certificates of Insurance state under the cancellation clause that "the issuing company will endeavor to mail 30 days written notice to the ..." and "but failure to mail such notice shall impose no obligation or liability of any kind upon the Company, its agents or representatives. Direct Notice of Cancellation endorsement is to be attached to corresponding Certificates of Insurance. With regard to expiration, cancellation, reduction, restriction, or any other change, certificates shall state:

"Should any of the following described policies be canceled before expiration date or be due to expire within thirty (30) days, the insurer shall mail thirty (30) days prior written notice to named certificate holder."
11. Four copies of the Contract are sent to the Contractor. The original and duplicates should be signed and returned to the Owner for signature, after which two duplicates will be returned to the Contractor. One copy may be retained by the Contractor and the other is for the use of the Bonding Company(s).
12. Failure to fully complete all four sets of the Contract Documents will cause delays in the approval by the Owner and therefore delay the issuance of the Notice to Proceed.

**AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT**
CITY PURCHASE ORDER NO. enter number

THIS AGREEMENT is by and between The City of Raleigh (Owner) and [Contractor's Name] (Contractor).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

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

BASE BID:

- 26,000 LF of 84-inch and 96-inch gravity sewer interceptor and branch sewers
- 70 sanitary sewer manholes including precast concrete manholes and fiberglass pipe tee manholes
- A cast-in-place vortex drop structure and twin 66-inch inlet pipes and 72-inch outlet pipe
- Two trenchless NCDOT road crossings (Auburn-Knightdale Road and Poole Road) by hand excavation tunneling with liner plate
- Two open cut crossings of the Neuse River for installation of 72-inch gravity sewer interceptor
- Abandonment of two existing wastewater pumping stations (Neuse River Pump Station and Riverview Pump Station)

ALTERNATE BID:

- Install Precast Polymer Concrete Manholes in lieu of Standard Precast Concrete Manholes or Fiberglass Tee Manholes in the Base Bid

ARTICLE 2 – THE PROJECT

The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows: Neuse River East Parallel Interceptor

ARTICLE 3 – ENGINEER

The Project has been designed by Hazen – 4011 WestChase Boulevard, Suite 400, Raleigh, NC 27607 and CJS Conveyance – 320 S. Academy Street, Cary, NC 2751. However, the Owner shall act as the Engineer and Resident Project Representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

4.01 *Time of the Essence*

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

4.02 *Days to Achieve Substantial Completion and Final Payment*

- A. The Work will be substantially completed within seventy hundred and thirty (730) consecutive calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within seventy hundred and ninety (790) consecutive calendar days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner \$500.00 for each day that expires after the time specified in Paragraph 4.02 above for Substantial Completion until the Work is substantially complete.
2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times or any proper extension thereof granted by Owner, Contractor shall pay Owner \$1,000.00 after Final Completion time for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.
3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.

- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

4.04 *Milestone Dates*

- A. The following principal events shall be completed and ready for final payment in accordance with paragraph 15.06 of the General Conditions within days indicated below after the date when the Contract Time commences to run. In accordance with paragraph 4.03 above as liquidated damages for delay (but not as penalty) Contractor shall pay

Owner the amounts indicated below for each day that expires after the time specified below for completion and readiness for final payment.

Milestone Event	Consecutive Calendar Days	Liquidated Damages
A. Substantial Completion	730	\$500/day
B. Final Completion	790	\$1,000/day
C.		

ARTICLE 5 – CONTRACT PRICE

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

- A. The Bid prices for Unit Price Work set forth as of the Effective Date of the Agreement are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer as provided in Paragraph 10.05 of the General Conditions.
- B. For all Work, at the prices stated in Contractor’s Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor’s Applications for Payment on or about the [25th] day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.05 of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.
 - 1. Prior to Final Completion, progress payments will be made in an amount equal to the percentage indicated in the Supplemental Conditions but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 15.01 of the General Conditions.

6.03 *Final Payment*

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

ARTICLE 7 – INTEREST

- 7.01 Once a Progress or Final Payment Application has been submitted by the contractor, recommended by the Engineer, and Approved by the Owner, if payment is not made, the Contractor will be due interest beginning on the 46th day following Owner acceptance at a rate of 1% per month or fraction thereof in accordance with NC General Statute 143-134.1(a).

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

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

- A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.
- B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
- D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-5.03 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-5.06 of the Supplementary Conditions as containing reliable "technical data."
- E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in Paragraph 8.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 00520-1 to 00520- , inclusive).
 - 2. Performance bond (pages 00610-1 to 00610- , inclusive).
 - 3. Payment bond (pages 00615-1 to 00615- , inclusive).
 - 4. Certificate of Owner's Attorney (page 00616)
 - 5. Affidavit (page 00617)
 - 6. Certificate of Insurance (pages 00618-1 to 00618- , inclusive).
 - 7. General Conditions (pages 00700-1 to 00700- , inclusive).
 - 8. Supplementary Conditions (pages 00800-1 to 00800- , inclusive).
 - 9. Specifications as listed in the table of contents (pages 00010-1 to 00010-) of the Project Manual.
 - 10. Drawings consisting of 124 sheets with each sheet bearing the following general title: Neuse River East Parallel Interceptor.
 - 11. Addenda as follows: [1 through xx or N/A]
 - 12. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (Sections 00410, 00411, and 00430).
 - b. Documentation submitted by Contractor prior to Notice of Award (City of Raleigh Bid Documentation; Sections 00440, 00441, 00442, 00443, and 00444).
 - c. Notice of Award (Section 00510).
 - 13. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed (Section 00550).

- b. Work Change Directives (Section 00940).
- c. Change Orders (Section 00941).
- d. Field Orders (Section 00942).
- e. Warranty Bonds, if any.

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

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

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 10 – MISCELLANEOUS

10.01 Terms

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

10.02 Assignment of Contract

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

10.03 Successors and Assigns

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

10.04 Severability

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

10.05 Contractor's Certifications

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

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

10.06 *Right to Audit Clause*

- A. Contractor's, subcontractors' and sub-subcontractors' "records" shall upon reasonable notice be open to inspection and subject to audit and/or reproduction during normal business working hours. Such audits may be performed by a City's representative or an outside representative engaged by City. The City or its designee may conduct such audits or inspections throughout the term of this Contract and for a period of three years after final payment or longer if required by law. City's representatives may (without limitation) conduct verifications such as counting employees at the Construction Site, witnessing the distribution of payroll, verifying information and amounts through interviews and written confirmations with Contractor employees, field and agency labor, subcontractors, and vendors.
- B. Such records shall include (hard copy, as well as computer readable data if it can be made available): written policies and procedures; time sheets; payroll registers; payroll records; cancelled payroll checks; subcontract files (including proposals of successful and unsuccessful bidders, bid recaps, negotiation notes, etc.); original bid estimates; estimating work sheets; correspondence; Change Order files (including documentation covering negotiated settlements); back charge logs and supporting documentation; invoices and related payment documentation; general ledger information detailing cash and trade discounts earned, insurance rebates and dividends; and any other Contractor records which may have a bearing on matters of interest to the City in its sole discretion in connection with the Contractor's dealings with the City, including but not limited to:
 1. Compliance with Contract requirements for deliverables;
 2. Compliance with Construction Documents;
 3. Compliance with City's business ethics expectations;
 4. Compliance with Contract provisions regarding the pricing of Change Orders;
 5. Accuracy of Contractor representations regarding the pricing of invoices; or
 6. Accuracy of Contractor representations related to claims submitted by the Contractor or any of its payees.

- C. Contractor shall require all payees (examples of payees include subcontractors, material suppliers, insurance carriers, etc.) to comply with the provisions of this article by including the requirements hereof in a written contract agreement between Contractor and payee. Contractor will ensure that all payees (including those entering into lump sum contracts) have the same right to audit provisions contained in this Contract.
- D. City's authorized representative or designee shall have reasonable access to the Contractor's facilities, shall be allowed to interview all current or former employees to discuss matters pertinent to the performance of this Contract and shall be provided adequate and appropriate work space, in order to conduct audits in compliance with this article.
- E. If an audit, inspection or examination in accordance with this article, discloses overpricing or overcharges (of any nature) by the Contractor to the City in excess of one percent (1%) of the total contract billings, in addition to making adjustments for the overcharges, the reasonable actual cost of the City's audit shall be reimbursed to the City by the Contractor. Any adjustments and/or payments which must be made as a result of any such audit or inspection of the Contractor's invoices and/or records shall be made within a reasonable amount of time (not to exceed 90 days) from presentation of City's findings to Contractor.
- F. The Contractor agrees to maintain all information pertaining to billing for services performed under this Contract in accordance with state law for public records. The Contractor shall afford the City access to these records for audit at such intervals as may be desired by the City. The Contractor shall also preserve the records for a period of three (3) years after Final Payment (or, alternatively, for a period of three years after termination of this Contract), or longer if required by law, during which time the City shall have access for audit purposes.
- G. The rights established under this section shall survive the expiration or termination of this Contract, and shall not be deleted, circumvented, limited, confined, or restricted by contract or any other section, clause, addendum, attachment or subsequent amendment to this Contract or any of the other Contract Documents.

10.07 *Iran Divestment Act Certification*

- A. Contractor certifies that, as of the date listed below, it is not on the Final Divestment List as created by the State Treasurer pursuant to N.C.G.S. § 147-86.55, et seq. In compliance with the requirements of the Iran Divestment Act and N.C.G.S. § 147-86.59, Contractor shall not utilize in the performance of the contract any subcontractor that is identified on the Final Divestment List.

10.08 *E - Verify*

- A. Contractor shall comply with E-Verify, the federal E-Verify program operated by the United States Department of Homeland Security and other federal agencies, or any successor or equivalent program used to verify the work authorization of newly hired employees pursuant to federal law and as in accordance with N.C.G.S. §64-25 et seq. In addition, to the best of Contractor's knowledge, any subcontractor employed by Contractor as a part of this contract shall be in compliance with the requirements of E-Verify and N.C.G.S. §64-25 et seq.

10.09 *Companies Boycotting Israel Divestment Act Certification*

- A. Contractor certifies that it has not been designated by the North Carolina State Treasurer as a company engaged in the boycott of Israel pursuant to N.C.G.S. 147-86.81.

10.10 *Applicability of North Carolina Public Records Law*

- A. Notwithstanding any other provisions of this Contract, this Contract and all materials submitted to the City by the Contractor are subject to the public records laws of the State of North Carolina and it is the responsibility of the Contractor to properly designate materials that may be protected from disclosure as trade secrets under North Carolina law as such and in the form required by law prior to the submission of such materials to the City. Contractor understands and agrees that the City may take any and all actions necessary to comply with federal, state, and local laws and/or judicial orders and such actions will not constitute a breach of the terms of this Contract. To the extent that any other provisions of this Contract conflict with this paragraph, the provisions of this section shall control.

THIS SPACE LEFT BLANK INTENTIONALLY

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

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

OWNER:

CONTRACTOR

CITY OF RALEIGH, N.C.

****Name of Contractor****

By: _____

By: _____

Title: **City Manager or Authorized Designee**

Title: _____

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

Attest: **Gail G. Smith**

Attest: _____

Title: **City Clerk**

Title: _____

Address for giving notices:

Address for giving notices:

City of Raleigh

222 W. Hargett Street

Raleigh, North Carolina 27601

License No.: _____

THIS INSTRUMENT APPROVED AS TO FORM:

(Where applicable)

City Attorney

Agent for service of process:

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

NOTE: If the Contractor is a Corporation, the legal name of the Corporation shall be set forth above, together with the signature of the officer or officers authorized to sign contracts on behalf of the Corporation; if Contractor is a partnership, the true name of the firm shall be set forth above, together with the signatures of all the partners; and if Contractor is an individual, his signature shall be placed above. If signature is by an agent other than an officer of a Corporation or a member of a partnership, a Power of Attorney must be attached hereto. Signature of Contractor shall also be acknowledged before a Notary Public or other person authorized by law to execute such acknowledgement.

(PLEASE COMPLETE ACKNOWLEDGEMENTS)
(CORPORATE ACKNOWLEDGEMENT)

STATE OF NORTH CAROLINA
COUNTY OF WAKE

This is to certify that on the _____ day of _____, 20_____
before me personally came _____, with whom I am personally
acquainted, who, being by me duly sworn, says that ___he is the President and
_____ is the Secretary of _____, the corporation
described in and which executed the foregoing instrument: that (s)he knows the common seal of
said corporation: that the seal affixed to the foregoing instrument is said common seal, and the
name of the corporation was subscribed thereto by the said Secretary and the said corporate seal
was affixed, all by order of the Board of Directors of said corporation, and that the said instrument
is the act and deed of said corporation.

Witness my hand and official seal this _____ day of _____, 20_____

Notary Public

(SEAL)

My Commission Expires:

(CITY ACKNOWLEDGEMENT)

STATE OF NORTH CAROLINA
COUNTY OF WAKE

This is to certify that on the _____ day of _____, 20_____, before me
personally came R, with whom I am personally acquainted, who, being by me duly sworn, says that
he is the City Manager and Gail G. Smith is the City Clerk of the City of Raleigh, the municipal
corporation described in and which executed the foregoing: that she knows the corporate seal of
the said municipal corporation; that the name of the municipal corporation was subscribed thereto
by the said City Clerk and that the said corporate seal was affixed, all by order of the governing
body of said municipal corporation, and that the said instrument is the act and deed of said municipal
corporation.

Witness my hand and official seal this _____ day of _____ 20_____

Notary Public

(SEAL)

My Commission Expires:

NOTICE TO PROCEED

Owner: City of Raleigh Owner's Project No.: _____
Engineer: Hazen/CJS Conveyance Engineer's Project No.: 32426/100-002
Contractor: _____ Contractor's Project No.: _____
Project: Neuse River East Parallel Interceptor
Contract Name: _____
Effective Date of Contract: _____

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on **[date Contract Times are to start]** pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement: **[Insert number of days and dates.]**

The number of days to achieve Substantial Completion is **[number of days, from Agreement]** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of **[date, calculated from commencement date above]**; and the number of days to achieve readiness for final payment is **[number of days, from Agreement]** from the commencement date of the Contract Times, resulting in a date for readiness for final payment of **[date, calculated from commencement date above]**.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner: City of Raleigh
By (signature): _____
Name (printed): _____
Title: _____
Date Issued: _____
Copy: Engineer

PERFORMANCE BOND

<p>Contractor</p> <p>Name: [Full formal name of Contractor]</p> <p>Address (as registered with Secretary of State, if applicable): [Address of Contractor]</p>	<p>Surety</p> <p>Name: [Full formal name of Surety]</p> <p>Address (as registered with Secretary of State, if applicable): [Address of Surety]</p>
<p>Owner</p> <p>Name: City of Raleigh</p> <p>Mailing address: 222 W. Hargett Street Raleigh, NC 27601</p>	<p>Contract</p> <p>Description (name and location): [Owner's project/contract name, and location of the project]</p> <p>Contract Price: [Amount from Contract]</p> <p>Effective Date of Contract: [Date from Contract]</p>
<p>Bond</p> <p>Bond Amount: [Amount]</p> <p>Date of Bond: [Date]</p> <p><i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.</p>	
Contractor as Principal	Surety
<p>_____</p> <p><i>(Full formal name of Contractor)</i></p>	<p>_____</p> <p><i>(Full formal name of Surety) (corporate seal)</i></p>
<p>By: _____</p> <p style="text-align: center;"><i>(Signature)</i></p>	<p>By: _____</p> <p style="text-align: center;"><i>(Signature)(Attach Power of Attorney)</i></p>
<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>	<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p>Attest: _____</p> <p style="text-align: center;"><i>(Signature)</i></p>	<p>Attest: _____</p> <p style="text-align: center;"><i>(Signature)</i></p>
<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>	<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
2. If the Contractor **satisfactorily** performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
 - 3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
 - 3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
 - 3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
 - 5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
 - 5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
 - 5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or
 - 5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

- 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
 - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
 - 7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
 - 7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
 - 7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.
12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.
13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

- 14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
 - 14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. Modifications to this Bond are as follows: **None**

PAYMENT BOND

Contractor Name: [Full formal name of Contractor] Address <i>(as registered w/ Secretary of State, if applicable)</i> : [Address of Contractor]	Surety Name: [Full formal name of Surety] Address <i>(as registered w/ Secretary of State, if applicable)</i> : [Address of Surety]
Owner Name: City of Raleigh Mailing address: 222 W. Hargett Street Raleigh, NC 27601	Contract Description <i>(name and location)</i> : [Owner's project/contract name, and location of the project] Contract Price: [Amount, from Contract] Effective Date of Contract: [Date, from Contract]
Bond Bond Amount: [Amount] Date of Bond: [Date] <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>	

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
 - 5.1. Claimants who do not have a direct contract with the Contractor
 - 5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that **is shall be** sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2. Pay or arrange for payment of any undisputed amounts.
 - 7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety

shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. Definitions
 - 16.1. *Claim*—A written statement by the Claimant including at a minimum:
 - 16.1.1. The name of the Claimant;
 - 16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

- 16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 - 16.1.4. A brief description of the labor, materials, or equipment furnished;
 - 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic’s lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of “labor, materials, or equipment” that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: **None**

CERTIFICATE OF OWNER'S ATTORNEY

I hereby certify that I am the duly appointed attorney for the Owner of this project and that I have examined the foregoing instrument and Bond, and approve the same as being legal and in proper form.

This _____ day of _____, 20_____.

Attorney-at Law

CERTIFICATE OF PAYMENTS

I hereby certify that I am the legal and duly appointed Finance Officer for the Owner of this project and that provision for the payment of any monies due under this agreement has been made by appropriation duly made, or by Bonds or notes duly authorized, as required by the North Carolina Local Government Budget and Fiscal Control Act.

City of Raleigh

Date: _____

By: _____

Title: _____

AFFIDAVIT

(To be attached to all Contracts)

STATE OF _____)
) SS
COUNTY OF _____)

_____ being first duly sworn on oath deposes and says that (s)he is _____

(attorney-in-fact or agent) of _____
(bonding company) surety on the attached Contract on _____
_____ executed by _____ (Contractor).

Affiant further deposes and says that no officer, official, or employee of the Owner has any direct or indirect interest, or is receiving any premium, commission, fee, or other thing of value on account of the same or the furnishing of the Bond, undertaking, contract of indemnity, guaranty, or suretyship in connection with the above-mentioned contract.

Signed _____

Subscribed and sworn to before me this ____ day of _____, A.D., 20____.

(Notary Public, _____ County, _____)

My Commission Expires _____.

PAGE FOR ATTACHING

CERTIFICATE OF INSURANCE

Contractor's Application for Payment

Owner: <u>City of Raleigh</u>	Owner's Project No.: _____
Engineer: <u>Hazen/CJS Conveyance</u>	Engineer's Project No.: <u>32426/100-002</u>
Contractor: _____	Contractor's Project No.: _____
Project: <u>Neuse River East Parallel Interceptor</u>	
Contract: _____	
Application No.: _____	Application Date: _____
Application Period: From _____ to _____	

1. Original Contract Price	\$	-
2. Net change by Change Orders	\$	-
3. Current Contract Price (Line 1 + Line 2)	\$	-
4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)	\$	-
5. Retainage		
a. _____ X \$ _____ Work Completed	\$	-
b. _____ X \$ _____ Stored Materials	\$	-
c. Total Retainage (Line 5.a + Line 5.b)	\$	-
6. Amount eligible to date (Line 4 - Line 5.c)	\$	-
7. Less previous payments (Line 6 from prior application)		
8. Amount due this application	\$	-
9. Balance to finish, including retainage (Line 3 - Line 4)	\$	-

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor: _____

Signature: _____ **Date:** _____

Recommended by Engineer	Approved by Owner
By: _____	By: _____
Title: _____	Title: _____
Date: _____	Date: _____
Approved by Funding Agency	
By: _____	By: _____
Title: _____	Title: _____
Date: _____	Date: _____

Progress Estimate - Lump Sum Work

Contractor's Application for Payment

Owner:	City of Raleigh	Owner's Project No.:	
Engineer:	Hazen/CJS Conveyance	Engineer's Project No.:	32426/100-002
Contractor:		Contractor's Project No.:	
Project:	Neuse River East Parallel Interceptor		
Contract:			

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I
Item No.	Description	Scheduled Value (\$)	Work Completed		Materials Currently Stored (not in D or E) (\$)	Work Completed and Materials Stored to Date (D + E + F) (\$)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) (\$)
			(D + E) From Previous Application (\$)	This Period (\$)				
Original Contract								
			-			-		-
						-		-
						-		-
						-		-
						-		-
						-		-
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						-		-
						-		-
Original Contract Totals		\$ -	\$ -	\$ -	\$ -	\$ -		\$ -

Progress Estimate - Unit Price Work

Contractor's Application for Payment

Owner: City of Raleigh
 Engineer: Hazen/CJS Conveyance
 Contractor: _____
 Project: Neuse River East Parallel Interceptor
 Contract: _____

Owner's Project No.: _____
 Engineer's Project No.: 32426/100-002
 Contractor's Project No.: _____

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I	J	K	L		
Bid Item No.	Description	Contract Information				Work Completed		Materials Currently Stored (not in G) (\$)	Work Completed and Materials Stored to Date (H + I) (\$)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) (\$)		
		Item Quantity	Units	Unit Price (\$)	Value of Bid Item (C X E) (\$)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) (\$)						
Original Contract													
					-		-		-		-		
					-		-		-		-		
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					-		-		-		-		
Original Contract Totals					\$	-		\$	-	\$	-	\$	-

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.

APPLICATION FOR PAYMENT

Prepared By



Endorsed By



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GUIDELINES FOR THE INTENDED USE OF EJCDC C-620, APPLICATION FOR PAYMENT

1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

The Application for Payment is used to facilitate periodic progress payments to the Contractor for Work completed and for stored materials and equipment (referred to in this document as "Stored Materials").

For additional information regarding the Application for Payment, see EJCDC® C-700, Standard General Conditions of the Construction Contract (2018), Paragraph 15.01, and EJCDC® C-001, Commentary on the 2018 EJCDC Construction Documents (2018).

2.0 APPLICATION FOR PAYMENT OVERVIEW

This document was prepared in Microsoft Excel due to the number of calculations involved in the preparation of the Application for Payment. The application consists of a Summary worksheet, and 3 supporting worksheets: Lump Sum worksheet, Unit Price worksheet, and Stored Materials worksheet.

2.1 *Summary Worksheet* — calculates the amount to be paid to the Contractor at the end of each Application for Payment period. This calculation imports numbers from the supporting worksheets to determine the value of the Work completed and Stored Materials, calculate retainage, and deduct amounts previously paid to determine the amount the Contractor should be paid for the current application period. Application periods are typically one month; however these periods may be extended when Contractor's efforts do not result in the billable completion of Work or storage of materials and equipment during the payment period.

2.2 *Lump Sum Worksheet* — calculates the total value for completed Work for which compensation is paid on a Lump Sum basis. The schedule of values included in this worksheet reflects a breakdown of lump sum Work items to which Contractor and Engineer have agreed, pursuant to Article 2 of the General Conditions. Costs for Stored Materials associated with lump sum items are included on this worksheet to calculate the total value for completed lump sum Work and associated Stored Materials. This total is exported to the Summary worksheet. Separate totals for Work Completed and for materials currently stored are also exported to the Summary worksheet for use in calculating the amount of retainage to be held for each.

- 2.3 *Unit Price Worksheet* — calculates the total value for completed Work for which compensation is paid on a Unit Price basis. The schedule of values included in this spreadsheet is typically a tabulation of Unit Price items from the Agreement. Costs for Stored Materials associated with unit price items are included in this worksheet to calculate the total value for completed Unit Price Work and associated Stored Materials. This total is exported to the Summary worksheet. Separate totals for Work Completed and for Materials Currently Stored are also exported to the Summary worksheet for use in calculating the amount of retainage to be held for each.
- 2.4 *Stored Materials Worksheet* — calculates the total value for materials and equipment that have been purchased and are being stored until they are incorporated into the Work. This worksheet adds materials and equipment to the worksheet as they are brought to the site and stored; such Stored Materials are then deducted from the Stored Materials worksheet total as they are incorporated into the Work, providing a running net value for the materials and equipment remaining in storage. The values of Stored Materials must be manually added to the Lump Sum or Unit Price line items. These do not automatically update when changes are made. The amount of materials remaining in storage is eligible for payment but must be tracked separately from Work completed since different retainage rates may apply to Work completed and Stored Materials.

3.0 Instructions for filling out the Payment Application form

- 3.1 Project-specific information is to be entered in the top portion (header) of the Summary worksheet. This same information will automatically be copied to the other worksheets to complete the headers on all other worksheets.
- 3.2 Outside of the header, data can be entered in non-shaded cells when the sheet is protected. Cells shaded light blue contain equations that will automatically transfer data from other cells or make calculations to complete the worksheet. Altering any of these cells can result in errors in the Application for Payment. It is recommended that the worksheets be protected at all times unless alterations are deliberately being made to the Application for Payment form other than to enter data. See Paragraph 4.0 below for information on Protection of Worksheets.
- 3.3 Enter information regarding each item in the Lump Sum and/or Unit Price worksheets. For Lump Sum projects, each item should represent an item in the schedule of values prepared by the Contractor and approved by the Engineer/Owner, breaking down the Lump Sum amount into measurable components. For Unit Price contracts, use numbers from the Agreement as the schedule of values. Specific information on the data to be entered into each column may be seen by clicking on the header description for that column. Similar comments may be seen for cells in the "Totals" row that indicates how the number is calculated and where this number is exported to another part of the spreadsheet. See the Commentary for additional information.

3.4 The equations in the Summary worksheet use numbers imported from both the Lump Sum and Unit Price worksheets. Projects will typically either use the Lump Sum or the Unit Price worksheet, but some projects may use both. If one of the worksheets is not used, it should be hidden and not deleted. If it is deleted, Users will need to correct the equations in the Summary worksheet by unprotecting the worksheet and editing the equations. To hide a worksheet, right click on the worksheet tab at the bottom of the worksheet and select "Hide." To unhide a worksheet, right click on any worksheet tab and select "Unhide," and then select the worksheet to unhide and click "Okay." This same process may be used to hide these Guidelines for Use.

4.0 Protection of Worksheets

- 4.1 The cells in this Workbook that create the forms or contain equations have been coded to "lock" the cells that should not be altered. It is recommended that the Workbook be Protected (cells locked) at all times unless it is necessary to add or delete rows. Directions for adding and deleting rows are provided in the next section. Passwords can be used to lock the Protect / Unprotect settings on spreadsheets, however the worksheets in this workbook do not require a password.
- 4.2 To unprotect a worksheet, click on the "Review" menu tab at the top of Excel, then click "Unprotect Sheet." To protect a worksheet, click on the "Review" menu tab at the top of Excel, then click "Protect Sheet." This will open a dialog box in which the User is allowed to select protection options. It is recommended that only the top two checkboxes for "Select Locked Cells" and "Select Unlocked Cells" be checked. This will reset the protection for the Worksheet.

5.0 Adding and Deleting Rows

- 5.1 A limited number of blank rows are provided in the Lump Sum, Unit Price, and Stored Material worksheets. Additional rows may be added to these worksheets by the User. The first step in this process is to unprotect the worksheet as previously discussed. After the sheet is unprotected, move with caution to prevent inadvertently deleting any cells that contain equations. To insert a row, right click in the row heading at the left of the spreadsheet and select "Insert." A new row will be inserted at the location where the cursor was placed in the row heading. If more than one new row is desired, left click and drag the cursor to include the desired number of rows, right click in the selected row headings and then select "Insert." It is important that the line immediately above the "Totals" row not be included in the rows selected. Doing so will require that equations in the "Totals" row be adjusted. When rows are inserted, Excel automatically adjusts the equations to include the new rows, unless the row directly above the "Totals" row is also selected.
- 5.2 After new rows are inserted, it is important to copy a line from one of the original rows so correct formatting and equations are copied into each new row. To do this, select the row to be copied by clicking the cell in Column A and dragging the cursor to the last column in the table. Then select "Copy" from the menu or type CTRL+C to copy the cells. Excel will show that this row has been copied by showing a moving dashed line around the cells that are to be copied. Then select the new rows into which the information is to be copied as before and select Paste from the menu or type CTRL+V.
- 5.3 To delete an unused row, right click in the row heading on the left of the spreadsheet for the row to be deleted and select "Delete." The selected row will be deleted. If more than one row is to be deleted, left click and drag the cursor to the desired number of rows to be deleted and then right click to open the menu and select "Delete." Unlike the admonition on adding new rows, it is okay to delete the row just above the "Totals" row.

5.4 After rows have been added or deleted, it is important reset the worksheet protection.

6.0 Saving Files

This file is provided as a Microsoft[®] Excel Open XML workbook template (.xltx) to prevent this file from being inadvertently changed. When an application for payment is created for a specific project it should be saved as an Excel workbook (.xlsx) file. To do this, select Save As (F12), type in a new file name and select Excel Workbook (.xlsx) from the drop down Save As Type menu.

7.0 License Agreement

This document is subject to the terms and conditions of the License Agreement, 2018 EJCDC[®] Construction Series Documents. A copy of the License Agreement was furnished at the time of purchase of this document, and is available for review at www.ejcdc.org and the websites of EJCDC's sponsoring organizations.

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: **City of Raleigh** Owner's Project No.:
Engineer: Engineer's Project No.:
Contractor: Contractor's Project No.:
Project: Neuse River East Parallel Interceptor
Contract Name:

This Preliminary Final Certificate of Substantial Completion applies to:

All Work The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: None As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: None As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

PAGE FOR ATTACHING

POWER OF ATTORNEY

*Note: If the recorded POA from the Register of Deeds
is attached, page 00634-2 is not necessary.*

STATE OF NORTH CAROLINA
COUNTY OF _____

This is to certify that on the _____ day of _____, 20__, before me personally appeared before me to the undersigned Notary Public, _____ who, being first duly sworn, acknowledged the due execution of the foregoing instrument for the purpose therein stated.

Witness my hand and notarial seal this the _____ day of _____, 20

(SEAL)

Notary Public

My Commission Expires:

STATE OF NORTH CAROLINA
COUNTY OF _____

This is to certify that on the _____ day of _____, 20__, before me personally came _____, with whom I am personally acquainted, who, being by me duly sworn, says that (s)he is the President and _____ is the Secretary of _____, Incorporated, the corporation described in and which executed the foregoing instrument; that (s)he knows the common seal of said corporation; that the seal affixed to the foregoing instrument is said common seal, and the name of the corporation was subscribed thereto by the said Secretary and the said corporate seal was affixed, all by order of the Board of Directors of said corporation, and that the said instrument is the act and deed of said corporation.

Witness my hand and notarial seal this the _____ day of _____, 20

(SEAL)

Notary Public

My Commission Expires:

STATE OF NORTH CAROLINA
COUNTY OF _____

I, _____, a Notary Public duly commissioned and qualified to act in _____ County, State of _____, do hereby certify that _____, Attorney-in Fact for _____, a corporation, personally appeared before me this day, and being by me duly sworn, says that (s)he executed the foregoing and attached Payment and Performance Bonds, dated _____, 20__, for and in behalf of _____ as Surety and that his authority to execute and acknowledge said Bonds is contained in an instrument duly executed, acknowledged, and recorded in the Office of Register of Deeds of _____ County, State of _____, on the _____ day of _____, 20__, being recorded in Book Number _____, Page _____, of said Registry, and that the foregoing and attached Bonds were executed under and by virtue of the authority given by said instrument granting (him) (her) the said _____, Power of Attorney; and that the said _____, Attorney-in-Fact, acknowledged the due execution of the foregoing and annexed Bonds for the purpose therein expressed for and in behalf of said _____.

Witness my hand and notarial seal this the _____ day of _____, 20__.

(SEAL)

Notary Public

My Commission Expires:

00700
STANDARD GENERAL CONDITIONS
OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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 document prepared by Contractor, in a form acceptable to Engineer, to request 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; 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; 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.
- 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.
 - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
 - d. 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), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations 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 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. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *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.
24. *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.
 - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
 - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
 - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *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.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *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.
30. *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.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *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.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *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.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *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.
37. *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.
38. *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 or areas furnished by Owner which are designated for the use of Contractor.
39. *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.
40. *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.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *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 of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, 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.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
 - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
 - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *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.
50. *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 Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* 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:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
1. does not conform to the Contract Documents;
 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 3. 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 Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
1. The word “furnish,” when used in connection with services, materials, or equipment, means 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, means 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, means 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. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. 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 Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), 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 signed 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 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 *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 the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will 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.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents 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 Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document 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 versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will 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.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will 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.
- G. Nothing in the Contract Documents creates:
 - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
 - 2. 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.

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, means 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, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer 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 or Engineer 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 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 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 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 in writing 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.

- 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 notify Owner and Contractor in writing 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 versions, 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 precludes 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 30th 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 60th day after the day of Bid opening or the 30th 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 may 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 must 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 will 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 Contract Price or 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. Such an adjustment will 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 third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
 - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
 2. Contractor shall not be entitled to an adjustment in Contract Price 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. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
 3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
 2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
 3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
 4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
 5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. 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, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses 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.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing 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, or to improvements, structures, utilities, or similar facilities located at such adjacent lands 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 7.13, 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 in a court of competent jurisdiction; 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 will 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 of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* 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 Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* 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;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. 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:
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;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 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 whether it is necessary for Owner to obtain 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; 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, 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 subject to the provisions of Paragraphs 4.05.D and 4.05.E.
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;
 - 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 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, then any such adjustment will 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, 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.
- F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. 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 on the Drawings, or was not shown or indicated on the Drawings 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), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; 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
 4. 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

or indicated on the Drawings, 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. 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;
 - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
 - c. 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, then any such adjustment will 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, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
 4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

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

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; 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 on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. 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;
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, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, 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. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- 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, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates 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 obligates 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 Contractor's obligations under the Contract. These bonds must 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 terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, 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 must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. 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.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

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. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

- Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.
- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
 - F. 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, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
 - G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. 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.
 - H. Contractor shall require:
 - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
 - I. If either party does not purchase or maintain 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.
 - J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
 - K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) 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 will be adjusted accordingly.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, 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 and Engineer.

6.03 Contractor's Insurance

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
 - 1. include at least the specific coverages required;
 - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
 - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, 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;
 - 4. apply with respect to the performance of the Work, whether such performance is 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; and
 - 5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
 - 1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
 - 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
 - 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and
5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other 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 Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- 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 advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. 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 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer 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.

1. 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, risks, 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 individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater 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.
 2. None of the above waivers extends 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. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, 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, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. 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 all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights 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 insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract 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 fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 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 6.04 shall maintain such proceeds in a segregated account, and 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, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *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.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *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 maintain good discipline and order at the Site.

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. 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 will 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.

7.04 *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 must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will 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 must 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.

7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, 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 equipment or material, or items from other proposed Suppliers, under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
 - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) 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) has a proven record of performance and availability of responsive service; and
 - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) the item 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 will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material 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 equipment or material under the circumstances described below. To the extent possible such requests must 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 equipment or material from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.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 equipment or material that Contractor seeks to furnish or use. The application:
 - a. will 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 the item specified; and
 - 3) be suited to the same use as the item 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 the item specified; and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. will 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 will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers 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 or Supplier 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 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. 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 or Suppliers 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 or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, 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 or Supplier, whether initially or as a replacement, will 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 solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *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 an 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 will be disclosed 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.

7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. 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.

7.10 *Taxes*

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

7.11 *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. 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 is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written 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 written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *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.

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. 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.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.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).
- E. 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.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that 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.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. 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.

- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will 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.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as 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 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 by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determine and verify:
 - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
 - 2) 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
 - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
 - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must 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 Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must 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.C.
 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.C.
 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. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. 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, comply with the requirements of 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 will 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 or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 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, will 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 or Sample will 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.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

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 Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
 - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
 - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
 - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

- d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

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 is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, 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.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
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. The end of the correction period established in Paragraph 15.08;
 8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.
- E. 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 will 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 losses, damages, costs, and judgments (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 from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage 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 will 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.

7.19 *Delegation of Professional Design Services*

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
 - 1. Checking for conformance with the requirements of this Paragraph 7.19;
 - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
 - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

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 third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. 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.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, 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.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

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 for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, 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. 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 will 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, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will 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 or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- 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.
 - 1. 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 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 8.03.B.
 - 2. 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 Contractor.
- C. 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 will 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 (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 10.07. 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 *Resident 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 the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *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.

10.06 *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.

10.07 *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, will 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 Contractor under 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 10.07 also apply to the Resident Project Representative, if any.

10.08 *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 of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that 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, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
 - 1. Changes in 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 11.05, (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 that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

- A. 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 11.07 regarding change of Contract Price.

- B. If Owner has issued a Work Change Directive and:
 - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
 - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

- A. 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.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *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. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work 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 must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates 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.

11.06 *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.C.2.

11.07 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must 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);
 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 11.07.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 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will 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 will be 15 percent;
 - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 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 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.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 5 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 will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
 - d. No fee will 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 of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
 - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
2. *Supporting Data:* 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.
 - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
 - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must 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.

3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must 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.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *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 in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *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 are subject 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;
 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; and
 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- 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 rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, 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 will 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 will 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 will 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 will 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 will 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 will 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 will be incorporated in a Change Order or other written document 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. When needed 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 will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will 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 in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, 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, will 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 accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will 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, which 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 will 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 or retained for services specifically related to the Work.
 5. Other costs consisting of 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, 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.

- 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
 - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
 - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed 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 builder's risk or other property insurance established in accordance with Paragraph 6.04), 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 include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will 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 does not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general 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. The cost of purchasing, renting, or furnishing small tools and hand tools.
- 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 5. 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.
- 6. Expenses incurred in preparing and advancing Claims.
- 7. 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*

- 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
- 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

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 for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's 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 for Work covered by allowances, and the Contract Price will 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, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
 - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

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 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 with such procedures and programs 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 will 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 will 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 will 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 written 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 will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, 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 will 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 defective Work as required by Engineer, then Owner may, after 7 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 for 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.
 - 2. 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 must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) 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.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. 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;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; 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 based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from 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 has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
 - j. Liquidated or other 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; or
 - l. Other items entitle 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 will 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 will be treated as an amount due as determined by Paragraph 15.01.D.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 7 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 will 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 7 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 15.03.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 6.04 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 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must 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 duly pending Change Proposals and Claims; 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 Final Application and Recommendation of Payment:* 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 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will 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. 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. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *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 and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- 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 as a Claim, 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 Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect 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 adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, 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 from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, 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 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). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. 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.
- E. 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.

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to 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 directly attributable to any such suspension. Any Change Proposal seeking such adjustments must 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) 10 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) written 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 7 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 will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 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 for any loss of anticipated profits or revenue, post-termination overhead costs, 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 7 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, 7 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, pursuant to Article 12; and
 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise 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;
 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 requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

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 will not constitute a waiver of that provision, nor will 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 of the Contract or 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 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party 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.

18.09 *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.

18.10 *Headings*

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

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

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—for example, “Paragraph SC-4.05.”

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

SC-1.01.A.3. Add the following language to the end of Paragraph 1.01.A.3:

The Application for Payment form to be used on this Project is per City of Raleigh standards. Standard form to be used as a summary and signature sheet is included in Section 00620. Contractor shall use the City’s standard computerized forms, as included in these Contract Documents, for providing detail payment breakdown as an attachment to summary sheet. Contractor shall also include as part of the Application for Payment the “Certificate of the Contractor or His Duly Authorized Representative”.

SC-1.01.A.8. Add the following language to the end of Paragraph 1.01.A.8:

The Change Order form to be used on this Project is the City of Raleigh standard. The Standard Form to be used is included in these Contract Documents.

SC-1.01.A.9. Add the following language to the end of Paragraph 1.01.A.9:

The Change Proposal form to be used on this Project is the City of Raleigh standard. The Standard Form to be used is included in these Contract Documents.

SC-1.01.A.42. Amend the first sentence of Paragraph 1.01.A.42 to read as follows:

The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer and Owner, 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.

SC-1.01.A.51. Add the following definitions after Paragraph 1.01.A.50:

A.51 *City* – City of Raleigh.

A.52 *Minority Business* - A business:

- a. In which at least fifty-one percent (51%) is owned by one or more minority persons or socially and economically disadvantaged individuals, or in the case of a corporation,

in which at least fifty-one percent (51%) of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and

- b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.

A.53 *Minority Person* - A person who is a citizen or lawful permanent resident of the United States and who is:

- a. Black, that is, a person having origins in any of the black racial groups in Africa;
- b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
- c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, or the Pacific Islands;
- d. American Indian, that is, a person having origins in any of the original Indian peoples of North America; or
- e. Female.

A.54 *Notice of Violation* - A written notification from a governmental agency that the Owner has violated a law or regulation that the agency has jurisdiction over. Notice will take the form used by the agency and may outline action to be taken by the Owner to correct the violation and may include a monetary fine.

A.55 *Small Tools* - Tools and equipment with an individual cost of less than \$1,000.

A.56 *Socially and Economically Disadvantaged Individual* - Same as defined in 15 U.S.C. 637; "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged."

ARTICLE 2 - PRELIMINARY MATTERS

2.01 Delivery of Performance and Payment Bonds; Evidence of Insurance

SC-2.01.A Amend the first sentence of Paragraph 2.01.A by striking out the following words:

"(if the Contract requires Contractor to furnish such bonds)."

2.02 *Copies of Documents*

SC-2.02.A Delete the word "four" and insert "five" in its place in Paragraph 2.02.A.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, REQUIREMENTS , REUSE

3.01 *Intent*

SC-3.01 Add the following new paragraphs immediately after Paragraph 3.01.G:

- H. The Contract Drawings may be supplemented from time to time with additional Drawings by the Engineer as may be required to illustrate the Work or, as the Work progresses, with additional Drawings, by the Contractor, subject to the approval of the Engineer. Supplementary Drawings, when issued by the Engineer or by the Contractor, after approval by the Engineer, shall be furnished in sufficient quantity to all those who, in the opinion of the Engineer, are affected by such Drawings.

ARTICLE 4 - COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

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

The Contract Times will commence to run on the day indicated in the Notice to Proceed; but in no event will the Contract Time commence to run later than the thirtieth day after the effective date of the Agreement. By mutual consent of the parties to the Contract, these time limits may be changed.

4.05 *Delays in Contractor's Progress*

SC-4.05.C Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

- a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions adversely affected an activity on the critical path to completion of the Work, as of the time of the weather condition.
- b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following.
 - 1) Bad Weather Day: a workday where weather conditions adversely affect the Work and the impacted Work is on the critical path.
 - a) Determination of actual Bad Weather Days during performance of the Work will be based on weather at the Site. When Site weather data is not available, use nearest USGS weather station data.

- b) A workday after a daily rainfall amount greater than 1 inch will be considered an additional Bad Weather Day, subject to having an adverse effect on the Work as scheduled.
- 2) Foreseeable Bad Weather Days: determination of Foreseeable Bad Weather Days during performance of the Work will be based on the weather records measured and recorded by the National Oceanic & Atmospheric Administration, National Centers for Environmental Information (NOAA-NCEI) at the nearest weather monitoring station. For example, one source of weather records is from the NOAA-NCEI website: <https://www.ncdc.noaa.gov/cdo-web/datatools/normals>. From the website, click on the "View Station Report" link to find the Summary of Monthly Totals report.
- a) Contractor shall anticipate and factor into its bid and construction schedule the number of Foreseeable Bad Weather Days per month.
- 3) Abnormal Weather Conditions: is defined as the total Bad Weather Days in each month minus the Foreseeable Bad Weather Days.
- a) The existence of Abnormal Weather Conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by Abnormal Weather Conditions are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.

SC-4.05 Add the following new paragraph immediately after Paragraph 4.05.G:

- H. Claims for additional Contract Time for delays beyond the Contractor's control shall be submitted within 30 days following the event(s) that caused the delay.

ARTICLE 5 - SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.02 Use of Site and Other Areas

SC-5.02.A Delete Paragraph 5.02.A.2 in its entirety and insert the following in its place:

- 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 its Derivative Parties (as defined in SC-7.18.E.3), Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise and (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 in a court of competent jurisdiction. In addition, the Contractor's indemnity, defense and hold harmless obligations to the Indemnified Parties (as defined in SC-7.18.A) under SC-7.18 shall apply as to any and all Losses (as defined in SC-7.18.E.2),

liabilities, damages, expenses and costs arising out of, resulting from, or in connection with any and all claims or actions brought by any such owner or occupant against one or more of the Indemnified Parties when the Fault of the Contractor or its Derivative Parties is a proximate cause of the Losses, liabilities, damages, expenses and costs so indemnified. Provided, however, nothing herein shall require the Contractor to indemnify the Indemnified Parties against any Losses, liabilities, damages, expenses and costs arising out of, resulting from, or in connection with any negligent acts of one or more of the Indemnified Parties.

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Subsurface Investigation Report (205 pages)	March 27, 2020	Geotechnical Investigation for Subsurface Materials

- F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data in the drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
N/A		

5.05 *Underground Facilities*

SC-5.05.A Add the following new subparagraphs immediately after Subparagraph 5.05.A.5:

6. following the North Carolina General Statutes, Chapter 87, Article 8 Underground Damage Prevention;
7. notifying owners of Underground Facilities prior to start of Work;
8. investigating ahead of the Work to verify the existence of Underground Facilities;
9. assuming risks and repairing damage caused by the Work to existing Underground Facilities whether indicated or not in the Contract Documents. Repairs to Underground Facilities shall be done to the satisfaction of the Underground Facility owner. Underground Facility owner reserves the right to repair damage by the Contractor to their Underground Facilities. If the owner

exercises this right, the owner's cost of this Work shall be deducted from the money due the Contractor;

10. uncovering Underground Facilities, with that Owners approval, that are located within the Work as necessary for Engineer to determine the requirements for the change in the Work;
11. unforeseen Underground Facilities unless a design change is required; this includes Underground Facilities not shown on the Drawings/ Bidding Documents. The Engineer and the Owner assume no responsibility for the locations of Underground Facilities shown or not shown. There will be no compensation for "lost time" due to unforeseen utilities. If existing Underground Facilities require change(s) to the design, the Contractor shall provide a price to complete revised Work.

5.06 *Hazardous Environmental Conditions at Site*

SC-5.06.A Add the following new subparagraphs immediately after subparagraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) contained in such reports upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Phase II Environmental Site Assessment (661 pages)	January 29, 2020	Environmental Areas of Concern and Investigations
Phase II Environmental Site Assessment Letter (1 page)	March 18, 2019	Recommendations for Phase II ESA
Summary of Hand Auger Borings @ Landfill #12 (24 pages)	March 1, 2019	Subsurface Materials Investigations
Phase I Environmental Assessment Report for Neuse River East Parallel Interceptor (179 pages)	November 3, 2020	Environmental Areas of Concern Research and Investigations
Threatened and Endangered Species Report for Neuse River East Parallel Interceptor (15 pages)	February 15, 2019	Threatened and Endangered Species Investigations

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
N/A		

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

B. Not used.

SC-5.06.I In the first line, insert “North Carolina” between “by” and “Laws”.

SC-5.06.I Add the following language at the end of Paragraph 5.06.I:

The parties understand and acknowledge that no North Carolina case, statute, or Constitutional provision authorizes a local government to indemnify a Contractor and that this contract provision may be unenforceable.

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

- J. Contractor’s indemnity, defense and hold harmless obligations to the Indemnified Parties under SC-7.18 shall apply as to any and all Losses, liabilities, damages, expenses and costs caused by, arising out of, resulting from, or in connection with the Contractor’s or its Derivative Parties’ failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or its Derivative Parties, or to a Hazardous Environmental Condition created by Contractor or its Derivate Parties when the Fault of the Contractor or its Derivative Parties is a proximate cause of the Losses, liabilities, damages, expenses and costs so indemnified. Provided, however, nothing herein shall require the Contractor to indemnify the Indemnified Parties against any such Losses, liabilities, damages, expenses and costs arising out of, resulting from, or in connection with any negligent acts of one or more of the Indemnified Parties.

ARTICLE 6 - BONDS AND INSURANCE

Article 6 Delete Article 6 in its entirety and insert the following in its place:

SC-6.01 *Performance and Payment Bonds*

- A. Concurrent with execution of the Contract and within fifteen (15) days of the Notice of Award, the successful Contractor shall procure, execute and deliver to the Owner and maintain, at Contractor’s own cost and expense, the following bonds, in the forms included (Sections 00610 and 00615), of a surety company approved by the State of North Carolina as a Surety:

- B. Performance Bond - in an amount not less than 100% of the total amount payable to the Contractor by the terms of the Contract as security for the faithful performance of the Work. Bond must be valid until one year after the date of issuance of the certificate of Substantial Completion.
- C. Payment Bond - in an amount not less than 100% of the total amount payable to the Contractor by the terms of the Contract as security for the payment of all persons performing labor and furnishing material in connection with the Work. Bond must be valid until one (1) year after date of issuance of the certificate of Substantial Completion.
- D. All bonds signed by an agent must be accompanied by a certified copy of the authority to act.
- E. If the surety on any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business in the State of North Carolina is revoked, the Contractor shall within five (5) days thereafter substitute another.

SC-6.02 *Insurance Requirements*

- A. The Owner shall not be required under this Contract to procure or maintain any insurance for the Project or for the benefit of the Project participants.
- B. The Contractor shall ensure that it and all its Subcontractors shall procure and maintain insurance as required herein and as required by Laws and Regulations.
- C. All insurance required by the Contract to be purchased and maintained by Contractor shall be obtained from insurance companies that are duly licensed or authorized to do business in the state of North Carolina and to issue insurance policies for the required limits and coverages. Unless a different standard is authorized by the Owner in writing, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- D. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract.
- E. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.
- F. Owner, only if specified in this agreement, shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance that Owner

has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). None Required.

- G. 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, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- H. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's sole option, may purchase and maintain Owner's own liability insurance. 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.
- I. Contractor shall require:
 - 1. Subcontractors to purchase and maintain workers' compensation, commercial general liability and other insurance coverages required by Contractor where appropriate and applicable for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability, automobile liability, and excess or umbrella insurance policy. Owner, Engineer and other additional insureds shall be covered under Subcontractors' commercial general liability and any umbrella insurance with respect to liabilities arising out of both ongoing and completed operations of Subcontractor(s). Such additional insured coverage shall be subject to the terms of ISO additional insured endorsement forms CG 20 10 (ongoing operations) and CG 20 37 (products-completed operations), or substitute form(s) providing equivalent coverage and utilizing 10/01 as the edition date of the ISO endorsements; and
 - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project; and
 - 3. If the Scope of Work to be performed and/or the work site and surrounding area creates a special or high risk exposure to on-site individuals or the public, the Owner reserves the right to require the Contractor to ensure its Subcontractors, Suppliers, or categories of Subcontractor or Supplier, to provide specific insurance with policy limits as follows: **None**
- J. If either party does not purchase or maintain 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.
- K. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but

not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, without at least 30 days prior written to Owner (10 days for cancellation due to non-payment of premium). Direct Notice of Cancellation endorsement is to be attached to corresponding certificates of insurance. In the event of any such cancellation, non-renewal or material limitation, the Contractor or subcontractor, as applicable, is obligated to replace such insurance within seven (7) days of any such cancellation, non-renewal or material limitation without a gap in coverage and file accordingly such notice with the Owner and other interested parties.
- O. The Work under this Contract shall not commence until the Contractor has verified to the Owner that all required insurance coverage as described herein, have been obtained and verifying Certificates of Insurance have been approved in writing by the Owner. The Owner's review and/or acceptance of certificates of insurance shall neither relieve Contractor of any requirement to provide the specific coverages set forth herein nor shall it constitute a waiver or acknowledgement of satisfaction of the specific insurance coverage requirements set forth in this Contract.
 - 1. The Description of Operations/Locations/Vehicles section in the certificates of insurance should include the City of Raleigh Department/Division, Name of Project or Services, Project Dates of contract.

The Certificate holder address should read:

City of Raleigh
Post Office Box 590
Raleigh, NC 27602-0590

SC-6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, Automobile Liability, Excess/Umbrella insurance and any other insurance specified within these Supplementary Conditions. Any and all deductibles and Self-insured Retentions (SIRs) in the insurance policies shall be assumed by, and at the sole risk of the Contractor.

B. *Supplemental Provisions:* The policies of insurance required by this SC-6.03 as supplemented must:

1. include at least the specific coverages required;
2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, 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;
4. apply with respect to the performance of the Work, whether such performance is 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;
5. be primary and noncontributory, evidenced by ISO form CG 20 01 04 13 (Primary and Non-Contributory – Other Insurance condition) endorsement or its equivalent, with respect to the Owner's insurance or self-insurance to the extent of the Contractor's liability hereunder. Any other insurance or self-insurance maintained by the Owner shall be excess of, and non-contributory with the coverage afforded by Contractor's commercial general liability insurance and commercial umbrella insurance, if any;
6. provide for reinstatement of full coverage after payment of any claim;
7. state insurers have no right of recovery or subrogation against the Owner, its agents and agencies and shall have no recourse against them for the payment of any premiums or assessments under any form of policy; and
8. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in this agreement;
2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
3. afford primary and noncontributory coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations); and
4. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or

the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

D. *Other Additional Insureds:* If specified herein, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: **None**

E. *Workers' Compensation and Employer's Liability:* 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).

Workers' Compensation and Related Policies	Policy limits of not less than:
Workers' Compensation	
North Carolina - State	Statutory
Employer's Liability	
Each accident	\$1,000,000
Each employee	\$1,000,000
Policy limit	\$1,000,000

F. *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 claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
2. damages insured by reasonably available personal injury and advertising liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on an Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.

- a. Such insurance must be maintained for the period of the applicable statute of repose for any and all claims that may arise from operations of this Contract.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in herein or elsewhere in the Contract) certificates of insurance evidencing continuation of such insurance at final payment and for the period of the applicable statute of limitations and repose.
2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in this Contract in accordance with ISO policy form CG 00 01.
- a. Premises/Operations liability
 - b. Underground fault, explosion, and collapse coverage
 - c. Independent Contractor's and Independent Subcontractor's coverage
 - d. Broad form property damage
 - e. Personal injury and advertising coverage
 - f. Cross Liability/Severability of Interest clause
 - g. Employer's Stop Gap Liability endorsement, if applicable
 - i. Amendment of the Pollution Exclusion Endorsement to allow coverage for bodily injury or property damage caused by heat, smoke, or fumes from a hostile fire
 - j. Designated General Aggregate Limit Endorsement, if required in Contract
 - k. Products completed operations including construction defect and contractual liability
 - l. Insurance coverage limits to be on a "per project" basis
3. 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). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
4. For design professional additional insureds, ISO Endorsement CG 20 32 07 13 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. *Commercial General Liability—Excluded Content*: The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of “insured contract” (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured’s vicarious liability, strict liability, or statutory liability (other than worker’s compensation).
6. Any limitation or exclusion based on the nature of Contractor’s Work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	\$5,000,000
Products—Completed Operations Aggregate	\$5,000,000
Bodily Injury and Property Damage—Each Occurrence	\$2,000,000
Personal and Advertising Injury	\$2,000,000

- J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance 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 owned, hired or otherwise operated or used by or on behalf of the Contractor or any of its Derivative Parties and as used in the execution of the Work. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage) (Any/Owned, Hired, and Leased)	\$1,000,000

- K. *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. The coverage afforded must be at least as broad as that of each and every one of the underlying policies using a follows form coverage for all layers and coverage shall remain continuously in effect and without interruption from the date of commencement of construction until the end of the applicable statute of limitations and repose.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	\$2,000,000
General Aggregate	\$2,000,000

- L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and limits of an umbrella or excess liability policy.
- M. *Contractor's Pollution Liability Insurance:* Contractor shall purchase and maintain a policy that must include Asbestos Legal Liability and Errors and Omissions due to potential environmental hazards.
1. Coverage shall apply to the scope of work described in this Contract including transportation and shall include coverage for bodily injury, property damage, including loss of use of damaged property, clean-up costs, mold, defense and investigative costs. Contractor shall maintain Completed Operations coverage for three (3) years following final acceptance of the project or termination of the Contract.
 2. If the insurance policy is written on a claims-made basis, Contractor warrants that continuous coverage will be maintained or an extended discovery period will be exercised for a period of three (3) following final acceptance of the Work under the Contract is completed or termination of the Contract..
 3. If coverage is canceled or non-renewed, and not replaced with another claims made policy form with a retroactive date prior to the Contract effective date or start of work date the Contractor must purchase an extended period coverage for a minimum of five (5) years following final acceptance of the Work or termination of the Contract.. A copy of the claims reporting requirements must be submitted to Owner for review. Pollution Liability shall not contain lead-based paint or asbestos exclusions.

This insurance must be maintained for no less than three years after final completion.

Contractor's Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	\$3,000,000
General Aggregate	\$3,000,000

- N. *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 to protect Owner from liability arising out of or resulting from the performance of professional services by Contractor or its Derivative Parties.

1. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable and shall contain full prior acts coverage.
2. Coverage shall not include any exclusions or limitations related to a) Scope of professional services; b) Delays in project completion or cost overruns; c) Who is authorized to notify the carrier of a claim or a potential claim; and d) Mold, fungus, asbestos, pollutants or hazardous substances.
3. The insurance must be maintained continuously throughout the duration of the Contract and through the applicable statute of limitations and repose.
4. Claims made coverage is permitted providing the retroactive date on the policy pre-dates the commencement of furnishing services on the Project.

Contractor's Professional Liability	Policy limits of not less than:
Each Claim	\$1,000,000
Annual Aggregate	\$3,000,000

- O. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, Contractor shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance from an insurer or directly from the subject railroad(s) meeting their specific requirements, (3) furnish a copy of the endorsement to Owner, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify Owner of such submittal.

Railroad Protective Liability Insurance	Policy limits of not less than:
Each Claim	\$6,000,000
Aggregate	\$6,000,000

- P. *Unmanned Aerial Vehicle Liability Insurance:* If Contractor or its Subcontractors uses unmanned aerial vehicles (UAV—commonly *referred* to as drones) at the Site or in support of any aspect of the Work, Contractor shall obtain UAV liability insurance in the amounts stated; name Owner, Engineer, and all individuals and entities identified herein as additional insureds; and provide a certificate to Owner confirming Contractor's compliance with this requirement.

1. Such insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy. The operator of the aircraft and their insurer(s) must hold the Owner and all additional insureds harmless and waive subrogation with respect to damage to the aircraft. If the aircraft is to be used to perform lifts at the Site, a "slung cargo" endorsement must be included to cover the full replacement value of any equipment being lifted.

Unmanned Aerial Vehicle Liability Insurance	Policy limits of not less than:
Each Claim	\$1,000,000

Unmanned Aerial Vehicle Liability Insurance	Policy limits of not less than:
General Aggregate	\$1,000,000

Q. *Other Required Insurance:* **None**

SC-6.04 *Builder's Risk and Other Property Insurance*

- A. *Builder's Risk:* If applicable, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in this Section or required by Laws and Regulations) and name the Owner a Loss Payee on the insurance coverage(s).
- B. *Property Insurance for Facilities of Owner Where Work Will Occur:* Owner is responsible for obtaining and maintaining property insurance covering each Owner owned structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities:* Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- 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 advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. 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 SC-6.04, it may do so at Contractor's sole expense.
- F. *Builder's Risk Requirements:* The builder's risk insurance must:
 - 1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks:

Blasting and explosion, fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse of or structural injury to any structure due to the Contractor's operations; damage to underground structures, pipes or conduits; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

- a. The builder's all-risk coverage shall not contain an exclusion for resulting damage caused by faulty workmanship, design or materials.
 - b. 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 will be provided through other insurance policies acceptable to Owner and Contractor.
2. 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.
 3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of Contractors, Engineers, and Architects).
 4. 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).
 5. extend to cover damage or loss to insured property while in transit.
 6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.
 7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.
 8. include performance/hot testing and start-up, if applicable.
 9. be maintained in effect until the Work is complete, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.

10. include as named insureds the Owner, Contractor, Subcontractors (of every tier), all lenders with security interests in the Site or the Project, and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of SC-6.04, SC-6.05, and SC-6.06 of this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:

a. **None**

11. if applicable, include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:

a. **None**

G. Installation Floater

1. Contractor shall provide and maintain installation floater insurance on a broad form or "all risk" policy providing coverage for materials, supplies, machinery, fixtures, and equipment that will be incorporated into the Work ("Covered Property"). Coverage under the Contractor's installation floater will include loss from covered "all risk" causes (perils) to Covered Property:

a. of the Contractor, and Covered Property of others that is in Contractor's care, custody, and control;

b. while in transit to the Site, including while at temporary storage sites;

c. while at the Site awaiting and during installation, erection, and testing;

d. continuing at least until the installation or erection of the Covered Property is completed, and the Work into which it is incorporated is accepted by Owner.

2. The installation floater coverage cannot be contingent on an external cause or risk, or limited to property for which the Contractor is legally liable.

3. The installation floater coverage will be in an amount sufficient to protect Contractor's interest in the Covered Property. The Contractor will be solely responsible for any deductible carried under this coverage.

4. This policy will include a waiver of subrogation applicable to Owner, Contractor, Engineer, all Subcontractors, and the officers, directors, partners, employees, agents and other consultants and Subcontractors of any of them.

H. *Builder's Risk and Other Property Insurance Deductibles*: The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.

1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount of no more than **\$10,000** for direct physical loss in any one occurrence.

SC-6.05 Property Losses; Subrogation/Waiver of Rights

- A. The builder's risk insurance policy purchased and maintained in accordance with SC-6.04 (or an installation floater policy if new construction is limited and authorized by the Owner), will contain provisions to the effect that in the event of payment of any loss or damage the insurer 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.
 1. 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, risks, 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 individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater 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.
 2. None of the above waivers extends 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. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03 as modified by these Supplemental Conditions, or after final payment pursuant to Paragraph 15.06 as modified by these Supplemental Conditions, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
 1. 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 all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this SC-6.05 include the waiver of rights 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 insured peril, risk, or cause of loss.

- D. Contractor shall be responsible for assuring that each Subcontract 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 fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

SC-6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by SC-6.04 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 receipt of 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 SC-6.04 shall maintain such proceeds in a segregated account and 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, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

7.02 *Supervision and Superintendence*

SC-7.02 Add the following new paragraph immediately after Paragraph 7.02.B:

C. Contractor's On-Site Supervision: For pipeline Contractors who have more than two construction crews performing work under one contract, a general superintendent shall be assigned to the Project Site to supervise all construction crews on site. The general superintendent shall be responsible for addressing any construction related issues from the Owner, the Engineer, and/or the Department of Transportation having jurisdiction.

7.03 *Labor; Working Hours*

SC-7.03 Add the following new paragraphs immediately after Paragraph 7.03.C:

D. Regular Working Hours: [8:00] am to [5:00] pm, Eastern Standard Time.

E. Overtime Work: If Contractor's Work requires inspection, as determined by the Owner, more than 10 hours in a work day or 40 hours in a work week, Monday through Friday excluding holidays, or on the weekends, Contractor shall submit a written request to the Owner five (5) working days prior to the scheduled Work. Contractor shall pay for the Resident Project Representative's time beyond the above hours at the rate of \$85 / hour.

F. Paragraph 7.03.C will not prevent the Contractor from working outside the regular working hours provided the work will not require the inspector to be present. Such work may include start up, clean up, seeding, painting (after the base surface has been approved by the inspector), and similar items. Contractor shall submit a written request to the Owner one (1) working day prior to the scheduled Work.

G. Contractor shall not be charged for RPR's time for Work specifically identified by the Contract Documents to be performed outside the above Work time or on weekends.

7.05 *"Or Equals"*

SC-7.05 Add the following new paragraph immediately after Paragraph 7.05.E:

F. Requirements for "or equals" shall be submitted prior to bidding. Reference Section 00100 (Advertisement for Bids) and Section 00200, Article 11 (Instructions to Bidders) for submission deadlines of requirements for "or equals".

7.07 *Concerning Subcontractors and Suppliers*

SC-7.07.C Add the following sentences to the end of Paragraph 7.07.C:

1. Bidder shall indicate subcontractors as required on the Bid Form.
2. Bidder shall indicate Minority Business Participation on the attachment to the Bid Forms. Low Bidder shall be required to submit the followings Affidavits as included in the City of Raleigh Business Assistance Program Guidelines:

- a. Affidavit C, Portion of the Work to be Performed by Minority Firms.
 - b. Affidavit D, Good Faith Efforts
3. Contractor whose Bid is accepted shall not substitute any person as Subcontractor in the place of the Subcontractor listed in the Bid, except:
- a. If the listed Subcontractor's bid is later determined by the Contractor to be non-responsible or non-responsive, or the listed Subcontractor refuses to enter into a contract for the complete performance of the bid work;
 - b. or with the approval of the City for good cause shown by the Contractor.

SC-7.07.K Delete Paragraph 7.07.K in its entirety and insert the following in its place:

- K. All work performed for Contractor by a Subcontractor shall be pursuant to an appropriate agreement between the Contractor and Subcontractor. The Subcontractor shall not commence work until the Contractor has obtained all insurance as required by Paragraphs 6.02 through 6.03 inclusive as amended by these Supplementary Conditions.

SC-7.07.N Add the following new paragraph immediately after Paragraph 7.07.M:

- N. Contractor shall not award work valued at more than [fifty (50%)] percent of the Contract Price to Subcontractor(s). Contractor shall perform at least [fifty (50%)] percent of the labor with own forces, unless prior written approval is provided by the Owner.

7.08 *Patent Fees and Royalties*

SC-7.08.B In the first line, insert "North Carolina" between "by" and "Laws".

SC-7.08.B Add the following language at the end of Paragraph 7.08.B:

The parties understand and acknowledge that no North Carolina case, statute, or Constitutional provision authorizes a local government to indemnify a Contractor and that this contract provision may be unenforceable.

SC-7.08.C Delete Paragraph 7.08.C in its entirety and insert the following in its place:

- C. Contractor's indemnity, defense and hold harmless obligations to the Indemnified Parties under SC-7.18 shall apply as to any and all Losses, liabilities, damages, expenses and costs caused by, arising out of, resulting from, or in connection with 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 when the Fault of the Contractor or its Derivative Parties is a proximate cause of the Losses, liabilities, damages, expenses and costs so indemnified. Provided, however, nothing herein shall require the Contractor to indemnify the Indemnified Parties against any such Losses, liabilities, damages, expenses and

costs arising out of, resulting from, or in connection with any negligent acts of one or more of the Indemnified Parties.

7.09 *Permits*

SC-7.09.A Amend the last sentence of Paragraph 7.09.A to read as follows:

Contractor shall pay all charges of utility owners for connections for providing permanent service to the Work.

SC-7.09.B Add the following new paragraphs after Paragraph 7.09.A:

- B. Owner obtained encroachment agreements and permits are included as part of the Contract Documents. The encroachment agreements and permits are attached as an appendix to the specifications or project manual. This Paragraph does not relieve Contractor of responsibility to comply with applicable Laws and Regulations as stated in Paragraph 7.11.
- C. Contractor shall be responsible for compliance with the terms of the encroachment agreements and permits issued by Federal/State/Local regulatory agencies. Compliance with the terms listed in the encroachment agreements and permits shall be at no additional cost to the Owner. This shall include generating and submitting any reports that may be required as a condition of the encroachment agreements and permits. All costs shall be included in the bid prices of applicable items.

7.10 *Taxes*

SC-7.10 Add the following new paragraphs after Paragraph 7.10.A:

- B. Procedures for reporting sales tax are included in Section 00805.

7.11 *Laws and Regulations*

SC-7.11.B Delete Paragraph 7.11.B in its entirety and insert the following in its place:

- B. If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, Contractor shall give Engineer prompt written notice thereof. If Contractor performs any Work knowing it to be contrary to such Laws or Regulations, and without such notice to Engineer, Contractor shall bear all costs arising therefrom. Contractor shall, at all times, observe and comply with and shall cause its Derivative Parties to observe and comply with all such existing Laws or Regulations. Further, Contractor's indemnity, defense and hold harmless obligations to the Indemnified Parties under SC-7.18 shall apply as to any and all Losses, liabilities, damages, expenses and costs caused by, arising out of, resulting from, or in connection with any claim, civil penalty, fine or liability arising from or based on the violation of any such Law or Regulations by the Contractor or its Derivative Parties.

SC-7.11 Add the following new paragraphs after Paragraph 7.11.C:

- D. Contractor shall be responsible for conforming to the requirements of the approved sedimentation control plan, the rules and regulations of the Erosion Control Laws of the State of North Carolina, specifically the Sedimentation Pollution Control Act of 1973 (G.S. 113A) as amended, and the local jurisdiction where the Project is located as it relates to land disturbing activities undertaken by Contractor. Contractor shall be responsible to Owner for any fines imposed on Owner as a result of Contractor's failure to comply with the above as it is further described in the Erosion Control Section of the Specifications.
- E. Contractor shall be responsible for conforming to the requirements of the NC Department of Transportation Encroachment Agreement, if attached to the Contract Documents.
- F. Should the Contractor cause the Owner to receive a Notice of Violation from a governmental agency, Contractor shall pay costs associated with Notice of Violation within ten (10) days of receipt of written notification. Costs shall include, but not be limited to:
 - 1. Fines imposed on the Owner by the agency.
 - 2. Required legal newspaper publications concerning violation.
 - 3. Required mailings to customers concerning notification of violation.
 - 4. Administrative and engineering costs associated with resolving the Notice of Violation.
- G. Notice of Violation may include, but not be limited to, the following problems:
 - 1. Sewage spill.
 - 2. Inadequate erosion control measures.
 - 3. Equipment failure during the warranty period.
- H. In the event of a sewage spill during construction, Contractor shall take the following steps as a minimum:
 - 1. Take immediate action to contain the spill.
 - 2. Notify the Owner and Engineer within 30 minutes of realizing a spill has occurred.
 - 3. Clean up the spill as directed by the Owner. Contractor shall bear all costs associated with the cleanup.

7.12 *Record Documents*

SC-7.12 Add the following new paragraph after Paragraph 7.12.A:

- B. Record Documents shall be updated daily. Should the Owner or Engineer determine that the Record Documents are not being properly maintained, approval of future payment requests shall be withheld.

7.13 *Safety and Protection*

SC-7.13.A Add the following new subparagraph after Paragraph 7.13.A:

- 1. When tasks (operating valves, lock out – tag out, etc.) must be accomplished by City staff to allow Contractor to perform or continue its Work, Contractor shall independently verify and confirm the performance of the tasks prior to performing the impacted Work.

SC-7.13.D Delete Paragraph 7.13.D its entirety and insert the following in its place:

- D. Contractor shall be responsible for remedying damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 as follows:
 - 1. To the fullest extent allowed by Laws and Regulations, Contractor shall remedy at its own expense any and all damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 arising out of, or resulting from the sole negligence of the Contractor, the Contractor's agents, the Contractor's employees, 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.
 - 2. In matters other than those covered by subsection SC-7.18.A, and to the fullest extent allowed by Laws and Regulations, Contractor shall remedy at its own expense any and all damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 arising out of, resulting from, or in connection with the execution of the Work provided for in this Contract when the Fault of the Contractor or its Derivative Parties is a proximate cause of such damage, injury, or loss. For the purposes of this section, the terms "Fault" and "Derivative Parties" shall have the same meaning as that set forth in SC-7.18.E.

7.16 *Submittals*

SC-7.16D.2 In the first sentence, replace "two" with "three".

SC-7.16 Add the following new paragraph immediately after Paragraph 7.16.F:

- G. All materials or equipment delivered to the Site shall be accompanied by certificates, signed by an authorized officer of the supplier, and notarized guaranteeing that the materials or equipment conform to specification requirements. Such certificates shall be immediately turned over to the Engineer. Materials or equipment delivered to the Site without such certificates will be subject to rejection.

7.18 *Indemnification*

SC-7.18 Delete Paragraphs 7.18.A and 7.18.B in their entirety and insert the following in their place:

- A. To the fullest extent allowed by Laws and Regulations, Contractor shall indemnify, defend, and hold harmless the Owner, its officers, officials, employees, agents, or indemnities (collectively called "Indemnified Parties") from and against those Losses, liabilities, damages, and costs proximately caused by, arising out of, or resulting from the sole negligence of the Contractor, the Contractor's agents, or the Contractor's employees.
- B. In matters other than those covered by subsection 7.18A, above, and to the fullest extent allowed by Laws and Regulations, Contractor shall indemnify, defend, and hold harmless the Indemnified Parties from and against those Losses, liabilities, damages, and costs caused by, arising out of, resulting from, or in connection with the execution of the Work provided for in this Contract when the Fault of the Contractor or its Derivative Parties is a proximate cause of the Loss, liability, damage, or expense indemnified.
- C. Costs and expenses shall include attorneys' fees, litigation or arbitration expenses, or court costs actually incurred by the Indemnified Parties to defend against third-party claims alleged in any court, tribunal, or alternative dispute resolution procedure required of any of the Indemnified Parties by Laws and Regulations or by contract, only if the Fault of the Contractor or its Derivative Parties is a proximate cause of the attorney's fees, litigation or arbitration expenses, or court costs to be indemnified.
- D. The Contractor's duty to indemnify, defend, and hold harmless described hereinabove shall survive the termination or expiration of this Contract.
- E. Definitions:
 - 1. For the purposes of SC-7.18, the term "Fault" shall mean any breach of contract; negligent, reckless, or intentional act or omission constituting a tort under applicable statutes or common law; or violation of applicable statutes or regulations.
 - 2. For the purposes of SC-7.18, the term "Loss" or "Losses" shall include, but not be limited to, fines, penalties, and/or judgments issued or levied by any local, state, or federal governmental entity.
 - 3. For the purposes of SC-7.18, the term "Derivative Parties" shall mean any of the Contractor's Subcontractors, agents, employees, or other persons or entities for which the Contractor may be liable or responsible as a result of any statutory, tort, or contractual duty.

ARTICLE 8 - OTHER WORK AT THE SITE

8.01 *Other Work*

SC-8.01.E Amend the first sentence of Paragraph 8.01.E to read as follows:

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and within seven days 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.

SC-8.01 Add the following new paragraphs immediately after Paragraph 8.01.F.

- G. Prime contracts will be let in connection with the Project as outlined in Specification Section - Summary of Work.
- H. The Owner, Engineer, and Engineer's consultants shall not be liable to Contractor for any claims, costs, losses or damages incurred or sustained by Contractor on or in connection with any other project or anticipated project.

8.02 *Coordination*

SC-8.02 Add the following new Paragraph 8.02.C immediately after Paragraph 8.02.B:

- C. If Owner intends to contract with others for the performance of other work at or adjacent to the Site:
 - 1. The Contractor shall have authority and responsibility for coordination of the various contractors and work forces at the Site;
 - 2. The following specific matters are to be covered by such authority and responsibility:
 - 1. **Coordinate work schedules and ingress/egress with other contractors adjacent to the site for use of Access Road No. 1.**
 - 2. **Coordinate maintenance of Access Road No. 1 with the other contractors.**
 - 3. The extent of such authority and responsibilities is:
 - 1. **Allow the other contractors to shall use of Access Road No. 1 along the property owned by Mr. Billy Adams from Auburn-Knightdale Road to the Sanitary Sewer Easement.**

2. **Share responsibility for maintenance of the shared portion of Access Road No. 1 with the other contractors.**
3. **Provide for conversion of the temporary access road to the permanent access road per the Drawings and Specifications.**
4. **Coordinate take-over of Laydown Area No. 1 from the other contractors upon initial need of area.**
5. **Provide for on-going maintenance and final cleanup and restoration of Laydown Area No. 1.**

8.03 *Legal Relationships*

SC-8.03 Delete Paragraph 8.03.C in its entirety and insert the following in its place:

- C. If Contractor or its Derivative Parties damage(s), delay(s), disrupt(s), or interfere(s) with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's or its Derivative Parties' failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's or its Derivative Parties' action(s), inaction(s), 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 or Owner, then Contractor shall 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 in a court of competent jurisdiction. In addition, the Contractor's indemnity, defense and hold harmless obligations to the Indemnified Parties under SC-7.18 shall apply as to any and all Losses, liabilities, damages, expenses and costs arising out of, resulting from, or in connection with any and all claims brought by any such other contractor or utility owner against one or more of the Indemnified Parties that arise out of or relate to any such damage, delay, disruption or interference when the Fault of the Contractor or its Derivative Parties is a proximate cause of the Losses, liabilities, damages, expenses and costs so indemnified. Provided, however, nothing herein shall require the Contractor to indemnify the Indemnified Parties against any such claims arising out of, resulting from, or in connection with any negligent acts of one or more of the Indemnified Parties.

ARTICLE 9 - OWNER'S RESPONSIBILITIES

9.11 *Evidence of Financial Arrangements*

SC-9.11 Add the following new paragraph immediately after Paragraph 9.11.A:

- B. On request of Contractor, prior to the execution of any Change Order involving a significant increase in the Contract Price, Owner shall furnish to Contractor

reasonable evidence that adequate financial arrangements have been made by Owner to enable Owner to fulfill the increased financial obligations to be undertaken by Owner as a result of such Change Order.

ARTICLE 10 - ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

SC-10.01.A Delete Paragraph 10.01.A in its entirety and replace with the following:

- A. Engineer will be Owner's representative during the construction period and Engineer's instructions shall be followed promptly and efficiently.

10.03 *Resident Project Representative*

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

1. The Resident Project Representative (RPR) will serve as the Engineer's liaison with the Contractor, working principally through the Contractor's superintendent to assist the Contractor in understanding the intent of the Contract Documents.
2. The RPR shall conduct on-site observations of the Work in progress to confirm that the Work is proceeding in accordance with the Contract Documents. They will verify that tests, equipment and systems start-ups and operating and maintenance instructions are conducted as required by the Contract Documents. They will have the authority to disapprove or reject defective Work in accordance with Article 14.
3. The RPR will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
 - a. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 - b. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
 - c. *Liaison*
 - i) 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.

- ii) Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - iii) Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
 - d. *Review of Work; Defective Work*
 - i) Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
 - ii) Observe whether any Work in place appears to be defective.
 - iii) Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.
 - e. *Inspections and Tests*
 - i) Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.
 - ii) Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 - f. *Payment Requests: Review Applications for Payment with Contractor.*
 - g. *Completion*
 - i) Participate in Engineer's visits regarding Substantial Completion.
 - ii) Assist in the preparation of a punch list of items to be completed or corrected.
 - iii) Participate in Engineer's visits to the Site in the company of Owner and Contractor regarding completion of the Work and assist in preparation of a final punch list of items to be completed or corrected by Contractor.
 - iv) Observe whether items on the final punch list have been completed or corrected.
- 4. Except upon written instructions of the Engineer, the RPR or Owner's field staff shall not have authority to:
 - a. Authorize any deviation from the Contract Documents or approve any substitute materials or equipment (including "or-equal" items).
 - b. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

- c. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 - d. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.
 - e. 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.
 - f. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
 - g. Authorize Owner to occupy the Project in whole or in part.
 - h. 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.
 - i. Be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
 - j. 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.
5. Any decision made by RPR or Owner's field staff 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 RPR or Owner's field staff, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by RPR or Owner's field staff to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
6. RPR's or Owner's field staff'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 Contractor under 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.

SC-10.03.B Add the following new subparagraph immediately following Paragraph 10.03.B:

1. When the Owner assigns City field staff to monitor the project, such staff's limitations shall be as described in SC-10.03.A.4, SC-10.03.A.5 and SC-10.03.A.6.

ARTICLE 11 - CHANGES TO THE CONTRACT

11.07 *Change of Contract Price*

SC-11.07.B.2 Delete this subparagraph in its entirety and replace with the following:

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (with allowances for overhead and profit in accordance with Paragraph 11.07.C.2); or”

11.08 *Change of Contract Times*

SC-11.08 Add the following paragraph after Paragraph 11.08.B:

- C. Time Extension: Contract time extensions for weather delays do not entitle Contractor to "extended overhead" recovery.

ARTICLE 12 - CLAIMS

No Supplementary Conditions in this Article.

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

13.01 *Cost of the Work*

SC-13.01.B.1 Delete Paragraph 13.01.B.1 in its entirety and replace with the following:

Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. Labor will be based on direct labor cost, Contractor to provide certified payroll upon request. No claims for extra cost shall be considered based on an escalation of labor costs throughout the period of the Contract.

SC-13.01.B.2 Add the following language at the end of the Paragraph:

No claims for extra cost shall be considered based on an escalation of material costs throughout the period of the Contract.

SC-13.01.B.3 Delete the second sentence "If required...be acceptable."

SC-13.01.B.4 Delete in its entirety.

SC-13.01.B.5.a Delete Paragraph in its entirety.

SC-13.01.B.5.c Delete Paragraph 13.01.B.5.c in its entirety and insert the following in its place:

c. Construction Equipment and Machinery:

1. Rentals of all construction equipment and machinery, and the parts thereof 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.
2. Full rental cost for rented, leased, and/or owned equipment shall not exceed rates listed in the current version of Rental Rate Blue Book for Construction Equipment (Blue Book). If rental rates for the equipment being used for the Work are not listed in the Blue Book, the Contractor will receive the prevailing rental rates being paid for such equipment in the area where the Project is located. Computed durations will be based upon the Work completed. Computed rates will include all operating costs; costs will include the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, shall cease to accrue when the use thereof is no longer necessary for the changed Work. Equipment or machinery with a value of less than \$1,000 will be considered small tools. The Engineer/Owner reserves the right to request four rental quotes as backup.
3. The hours of operation shall be based upon actual equipment usage to the nearest full hour, as recorded by the Engineer.

<u>Usage</u>	<u>Blue Book Payment Category</u>
Less than 8 hours	Hourly Rate
8 or more hours but less than 4 days	Daily Rate
4 or more days but less than 16 days	Weekly Rate
16 or more days	Monthly Rate

SC-13.01.B.5.d Add the following language at the end of the Paragraph:

However, reimbursable sales and use taxes paid to the State of North Carolina or to local governments in North Carolina shall be included or excluded from the Cost of the Work as described in Section 00805.

SC-13.01.B.5.f Delete Paragraph in its entirety.

SC-13.01.B.5.g Delete Paragraph in its entirety.

SC-13.01.B.5.h Delete Paragraph in its entirety.

SC-13.01.C.1 Add the following language at the end of the Paragraph.

Project Management will not be included in the Cost of the Work.

13.03 *Unit Price Work*

SC-13.03.E.1.a Delete Paragraph 13.03.E.1.a in its entirety and insert the following in its place:

- a. The extended Bid price of a particular item of Unit Price Work (excluding rock excavation and undercut) amounts to five (5) 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 twenty-five (25) percent from the estimated quantity of such item indicated in the Agreement at the time of Contract formation; and

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

14.02 *Tests, Inspections, and Approvals*

SC-14.02.B Delete Paragraph 14.02.B in its entirety and insert the following in its place:

- B. Owner shall employ and pay for inspections and testing services specifically noted as such in the Contract. All others required shall be the responsibility of the Contractor.

SC-14.02.C Delete Paragraph 14.02.C in its entirety and insert the following in its place:

- C. If the Contract Documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any Work to be specifically inspected, tested, or approved by some public body, Contractor shall assume full responsibility therefore, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection, testing or approval.

SC-14.02.G Add the following paragraph(s) immediately following Paragraph 14.02.F:

- G. Owner reserves the right to independently perform at its own expense, laboratory tests on random samples of material or performance tests on equipment delivered to the Site. These tests if made will be conducted in accordance with the appropriate referenced standards or Specification requirements. The entire shipment represented by a given sample, samples or piece of equipment may be rejected on the basis of the failure of samples or pieces of equipment to meet specified test requirements. All rejected materials or equipment shall be removed from the Site, whether stored or installed in the Work, and the required replacement shall be made, all at no additional cost to the Owner.

14.03 *Defective Work*

SC-14.03.G Add a new paragraph after Paragraph 14.03.F:

- G. At any time during the progress of the Work and up to the date of final acceptance, the Engineer shall have the right to reject any Work which does not conform to the requirements of the Contract Documents, even though such Work has been previously inspected and paid for. Any omissions or failure on the part of the Engineer to disapprove or reject any Work or materials at the time of inspection shall not be construed as an acceptance of any defective Work or materials.

14.06 *Owner May Stop the Work*

SC-14.06.A Add the following language to the first sentence of Paragraph 14.06.A after:

".....will conform to the Contract Documents," add "or if the Work interferes with the operation of the existing facility", and then continue "then Owner may order..."

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

15.01 *Progress Payments*

SC-15.01.A Add the following paragraph immediately following Paragraph 15.01.A:

1. The Contractor shall submit for the Engineer's approval, a complete breakdown of all Lump Sum Items in the Bid. This breakdown, modified as directed by the Engineer, will be used as a basis for preparing estimates and establishing progress payments.

SC-15.01.B.4 Delete Subparagraph 15.01.B.4 in its entirety and replace with the following:

4. Progress payment request shall include the percentage of the total amount of the Contract which has been completed from the start-up of the Project to and including the last day of the preceding month, or other mutually agreed upon day of the month accompanied by such data and supporting evidence as Owner or Engineer may require.

SC-15.01.B. Add the following new subparagraphs after Subparagraph 15.01.B.4:

5. Forms shall be prepared by the Contractor and submitted to the Engineer for approval. Forms to be used are included in Section 00620 and will be supplied by the Engineer.
6. At the option of the Owner, partial payment up to the estimated value, less retainage, may be allowed for any materials and equipment not incorporated in the Work, pursuant to the following conditions:
 - a. Major equipment items stored off site shall be stored in a bonded warehouse and properly maintained during storage.

- b. Equipment or materials stored on the Site shall be properly stored, protected and maintained.
 - c. For any partial payment the Contractor shall submit, with the monthly progress payment from each material or equipment manufacturer, bills or invoices indicating actual material cost.
 - d. Contractor shall submit evidence that payment has been made for materials or equipment stored and for which the Engineer has authorized partial payment and previous progress payments, prior to submission of the next monthly payment request.
7. The Owner will retain five percent (5%) of the amount of each such estimate until Work covered by the Contract is 50% complete. When 50% of the Work of the original Contract has been completed and in the opinion of the Owner the Contractor continues to perform satisfactorily and nonconforming Work identified in writing prior to that time by the Engineer or Owner has been corrected by the Contractor and accepted by the Owner, the Owner with written consent of surety will adjust future partial payments so that two and one-half percent (2-1/2%) of the original Contract Price is retained.
8. The Project shall be deemed 50% complete when the Contractor's gross project invoices, excluding the value of materials stored off-site, equals or exceeds 50% of the original value of the Contract, except the value of materials stored on-site shall not exceed 20% of the Contractor's gross invoices for the purpose of determining whether the project is 50% complete.
9. If the Owner determines it is appropriate to reduce retainage, the method used for such adjustment shall be to fix retainage at two and one-half percent (2-1/2%) of the original Contract amount (when the Work is 50% complete) and to pay all subsequent Partial Payment Requests to the full approved amount. The intent of such an adjustment is to gradually reduce retainage to two and one-half percent (2-1/2%) of the original Contract amount when the Work is 100% complete. Following 50% completion of the Project, the Owner may also withhold additional retainage from any subsequent periodic payment, not to exceed five percent (5%), in order to allow the Owner to retain two and one-half percent (2-1/2%) total retainage through the completion of the Project.
10. If the Owner determines the Contractor's performance is unsatisfactory, the Owner may reinstate retainage for each subsequent periodic payment application up to a maximum amount of five (5) percent of the original Contract amount.
11. Within 60 days after the submission of a final pay application, the Owner with written consent of the surety shall release to the Contractor all retainage on payments held by the Owner if (1) the Owner receives a certificate of substantial completion from the Engineer, or (2) the Owner receives beneficial occupancy or use of the Project. However, the Owner may retain sufficient funds to secure completion of the Project or corrections on any Work. If the Owner retains funds, the amount retained shall not be more than 2.5 times the Engineer's estimated value of the Work to be completed or corrected. Any

reduction in the amount of the retainage on payments shall be with the written consent of the Contractor's surety.

12. Retainer provisions contained in Contractor's subcontracts may not exceed the terms and conditions for retainage provided herein. Contractor is further required to satisfy the retainage provisions of N.C.G.S. 143-134.1(b2) with regard to subcontracts for early finishing trades (structural steel, piling, caisson, and demolition) and to coordinate the release of retainage for such trades from the retainage held by the Owner from the Contractor pursuant to statute.
13. Nothing shall prevent the Owner from withholding payment to the Contractor in addition to the amounts identified herein for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the Owner or reasonable evidence that a third-party claim will be filed.

SC-15.01.C.6 Add the following new subparagraphs after Subparagraph 15.01.C.6.e:

- f. Sedimentation and erosion control are determined to be unsatisfactory or unacceptable. A deduction of up to 10% of the payment amount for bid items that include sedimentation and erosion control installed during the payment period may be withheld in order to ensure remediation of the unsatisfactory or unacceptable work. Upon remediation, Contractor may receive payment for the deduction in subsequent Application for Payment.
- g. Seeding and mulching are determined to be unsatisfactory or unacceptable. A deduction of up to 20% of the payment amount for bid items that include seeding and mulching installed during the payment period may be withheld in order to ensure remediation of the unsatisfactory or unacceptable work. Upon remediation, Contractor may receive payment for the deduction in subsequent Application for Payment.
- h. Record Documents are not maintained satisfactorily and in accordance with the Contract Documents. Payment requests shall not be approved until the deficiencies are satisfactorily corrected.

SC-15.01.D.1 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

1. Upon receipt from Engineer of an Application for Payment bearing Engineer's recommendation of payment, Owner shall set off against the amount recommended by Engineer any sums to which Owner is entitled pursuant to Sec. 15.01.E of the General Conditions and shall then approve the Application for Payment. Owner shall tender the resulting balance due to Contractor within thirty (30) days of Owner's approval of the Application for Payment

15.03 *Substantial Completion*

SC-15.03 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, will 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 this Article 15.

15.06 *Final Payment*

SC-15.06.E Delete Paragraph 15.06.E in its entirety and insert the following in its place:

Final Payment Becomes Due: Upon receipt from Engineer of the final Application for Payment bearing Engineer's recommendation of payment, Engineer's notice of acceptability, and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled pursuant to Sec. 15.01.E of the General Conditions, and shall then approve the final Application for Payment. Owner shall tender the resulting balance due to Contractor within thirty (30) days of Owner's approval of the final Application for Payment.

ARTICLE 16 - SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

SC-16.01 Add the following new paragraph immediately after Paragraph 16.01A:

- B. Should the Owner suspend Work due to unsafe Work conducted by the Contractor, the Contractor shall not be allowed any adjustment in Contract Price or extension of Contract Time attributed to this delay.

16.02 *Owner May Terminate for Cause*

SC-16.02.A.3 Add the following after "jurisdiction":

"(including those governing employee safety)"

SC-16.04.A Amend the first sentence of paragraph 16.04.A as follows:

Strike out the phrase "Owner fails for 30 days" and replace with "Owner fails for 45 days after Approval by Owner".

SC-16.04.B Amend the first sentence of paragraph 16.04.B as follows:

Strike out the phrase "Owner has failed for 30 days" and replace with "Owner has failed for 45 days after Approval by Owner".

ARTICLE 17 - FINAL RESOLUTION OF DISPUTES

SC-17.01.B Delete in its entirety and replace with the following:

- B. Either Owner or Contractor may request mediation of any claim submitted to Engineer for a decision under Article 12 - Claims before such decision becomes final and binding.

SC-17.01 Add the following new paragraphs after SC-17.01.B:

- C. In accordance with GS 143-128(f), any claim, dispute or other matter in question (involving greater than \$15,000) arising out of or related to this Agreement shall be subject to mediation as a condition precedent to the institution of legal or equitable proceeding by either party. The dispute resolution process adopted by the N.C. State Building Commission shall be followed. The process entitled "Rules Implementing Mediated Settlement Conferences in North Carolina Construction Projects" are included in Section 00810.
- D. All matters relating to this Contract shall be governed by the laws of the State of North Carolina, without regard to its choice of law provisions, and venue for any action relating to this Contract shall be Wake County Civil Superior Court or the United States District Court for the Eastern District of North Carolina, Western Division.

ARTICLE 18 - MISCELLANEOUS

18.01 *Giving Notice*

SC-18.01.A.3 Delete in its entirety and replace with the following:

- 3. by e-mail to the recipient, with the words "Formal Notice" in the e-mail's subject line.

SC-18.01 Add the following new paragraph after Paragraph 18.01.A:

- B. No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this Contract. Any notice by a party to this Contract to another party or parties to this Contract relative to any part of this Contract shall be in writing.

18.07 *Controlling Law*

SC-18.07.A Delete in its entirety and replace with the following:

- A. All matters relating to this Contract shall be governed by the laws of the State of North Carolina, without regard to its choice of law provisions, and venue for any action relating to this Contract shall be Wake County Civil Superior Court or the United States District Court for the Eastern District of North Carolina, Western Division.

END OF SECTION

**PROCEDURE FOR REPORTING NORTH CAROLINA SALES TAX
EXPENDITURES ON CITY OF RALEIGH CONTRACTS**
(for projects with reimbursable sales tax excluded from Bid)

1. The following procedure in handling the North Carolina Sales Tax is applicable to this project. Contractors shall comply fully with the requirements outlined hereinafter, in order that the owner may recover the amount of the tax permitted under the law. For the purposes of this section, "Sales Taxes" shall mean sales and use taxes paid to the State of North Carolina or to local governments in North Carolina.
 - (a) Reimbursable Sales Taxes are to be excluded from the bid price for this project.
 - (b) The City is entitled to refunds from the State of North Carolina for these reimbursable sales taxes. The Contractor that performs work under this contract is allowed to obtain a reimbursement from the City for those Sales Taxes for which the State will grant a refund to the City. The City will reimburse the Contractor, and the City later obtains a refund from the State.
 - (c) It shall be the general contractor's responsibility to furnish the City documentary evidence showing the materials used and sales tax paid by the general contractor and each of his subcontractors. Any county sales tax included in the contractor's statements must be shown separately from the state sales tax. If more than one county is shown, each county shall be listed separately.
 - (d) The documentary evidence shall be the attached Reimbursable Sales and Use Tax Statement. This evidence shall consist of a certified statement, by the general contractor and each of his subcontractors individually, showing total purchases of materials from each separate vendor and total sales taxes by each county paid each vendor. The certified statement must show the invoice number (s) covered and inclusive dates of such invoices. State sales tax shall be listed separately from county sales tax. If more than one county is shown, each county shall be listed separately. The invoices shall be provided to substantiate the information on the statement.
 - (e) Materials used from general contractor's or subcontractor's warehouse stock shall be shown in a certified statement at warehouse stock prices.
 - (f) The general contractor shall not be required to certify the subcontractor's statements. However, the subcontractor may submit for reimbursement by certifying a Reimbursable Sales and Use Tax Statement, submitting it to the general contractor for the general contractor to submit with the pay application for the properties listed on that form. The City will make the reimbursement payable to the Contractor.
 - (g) The documentary evidence to be furnished to owners eligible for Reimbursable Sales Tax refunds covers sales and/or use taxes paid on building materials used by general contractors and subcontractors in the performance of contracts with churches,

orphanages, hospitals not for profit, educational institutions not operated for profit and other charitable or religious institutions or organizations not operated for profit and incorporated cities, towns and counties in this State. The documentary evidence is to be submitted to the above-named institutions, organizations and governmental units to be included in claims for refunds to be prepared and submitted by them to obtain refunds provided by G.S. 105-164.14 and is to include the purchase of building materials, supplies, fixtures and equipment which become a part of or annexed to buildings or structures being erected, altered or repaired under contracts with such institutions, organizations or governmental units.

- (h) The Contractor may seek reimbursement separately from, but at the same time as, the application for payment is made for the properties that were taxed. The Contractor shall not file for reimbursement for Sales Taxes before the Contractor has the right to file an application for payment for the properties that were taxed.
- 2. If the State refuses to refund any such Sales Tax to the City, or if after a refund is made, the City is told to return a refund to the State, the Contractor shall upon demand repay the City for the amount of the failed refunds.
- 3. The contractor or contractors to whom an award is made on this project will be required to follow the procedure outlined above.
- 4. The contractor is advised that all requests for payment, partial or final, for work completed under this contract must include a sales tax report submitted in accordance with the procedures outlined above.

RULES IMPLEMENTING MEDIATED
SETTLEMENT CONFERENCES IN
NORTH CAROLINA PUBLIC CONSTRUCTION PROJECTS

Adopted
February 26, 2002

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RULE 1. INITIATING MEDIATED SETTLEMENT CONFERENCES

- A. Purpose of Mandatory Settlement Conferences.** Pursuant to G.S. 143-128(g) 143-135.26(11), these Rules are promulgated to implement a system of settlement events which are designated to focus the parties' attention on settlement rather than on claim preparation and to provide a structured opportunity for settlement negotiations to take place. Nothing herein is intended to limit or prevent the parties from engaging in settlement procedures voluntarily at any time prior to or during commencement of the dispute resolution process.
- B. Initiating the Dispute Resolution Process**
- 1) Any party to a public construction contract governed by Article 8. Ch. 143 of the General Statutes and identified in G.S. 143-128(g) and who is a party to a dispute arising out of the construction process in which the amount in controversy is at least \$15,000 may submit a written request to the public owner for mediation of the dispute.
 - 2) Prior to submission of a written request for mediation to the public owner, the parties requesting mediation,
 - a) If a prime contractor, must have first submitted its claim to the Project Designer for review as set forth in Exhibit A. If the dispute is not resolved through the Project Designer's instructions, then the dispute becomes ripe for mediation in the Formal Dispute Resolution Process, and the party may submit his written request for mediation to the public owner.
 - b) If the party requesting mediation is a subcontractor, it must first have submitted its claim for mediation to the prime contractor with whom it has a contract. If the dispute is not resolved through the Prime Contractor's involvement, then the dispute becomes ripe for mediation in the Formal Dispute Resolution Process, and the party may submit its written request for mediation to the public owner.
 - c) If the party requesting mediation is the Project Designer, then it must first submit its claim to the public owner to resolve. If the dispute is not resolved with the public owner's involvement, then the Project Designers' dispute is ripe for mediation in the Formal Dispute Resolution Process, and the Project Designer may submit its written request to the public owner for mediation.

RULE 2. SELECTION OF MEDIATOR

- A. Selection of Certified Mediator by Agreement of the Parties.** The parties may select a mediator certified pursuant to the Rules by agreement within 21 days of requesting mediation. The requesting party shall file with the State Construction Office (hereinafter collectively referred to as the "SCO") or public owner if a non-State project a Notice of Selection of Mediator by Agreement within 10 days of the request; however, any party may file the notice. Such notice shall state the name, address and telephone number of the mediator selected; state the rate of compensation of the mediator; state that the mediator and opposing counsel have agreed upon the selection and rate of compensation; and state that the mediator is certified pursuant to these Rules.

- B. Nomination and Public Owner Approval of a Non-Certified Mediator.** The parties may select a mediator who does not meet the certification requirements of these rules but who, in the opinion of the parties and the SCO or public owner, is otherwise qualified by training or experience to mediate the action.

If the parties select a non-certified mediator, the requesting party shall file with the SCO a Nomination of Non-Certified Mediator within 10 days of the request. Such nomination shall state the name, address and telephone number of the mediator; state the training, experience or other qualifications of the mediator; state the rate of compensation of the mediator; and state that the mediator and opposing counsel have agreed upon the selection and rate of compensation.

The SCO or public owner shall rule on said nomination, shall approve or disapprove of the parties' nomination and shall notify the parties of its decision.

- C. Appointment of Mediator by the SCO.** If the parties cannot agree upon the selection of a mediator, the party or party's attorney shall so notify the SCO or public owner and request, on behalf of the parties, that the SCO or public owner appoint a mediator. The request for appointment must be filed within 10 days after request to mediate and shall state that the parties have had a full and frank discussion concerning the selection of a mediator and have been unable to agree. The request shall state whether any party prefers a certified attorney mediator, and if so, the SCO or public owner shall appoint a certified attorney mediator. If no preference is expressed, the SCO or public owner may appoint a certified attorney mediator or a certified non-attorney mediator.
- D. Mediator Information Directory.** To assist the parties in the selection of a mediator by agreement, the parties are free to utilize the list of certified mediators maintained in any county participating in the Superior Court Mediation Settlement Conference Program.
- E. Disqualification of Mediator.** Any party may request replacement of the mediator by the SCO or public owner for good cause. Nothing in this provision shall preclude mediators from disqualifying themselves.

RULE 3. THE MEDIATED SETTLEMENT CONFERENCE

- A. Where Conference is to be Held.** Unless all parties and the mediator otherwise agree, the mediated settlement conference shall be held in the county where the project is located. The mediator shall be responsible for reserving a place and making arrangements for the conference and for giving timely notice of the time and location of the conference to all attorneys, unrepresented parties and other persons and entities required to attend.
- B. When Conference is to be Held.** The deadline for completion of the mediation shall be not less than 30 days nor more than 60 days after the naming of the mediator.
- C. Request to Extend Deadline for Completion.** A party, or the mediator, may request the SCO or public owner to extend the deadline for completion of the conference. Such request shall state the reasons the extension is sought and

shall be served by the moving party upon the other parties and the mediator. If any party does not consent to the request, said party shall promptly communicate its objection to the SCO or public owner.

The SCO or public owner may grant the request by setting a new deadline for completion of the conference.

D. **Recesses.** The mediator may recess the conference at any time and may set times for reconvening. If the time for reconvening is set before the conference is recessed, no further notification is required for persons present at the conference.

E. **The mediated settlement conference shall not be cause for the delay of the construction project which is the focus of the dispute.**

RULE 4. DUTIES OF PARTIES AND OTHER PARTICIPANTS IN FORMAL DISPUTE RESOLUTION PROCESS

A. **Attendance.**

- 1) All parties to the dispute originally presented to the Designer or Prime Contractor for initial resolution must attend the mediation. Failure of a party to a construction contract to attend the mediation will result in the public owner's withholding of monthly payment to that party until such party attends the mediation.
- 2) Attendance shall constitute physical attendance, not by telephone or other electronic means. Any attendee on behalf of a party must have authority from that party to bind it to any agreement reached as a result of the mediation.
- 3) Attorneys on behalf of parties may attend the mediation but are not required to do so.
- 4) Sureties or insurance company representatives are not required to attend the mediation unless any monies paid or to be paid as a result of any agreement reached as a result of mediation require their presence or acquiescence. If such agreement or presence is required, then authorized representatives of the surety or insurance company must attend the mediation.

B. **Finalizing Agreement.** If an agreement is reached in the conference, parties to the agreement shall reduce its terms to writing and sign it along with their counsel.

C. **The mediation fee shall be paid in accordance with G.S. 143-128(g).**

D. **Failure to compensate mediator.** Any party's failure to compensate the mediators in accordance with G.S. 143-128(g) shall subject that party to a withholding of said amount of money from the party's monthly payment by the public owner.

Should the public owner fail to compensate the mediator, it shall hereby be subject to a civil cause of action from the mediator for the 1/3 portion of the mediator's total fee as required by G.S. 143-128(g).

RULE 5. AUTHORITY AND DUTIES OF MEDIATORS

A. Authority of Mediator.

- 1) *Control of Conference.* The mediator shall at all times be in control of the conference and the procedures to be followed.
- 2) *Private Consultation.* The mediator may communicate privately with any participant or counsel prior to and during the conference. The fact that private communications have occurred with a participant shall be disclosed to all other participants at the beginning of the conference.
- 3) *Scheduling the Conference.* The mediator shall make a good faith effort to schedule the conference at a time that is convenient with the participants, attorneys and mediator. In the absence of agreement, the mediator shall select the date for the conference.

B. Duties of Mediator.

- 1) The mediator shall define and describe the following at the beginning of the conference:
 - a) The process of mediation;
 - b) The difference between mediation and other forms of conflict resolution;
 - c) The costs of the mediated settlement conference;
 - d) That the mediated settlement conference is not a trial, the mediator is not a judge, and the parties retain their legal rights if they do not reach settlement;
 - e) The circumstances under which the mediator may meet and communicate privately with any of the parties or with any other person;
 - f) Whether and under what conditions communications with the mediator will be held in confidence during the conference;
 - g) The inadmissibility of conduct and statements as provided by G.S. 7A-38.1(1);
 - h) The duties and responsibilities of the mediator and the participants; and
 - i) That any agreement reached will be reached by mutual consent.
- 2) *Disclosure.* The mediator has a duty to be impartial and to advise all participants of any circumstance bearing on possible bias, prejudice or partiality.
- 3) *Declaring Impasse.* It is the duty of the mediator timely to determine that an impasse exists and that the conference should end.
- 4) *Reporting Results of Conference.* The mediator shall report to the SCO or public owner within 10 days of the conference whether or not an agreement was reached by the parties. If an agreement was reached, the report shall state the nature of said agreement. The mediator's report shall inform the SCO or public owner of the absence of any party known to the mediator to have been absent from the mediated settlement conference without permission. The SCO or public owner may require the mediator to provide statistical data for evaluation of the mediated settlement conference program.
- 5) *Scheduling and Holding the Conference.* It is the duty of the mediator to schedule the conference and conduct it prior to the deadline of completion set by the rules. Deadlines for completion of the conference shall be strictly observed by the mediator unless said time limit is changed by a written order of the SCO or public owner.

RULE 6. COMPENSATION OF THE MEDIATOR

- A. **By Agreement.** When the mediator is stipulated by the parties, compensation shall be as agreed upon between the parties and the mediator provided that the provision of G.S. 143-128(g) are observed.
- B. **By Appointment.** When the mediator is appointed by the SCO or public owner, the parties shall compensate the mediator for mediation services at the rate in accordance with the rate charged for Superior Court mediation. The parties shall also pay to the mediator a one-time per case administrative rate in accordance with the rate charged for Superior Court mediation, which is due upon appointment.

RULE 7. MEDIATOR CERTIFICATION.

All mediators certified in the Formal Dispute Resolution Program shall be properly certified in accordance with the rules certifying mediators in Superior Court in North Carolina. * When selecting mediators, the parties may designate a preference for mediators with a background in construction law or public construction contracting. Such requirements, while preferred, are not mandatory under these rules.

All mediators chosen must either demonstrate they are certified in accordance with the Rules Implementing Scheduled Mediated Settlement Conference in Superior Court or must gain the consent of the SCO or public owner to mediate any dispute in accordance with these rules.

* Except when otherwise allowed by the SCO or public owner upon the request of the parties to the mediation.

RULE 8. RULE MAKING

These Rules are subject to amendment by rule making by the State Building Commission.

These Rules are mandated for State projects when the contracting state entity has not otherwise adopted its own dispute resolution provision. These rules are optional for all other projects subject to Article 8, Ch. 143 of the General Statutes.

RULE 9. DEFINITIONS

When the phrase "SCO or public owner" is used in these rules, "SCO" shall apply to state projects, "public owner" shall apply to non-state public projects.

RULE 10. TIME LIMITS

On state contracts, any time limit provided for by these Rules may be waived or extended by the SCO for good cause shown.

On non-state contracts, any time limit provided for by these Rules may be waived or extended by the mediator it appoints for good cause shown. If the mediator has not yet been appointed, the designer of record shall decide all waivers or extensions of time for good cause shown.

DISPUTE RESOLUTION

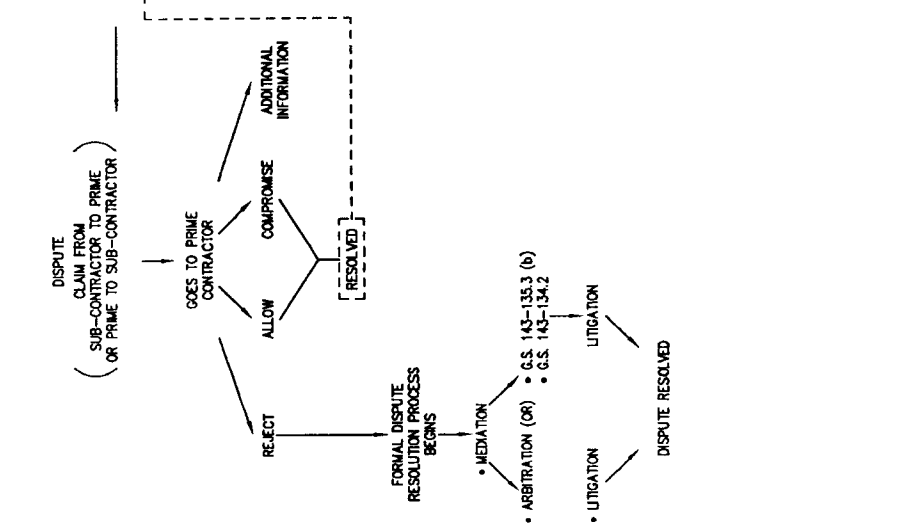
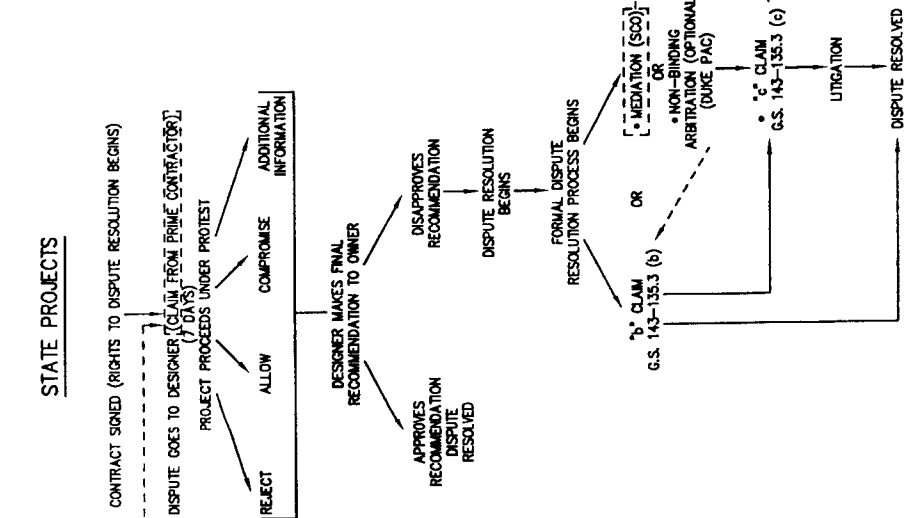
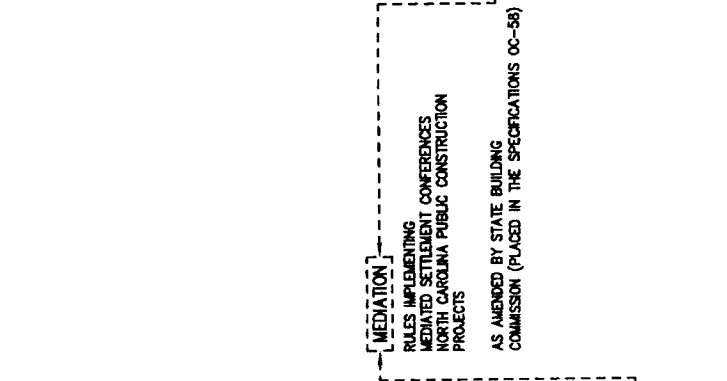
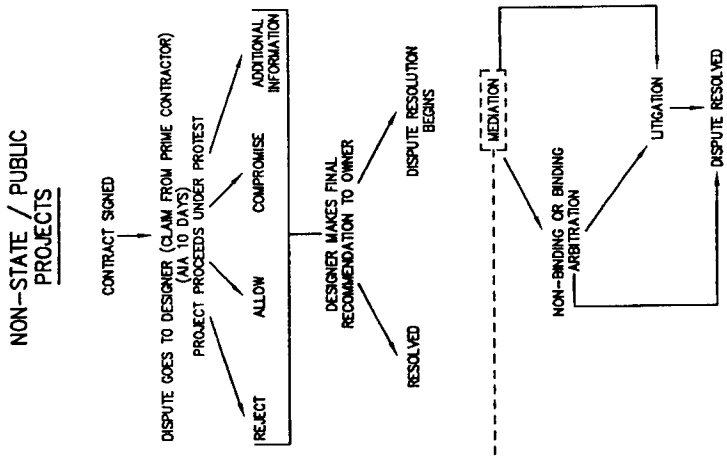
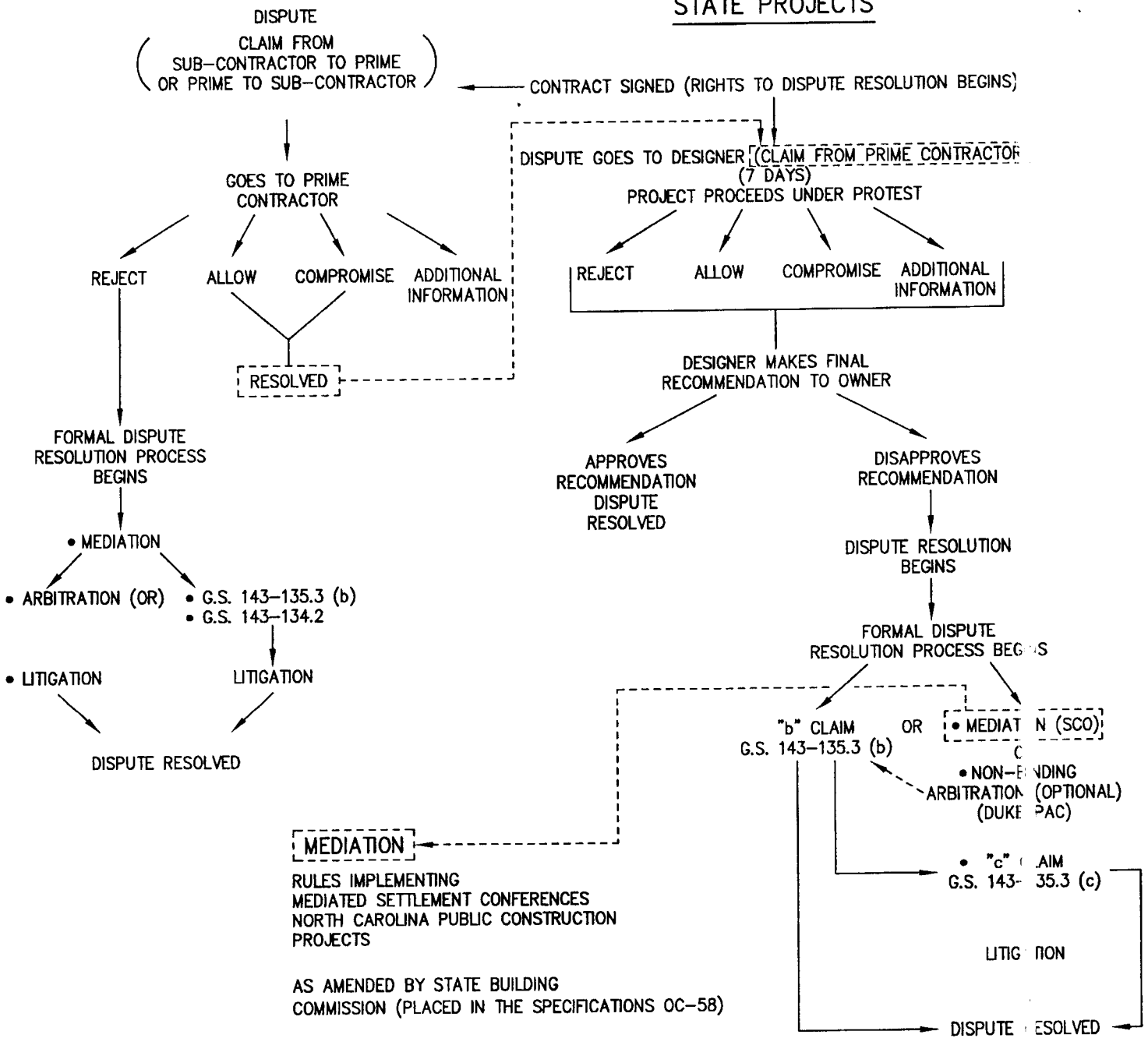


Exhibit A

DISPUTE RESOLUTION

STATE PROJECTS



WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner: City of Raleigh Owner's Project No.:
Engineer: Hazen/CJS Conveyance Engineer's Project No.: 32426/100-002
Contractor: Contractor's Project No.:
Project: Neuse River East Parallel Interceptor
Contract Name:
Date Issued: Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

Non-agreement on pricing of proposed change. Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: \$ _____ **[increase] [decrease] [not yet estimated].**
Contract Time: _____ days **[increase] [decrease] [not yet estimated].**

Basis of estimated change in Contract Price:

Lump Sum Unit Price Cost of the Work Other

Recommended by Engineer

Authorized by Owner

By:

Title:

Date:

CHANGE ORDER NO.: [Number of Change Order]

Owner: **City of Raleigh** Owner's Project No.:
 Engineer: Hazen/CJS Conveyance Engineer's Project No.: 32426/100-002
 Contractor: Contractor's Project No.:
 Project: Neuse River East Parallel Interceptor
 Contract Name:
 Date Issued: Effective Date of Change Order:

The Contract is modified as follows upon execution of this Change Order:

Description:

[Description of the change]

Attachments:

[List documents related to the change]

Change in Contract Price	Change in Contract Times
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. [Number of previous Change Order] : \$ _____	[Increase] [Decrease] from previously approved Change Orders No.1 to No. [Number of previous Change Order] : Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: \$ _____	[Increase] [Decrease] this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: \$ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

Recommended by Engineer (if required)

Accepted by Contractor

By: _____

Title: _____

Date: _____

Authorized by Owner

Approved by Funding Agency (if applicable)

By: _____

Title: _____

Date: _____

Attachment 1 - Final Change Order:

The Owner and Contractor intend that this Final Change Order incorporate and resolve all prior, pending, and unresolved change order requests, claims, and/or disputes which have been submitted or which could have been submitted prior to the date of execution of this Final Change Order. This Final Change Order represents full and final settlement of all disputes or claims between the Parties to the Contract, and by executing this Final Change Order and in consideration of the modifications agreed to herein, Contractor expressly releases and waives all further claims for equitable adjustment; compensation in the form of money or time (days) for additional work, services, labor, or materials; damages for delay including but not limited to claims for additional overhead, lost productivity, ripple effect, cumulative impact, or acceleration; and any direct, indirect, or impacts costs including but not limited to any costs, losses, damages, charges, fees, expenses, interest, or attorneys' fees arising from or in connection with the Contract or this Final Change Order.

FIELD ORDER NO.: [Number of Field Order]

Owner: City of Raleigh Owner's Project No.:
Engineer: Hazen/CJS Conveyance Engineer's Project No.: 32426/100-002
Contractor: Contractor's Project No.:
Project: Neuse River East Parallel Interceptor
Contract Name:
Date Issued: Effective Date of Field Order:

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____

Title: _____

Date: _____

SECTION 01100

SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work described in this Project Manual includes the provision of labor, materials, equipment, and services required to complete the Neuse River East Parallel Interceptor (NREPI) for the City of Raleigh, North Carolina.
- B. The City of Raleigh Public Utilities Handbook, as it relates to this project, shall be used in conjunction with these specifications. All aspects of the project construction shall conform to this handbook unless specifically addressed herein. It is the Contractor's responsibility to obtain this document from the City of Raleigh - Raleigh Water. It can be obtained by phone at 919-996-3474 or on the internet at <http://www.raleighnc.gov/> under Departments and Water.
- C. In the event of a discrepancy between these specifications and the Handbook, the Contractor shall use the more stringent of the two documents. Notify the Owner immediately of the discrepancy.

1.02 CONTRACT DESCRIPTION

- A. The description of work, which follows, is not all inclusive in listing the work. The description is abbreviated to provide a summary of the scope of the project to aid in the understanding and coordination. The Contractor shall refer to the applicable sections of these specifications for detailed description of the work involved and also refer to the contract drawings for the division of work indicated thereon.

1. Neuse River East Parallel Interceptor

a. Base Bid - Provision of:

- 26,000 LF of 84-inch and 96-inch gravity sewer interceptor piping
- 70 Sewer Manholes including precast concrete manholes and fiberglass pipe tee manholes
- A vortex drop structure with twin 66-inch inlet pipes and a single 72-inch outlet pipe
- Two trenchless NCDOT road crossings
- Two open cut crossings of the Neuse River for installation of 72-inch gravity sewer interceptor
- Abandonment of two existing wastewater pumping stations

b. Alternate Bid - Provision of:

- 1) Install polymer concrete manholes in lieu of standard precast concrete manholes or fiberglass pipe manholes at the following manholes for the depth classes and sizes indicated in the Bid Form.

1.03 WORK SEQUENCE

- A. Contractor shall not allow bypassing of sewage into surface water (e.g. stream, creek, river, ditch, etc.). Contractor is responsible for all bypass pumping required to construct the project as shown. Construction activities that interfere with normal operation of existing facilities shall be specifically noted on construction schedule. For each of these activities provide a detailed construction sequence showing the bypass pumping arrangement.
- B. Indicate switchovers and cut-ins between new Work and existing facility on the construction schedule. Submit proposed date for switchover in writing to Engineer and Owner a minimum of seven (7) days and again 24-hours in advance of actual field work. Owner shall have the right to delay Work due to operational requirements, without additional cost to Owner.
- C. Perform switchovers and cut-ins during low flow periods at the facility. This shall normally require night / weekend operations by Contractor at no additional compensation.
- D. The sequence of construction shall be in accordance with instructions included on the Drawings.
- E. It is recommended that construction of the gravity sewer begin at the lowest grade and proceed continuously up-gradient. The Contractor shall be allowed to install the road crossing tunnels at their discretion within the project schedule and be allowed to have more than one pipe laying crew on the project. However, it is the Contractor's responsibility to ensure that the installed grades of the tunnels be within the tolerances specified herein and any up-gradient or down-gradient open-cut sewer be as shown on the design drawings. Any locations where installed grades fall outside the specified tolerances or design shall be replaced or repaired at no additional cost to the Owner.
- F. Contractor shall schedule tunnel work such that once tunnel shafts/pits are excavated and shored at any tunnel crossing location, consistent construction progress is achieved and tunneling activities begin as soon as possible to avoid shafts/pits from remaining inactive for an extended period of time. Likewise, once tunnel installations are complete and approved by the Owner, the Contractor shall proceed with backfilling and closing shafts/pits.
- G. Contractor shall take all necessary precautions to avoid damaging the existing sanitary sewer infrastructure, including but not limited to preventing construction equipment from operating over shallow portions of the existing sewer. Contractor is responsible for repairing any damage to the existing sewer, caused by the Contractor during construction of the interceptor improvements project, at his own expense.

1.04 OWNER OCCUPANCY

- A. Owner will occupy site during entire period of construction.
- B. Contractors shall cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

1.05 CONTRACTOR USE OF SITE

- A. Work is located within Right-of-Ways of the NC Department of Transportation. Requirements of the owners of the right-of-ways must be complied with and specifically as required in the permits included in the project manual.
- B. Only Owner's right to perform construction and maintenance operations with its own forces and to employ separate contractors on portions of the Project limits contractor's use of site during the construction period. Work at the Project site by Owner will be coordinated with the Contractor.
- C. Contractor shall provide his own staging area as necessary for his Work. Contractor is required to modify the appropriate permits or obtain new permit for additional area at the Contractor's expense.
- D. Contractor's use of the site during the construction period may be limited by Owner's necessity to operate the existing facilities.
- E. The Contractor may request additional work area on City of Raleigh property by written request to the Owner at least 30 days prior to use of the additional area and only after receiving approval from the NCDEQ Division of Land Resources for an Erosion and Sedimentation Control Plan. The Contractor shall be responsible for all costs associated with the Erosion and Sedimentation Control Plan approval and any fees or notices of violations associate with the additional area."

1.06 OTHER CONTRACTS

- A. Owner will be letting the East Neuse Regional Pump Station under a separate construction contract and a portion of this contract work will occur in the direct vicinity of the work area for the Neuse River East Parallel Interceptor project. The Contractor will be required to coordinate with the contractor for the East Neuse Regional Pump Station project as detailed in the Contract Documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01230

ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section specifies administrative and procedural requirements for Alternates.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all Work:
 - 1. Section 01900 - Special Project Requirements
 - 2. Section 02530 - Sanitary Sewer System

1.03 DEFINITIONS

- A. Alternate: An Alternate is an item of work or equipment that the Owner is requesting separate bids for as indicated on the Bid Form and defined in the Contract Documents. The Alternates may be "Added To" or "Deducted From" the Base Bid as indicated on the Bid Form.

1.04 QUALITY ASSURANCE

- A. Coordinate related Work and modify adjacent Work as necessary to ensure that Work affected by each accepted Alternate is complete and fully integrated into the project.
- B. A "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements described under each Alternate.
 - 1. Include as part of each Alternate, miscellaneous devices, accessory objects, and similar items incidental to and required for a complete installation as part of the Alternate.

1.05 SELECTION AND AWARD OF ALTERNATES

- A. Bid award will be evaluated on the total of the base bid and any of the alternates or combination of the alternatives as selected by the Owner to the extent that project funds are available.
- B. Following the award of the Contract, the Engineer shall prepare and distribute to each Bidder notification of the status of each Alternate. Notification shall indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. It shall also include a complete description of all negotiated modifications to Alternates.
- C. Accepted Alternates will be identified in the Owner-Contractor Agreement.

1.06 SCHEDULE OF ALTERNATES

- A. Contract: Single Prime
 - 1. Alternate Bid No. 1: Install polymer concrete manholes in lieu of standard precast manholes or fiberglass pipe tee manholes at the depths and sizes indicated on the Bid Form.

- a. The Alternate Bid shall include, but not be limited to, the following major components, unless indicated otherwise:
 - 1) Precast Polymer Concrete Manholes/Structures as specified in Section 01900.
2. Alternate Bid No. 2: Install composite manhole frame and covers in lieu of standard cast iron frame and covers at locations selected by the Owner.
 - a. The Alternate Bid shall include, but not limited to, the following major components, unless indicated otherwise:
 - 1) Composite Manhole Frame and Covers as specified in Section 01900.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01270

UNIT PRICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Delineation of measurement and payment criteria applicable to Work performed under Contract by the unit price payment method.

1.02 FIELD MEASUREMENT

- A. Take measurements and compute quantities for submittal of the monthly pay request unless specified otherwise in the measurement paragraphs as indicated in this Section.

1.03 CHANGE IN QUANTITIES

- A. Increase in the quantity of a bid item above what is indicated in the Bid Form shall only be made by a Change Order as required by the Contract Documents.
- B. A final adjusting Change Order shall be made for adjustment of the actual quantities installed prior to submittal of the final pay request.

1.04 GENERAL

- A. Items with a "(X)" in the title of the following bid items represents the size or depth as indicated on the Bid Form.
- B. Method of measurement for the individual Bid Items shall be as specified below.
- C. Payment for each item shall be in accordance with the Contract Unit Price times the number of units installed in accordance with the Contract Documents.
- D. Work for each bid item shall include, but not be limited to, the work listed below and the labor, materials, equipment, and services required and reasonably implied by the Contract Documents for a complete installation.
- E. Traffic Control will not be measured but should be included in the individual unit price items, as appropriate. This includes traffic control equipment, flagman, signage, moving control devices, and establishing detours with the City and NCDOT.
- F. Payment for work required by the Contract Documents shall be based upon the pay items described herein. The Work associated with pay items is intended to include all of the work and materials as required for a complete installation as required by the Contract Documents. The descriptions herein may not be complete; however, the project shall be constructed in accordance with Contract Documents and for the cost associated with the unit prices in the Bid Form.

1.05 MOBILIZATION (BID ITEM #1)

- A. Measurement shall not be made for this item.
- B. Work shall include administrative cost including, but not limited to, construction staking, necessary movement of personnel, equipment, supplies, and incidentals to or near the project site, the subsequent removal of personnel, equipment, supplies and incidentals from the work site at the completion of the work, bonds, insurance, preconstruction video inspections, construction progress photos, shop drawing

submittal, as-built documentation/surveys and construction trailers. General office administration for the Project construction shall be included in the individual unit price items.

- C. When Contractor has made utility connections, installed Contractor's field offices, Owner's field offices, and all other facilities required to begin work on a substantial portion of the Project, a payment of 75 percent of the lump sum mobilization Bid item will be made provided Contractor has already satisfied the requirements. The remaining 25 percent will be made with the final application for payment.

1.06 UTILITY PIPING (BID ITEMS #2 - #8A)

- A. Measurement: Measure horizontally or from station to station as shown or indicated on the Drawings for the various types and sizes of pipes installed.
 - 1. (X)-(X) ft deep (X) inch Sanitary Sewer: Measure pipe from center to center of manholes. No deduction will be made for space occupied by manholes. Measure depth of pipe vertically from pipe invert to original grade.
 - a. When connecting to existing pipe instead of manhole, measure pipe from center of manhole to final connection to existing pipe.
 - b. When outside drops are involved, measure from upstream edge of wye/cross on outside drop to center of upstream manhole or to final connection to existing pipe, whichever is applicable
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 - 1. Clearing and grubbing of the permanent and temporary easement where necessary, including but not limited to, removing, piling, clearing material, stump grinding, windrowing, or disposing of the cleared and grubbed material and restoring and leveling the ground surface after debris removal. Trim branches of existing trees extending over the area occupied by the easement as directed by Owner to give a clear height of 16 feet above the easement. Onsite burning and backfilling of cleared and grubbed material is prohibited.
 - 2. Temporary removal and restoration/relocation or temporary support of, but not limited to, existing mailboxes, signs, fences, shrubs, plants, guardrails, power and telephone poles.
 - 3. **Removal of existing sewer when replacing in-place.**
 - 4. Cutting and removal of existing paved surfaces including curb and sidewalk. Patching/repair of existing paved surfaces, curb and sidewalk shall be paid as indicated in subsequent paragraphs.
 - 5. Excavating around pipe and manholes, shoring and bracing installation and removal where required, excess material disposal, existing pipe removal, removal of existing manholes, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well pointing as required, piping with required coatings, installing, backfilling and compacting (including Class I material as specified for the pipe bedding, haunching, and initial backfill), and trench maintenance after backfilling.
 - 6. Warning / identification tape over utilities
 - 7. Core-drilling of existing manholes, gaskets, couplings, adapters.
 - 8. Temporary support and protection of existing underground facilities.
 - 9. Pipe, coatings, gaskets, concrete blocking, connection to existing piping and fittings.
 - 10. Flushing of utility lines and testing of utility lines, manholes, valves, etc. before placing in service.
 - 11. Repair to damaged new and existing utilities.

12. All labor, materials and equipment necessary for a complete installation.
 13. Replacing gutters, storm sewers, and inlets (that are not indicated to be replaced either on the Drawings or in the Specifications) and utilities removed as part of construction. Storm sewers, inlets and utilities damaged through fault of the Contractor or removed at the convenience of the Contractor shall be replaced at the Contractor's expense.
- C. Payment: The first Application for Payment will be approved based on the utilities installed during the agreed upon payment period without testing. Subsequent Application for Payments shall not be approved by the Engineer unless utilities installed during the previous payment period have passed the specified tests and clean up and seeding is complete.
1. No payment will be allowed for excavation below the planned subgrade of the trench, except that excavation directed by the Owner.
- 1.07 GEOTEXTILE FABRIC FOR TRENCH BACKFILL STABILIZATION (BID ITEM #9)
- A. Measurement: Measure by square yard of fabric installed in trench as detailed on the Drawings. Payment shall include all labor, material, equipment, tools, and accessories necessary to place, wrap, and secure the fabric around the backfill.
 - B. Work: Placement, cutting, tightening, and securing of fabric.
- 1.08 TUNNEL LOCATION NUMBERS 1 AND 2 – STEEL LINER PLATE INSTALLED BY UTILITY HAND MINING WITH 96" FRP CARRIER PIPE (BID ITEM #10a AND #10c)
- A. The following descriptions shall apply to Utility Hand Mining for these locations as indicated on the Contract Drawings.
 - B. Measurement: by linear foot to the nearest 0.1 foot along the horizontal centerline as measured from front face of launching shaft to front face of receiving shaft.
 - C. Work shall include, but not be limited (unless specifically noted otherwise on the Bid Form and this specification section), the following:
 1. Mobilization and demobilization of tunneling equipment, materials and personnel.
 2. Design, stabilization of existing utilities, grade control monitoring/surveying and reporting, and guaranteed installation of initial tunnel support by Utility Hand Mining and labor and equipment necessary for complete installation.
 3. Flushing and testing of sewer before placing in service.
 4. Steel liner plate, carrier pipe with required coatings, gaskets, pipe supports, grouting of exterior and interior annular spaces, bulkheads and all labor and equipment necessary for completed installation.
 5. Grade control monitoring/surveying and reporting.
 6. All labor, materials and equipment necessary for a complete installation.
 7. Costs for bonds, insurance and provisions established by the NCDOT as indicated in the encroachment permit.
 8. Stockpiling, loading, hauling and disposal of all material including, but not limited to, from installation of launch and receiving shafts and tunnel spoils.
 9. All dewatering required for completion of the Work.
 - D. Payment:
 1. No payment shall be made for unusable pipe that is installed.
 2. Payment will not be made until the carrier pipe passes the low-pressure air test.

3. The tunnel installations are guaranteed at the bid price established in the Bid Form. The only additional compensation that the Contractor may be eligible to receive for said installation.

1.09 LAUNCHING AND RECEIVING SHAFTS (BID ITEMS #10b AND #10d)

- A. Measurement: for each shaft provided.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification section), the following:
 1. Clearing and grubbing of the permanent and temporary easement where necessary including, but not limited to, removing, piling, clearing material, stump grinding, windrowing, or disposing of the cleared and grubbed material and restoring and leveling the ground surface after debris removal. Trim branches of existing trees extending over the area occupied by the easement as directed by the Owner to give a clear height of 16 feet above the easement. Onsite burning and backfilling of cleared and grubbed material is prohibited.
 2. Cutting and removal of existing paved surfaces including curb and sidewalk. Patching/repair of existing paved surfaces, curb and sidewalk shall be paid as indicated in subsequent paragraphs.
 3. Temporary removal and restoration/relocation of temporary support of, but not limited to, existing mailboxes, signs, fences, shrubs, plants, guardrails, power and telephone poles.
 4. Provide shoring and bracing and removal where required, excess material disposal, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well pointing as required, installing, backfilling and compacting (including Class I material as specified for the pipe bedding, haunching and initial backfill), trench maintenance after backfilling.
 5. Rock removal to the limits as necessary for the construction of the shafts.
 6. Possible interim backfill, compaction and surface restoration of shafts after initial excavation and before tunneling commences.
 7. Temporary support and protection of existing underground facilities.
 8. Repair to damaged new and existing utilities.
 9. Temporary fence with gate and traffic barrier, where required adjacent to vehicular traffic, around excavation.
 10. All labor, materials and equipment necessary for a complete installation.
 11. Costs for bonds, insurance and provisions established by the NCDOT as indicated in the encroachment agreement.
 12. Replacing gutters, storm sewers, and inlets (that are not indicated to be replaced either on the Contract Drawings or in the Specifications) and utilities removed as part of construction. Storm sewers, inlets and utilities damaged through fault of the Contractor or removed at the convenience of the Contractor shall be replaced at the Contractor's expense.
 13. Cleanup and seeding for the full width of the disturbed area. Work shall include, but not be limited to: removal and proper disposal of debris and excess material, grading of disturbed areas to original surface profile prior to excavation, cleaning of paved surfaces, proper seeding of disturbed areas including mulching, obtaining approval of cleanup from owner of right-of-way and soil amendments (fertilizer/lime).

- C. Payment:
1. Payment will be made for 75 percent upon excavation completion. The remaining 25 percent will be made upon backfill of the shafts.
- 1.10 (X) –(X) FT DEEP, PRECAST CONCRETE MANHOLES (BID ITEMS #11, #12, #13, AND #14)
- A. Measurement: for each manhole of various sizes, material (standard precast or polymer precast) and at the depth installed. Measure depths from manhole rim elevation to invert out elevation.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. Stone sub base, furnishing and installing precast concrete sections as required for the depth, top adjusting rings, pipe boots, frame and cover (as indicated), coatings, anchor bolts, washers, gasket material, non-shrink grout, concrete channel fill, debris removal and stainless steel clamps.
 2. Vacuum testing.
 3. All labor, materials and equipment necessary for a complete installation.
 4. Rock excavation is not included and will be paid separately.
- C. Payment: The first Application for Payment will be approved based on the utilities installed during the agreed upon payment period without testing. Subsequent Application for Payments shall not be approved by the Engineer unless manholes installed during the previous payment period have passed the specified tests.
1. No payment will be allowed for excavation below the planned subgrade, expect that excavation directed by the Owner.
- 1.11 (X) –(X) FT DEEP, FIBERGLASS PIPE TEE MANHOLES (BID ITEMS #11, #11A AND #12)
- A. Measurement: for each manhole of various sizes and at the depth installed. Measure depths from manhole rim elevation to invert out elevation.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. Stone sub base, furnishing and installing fiberglass riser sections as required for the depth, top adjusting rings, pipe boots, frame and cover (as indicated), anchor bolts, washers, gasket material, non-shrink grout, , debris removal and stainless steel clamps.
 2. Vacuum testing.
 3. All labor, materials and equipment necessary for a complete installation.
 4. Rock excavation is not included and will be paid separately.
- C. Payment: The first Application for Payment will be approved based on the utilities installed during the agreed upon payment period without testing. Subsequent Application for Payments shall not be approved by the Engineer unless manholes installed during the previous payment period have passed the specified tests.
1. No payment will be allowed for excavation below the planned subgrade, expect that excavation directed by the Owner.

1.12 STUB OUT MANHOLES (POLYMER) INCLUDING SANITARY SEWER (BID ITEM #14A)

A. Measurement: For each at the locations shown on the Drawings.

B. Work shall include but not limited to the following:

1. Excavating structures, shoring and bracing installation and removal where required, excess material disposal, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well-pointing as required, installing, backfilling and compacting.
2. Stone sub base, furnishing and installing structure as required for depth, pipe boots, frame and cover or hatch, gates w/handwheels and associated equipment, miscellaneous metals, vents, coatings, washers, gasket materials, non-shrink grout, concrete channel fill, debris removal and stainless steel clamps.
3. Vacuum testing.
4. Temporary support and protection of existing underground facilities.
5. Repair of damaged new and existing utilities, structures and other existing above or below grade features.
6. **All pipe connecting the stub out manholes to the main interceptor manholes.**
7. All labor, materials, and equipment necessary for a complete installation.
8. Rock excavation is not included and will be paid separately.

C.

1.13 JUNCTION BOXES (BID ITEM #15)

A. Measurement: Lump Sum Basis for each junction box.

B. Work shall include but not limited to the following:

1. Excavating structures, shoring and bracing installation and removal where required, excess material disposal, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well-pointing as required, installing, backfilling and compacting.
2. Stone sub base, furnishing and installing structure as required for depth, pipe boots, frame and cover or hatch, gates w/handwheels and associated equipment, miscellaneous metals, vents, coatings, washers, gasket materials, non-shrink grout, concrete channel fill, debris removal and stainless steel clamps.
3. Vacuum testing.
4. Temporary support and protection of existing underground facilities.
5. Repair of damaged new and existing utilities, structures and other existing above or below grade features.
6. All labor, materials, and equipment necessary for a complete installation.
7. Rock excavation is not included and will be paid separately.

1.14 JUNCTION BOXES AT RIVERVIEW ROAD (BID ITEM #15A)

- A. Measurement: Lump Sum Basis for each junction box.
- B. Work shall include but not limited to the following:
 - 1. Excavating structures, shoring and bracing installation and removal where required, excess material disposal, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well-pointing as required, installing, backfilling and compacting.
 - 2. Stone sub base, furnishing and installing structure as required for depth, pipe boots, frame and cover or hatch, gates w/handwheels and associated equipment, miscellaneous metals, vents, coatings, washers, gasket materials, non-shrink grout, concrete channel fill, debris removal and stainless steel clamps.
 - 3. Vacuum testing.
 - 4. Temporary support and protection of existing underground facilities.
 - 5. Repair of damaged new and existing utilities, structures and other existing above or below grade features.
 - 6. All pipe connecting the junction boxes to the drop vortex structure.**
 - 7. All electrical work required to provide power and operate the electrical components at the junction boxes.**
 - 8. All labor, materials, and equipment necessary for a complete installation.
 - 9. Rock excavation is not included and will be paid separately.

1.15 DROP VORTEX STRUCTURE W/BYPASS PUMPING (BID ITEM #16)

- A. Measurement: for a single lump sum.
- B. Work shall include (unless specifically noted otherwise on the Bid Form and this specification Section):
 - 1. Clearing and grubbing of the permanent and temporary easement where necessary including, but not limited to, removing, piling, clearing material, stump grinding, windrowing, or disposing of the cleared and grubbed material and restoring and leveling the ground surface after debris removal. Trim branches of existing trees extending over the area occupied by the easement as directed by the Owner to give a clear height of 16 feet above the easement. Onsite burning and backfilling of cleared and grubbed material is prohibited.
 - 2. Cutting and removal of existing paved surfaces including curb and sidewalk. Patching/repair of existing paved surfaces, curb and sidewalk shall be paid as indicated in subsequent paragraphs.
 - 3. Temporary removal and restoration/relocation of temporary support of, but not limited to, existing mailboxes, signs, fences, shrubs, plants, guardrails, power and telephone poles.
 - 4. Provide shoring and bracing and removal where required, excess material disposal, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well pointing as required, installing, backfilling and compacting (including Class I material as specified for the pipe bedding, haunching and initial backfill), trench maintenance after backfilling.
 - 5. Rock removal to the limits as necessary for the construction of the structure.
 - 6. Temporary support and protection of existing underground facilities.
 - 7. Repair to damaged new and existing utilities.

8. Temporary fence with gate and traffic barrier, where required adjacent to vehicular traffic, around excavation.
9. All labor, materials and equipment necessary for a complete installation of the structure and connection to other structures as required for operation.
- 10. Bypass pumping for the construction of the structure and connection of the structure to other structures as required for operation.**
11. Cleanup and seeding for the full width of the disturbed area. Work shall include, but not be limited to: removal and proper disposal of debris and excess material, grading of disturbed areas to original surface profile prior to excavation, cleaning of paved surfaces, proper seeding of disturbed areas including mulching, obtaining approval of cleanup from owner of right-of-way and soil amendments (fertilizer/lime).

D. Payment:

1. Payment will be made for based on the percent completion of the lump sum total price as determined by review and acceptance by the Owner and in accordance with the Contractor's accepted schedule of values of the lump sum bid item.

1.16 CONNECTION OF SEWER LINES TO EXISTING MANHOLES INCLUDING INSIDE/OUTSIDE DROPS (BID ITEM #17)

A. Measurement: Measure by each connection as identified on the Bid Form. Payment shall include all labor, material, equipment and accessories necessary to connect the proposed utility pipe to the existing structure and create a water-tight seal.

B. Work:

1. Excavation, backfilling, coring, fittings, pipe boots/connections, seals, grout, and cleanup.
2. Couplings, concrete support at the bottom of the outside drop, adapters, pipe, pipe coating, pipe bedding, connection to existing piping, fittings, haunching and backfill material as indicated on the Contract Drawings.
3. All labor and equipment necessary for a complete installation.
4. Flushing and testing.

1.17 STANDARD MANHOLE VENTS (BID ITEM #18a)

A. Measurement: for each attached vent stack provided and installed on manholes as indicated on the Drawings.

B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:

1. Pipe, coatings, screens, gaskets and fittings.
2. All labor, materials and equipment necessary for a complete installation.

1.18 OFFSET VENTS FROM MANHOLES (BID ITEM #18b)

A. Measurement: for each offset vent provided from the manhole to the easement boundary as indicated on the Drawings.

B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:

1. Temporary removal and restoration/relocation or temporary support of, but not limited to, existing mailboxes, signs, fences, shrubs, plants, guardrails, power and telephone poles.
2. Cutting and removal of existing paved surfaces including curb and sidewalk. Patching/repair of existing paved surfaces, curb and sidewalk shall be paid as indicated in subsequent paragraphs.
3. Excavating, shoring and bracing installation and removal where required, excess material disposal, loading, hauling and stockpiling material, subgrade preparation, dewatering and/or well pointing as required, installing, backfilling including stone, concrete encasement, trench maintenance after backfilling, pipe supports.
4. Temporary support and protection of existing underground facilities.
5. Pipe, coatings, fittings. The below-ground section of the offset vent pipes may be up to 50 feet in length (from manhole to point which the vent pipe will turn to be extended vertically). The Contractor shall consult with the Owner on the exact route and termination point of vent pipe well in advance of installing the pipe and appurtenances.
6. Repair to damaged new and existing utilities.
7. All labor, materials and equipment necessary for a complete installation.
8. Replacing gutters, storm sewers, and inlets (that are not indicated to be replaced either on the Drawings or in the Specifications) and utilities removed as part of construction. Storm sewers, inlets and utilities damaged through fault of the Contractor or removed at the convenience of the Contractor shall be replaced at the Contractor's expense.
9. Cleanup and seeding for the full width of the disturbed area. Work shall include, but not be limited to: removal and proper disposal of debris and excess material, grade disturbed areas to original surface profile prior to trench excavation, cleaning of paved surfaces, proper seeding of disturbed area including mulching, obtain approval of cleanup from owner of right-of-way, soil amendments (fertilizer/lime).

1.19 REMOVE AND REPLACE EX MANHOLES (BID ITEM #19)

- A. Measurement: By each at the location shown on the Drawings regardless of size and depth.
- B. Work: Excavating, removal and off site disposal of existing manhole, backfilling, stone sub base, concrete sections as required for the depth, top adjusting rings, steps, pipe boots, and ring and cover.

1.20 ABANDON EXISTING SANITARY SEWER (BID ITEM #20)

- A. Measurement: by linear foot horizontally from center of manhole to center of manhole for the various sizes of pipes installed. No deduction will be made for space occupied by manholes except as noted below.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section):
 1. All labor, equipment and materials including the cost of cutting and plugging existing pipe and purchasing, transporting and placing flowable fill (where required – in NCDOT right-of-ways).

- 1.21 CCTV INSPECTION OF SEWER MAIN (BID ITEM #21)
- A. Measurement: by the linear foot of pipe horizontally from center to center of manholes. No deduction will be made for space occupied by manhole.
 - B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification section) the following;
 - 1. All labor, materials, equipment necessary to televise the existing sewers, accessing manholes for inspection, oral and written documentation of location of discovered services, and determining accurate location of sewer services on the surface.
 - 2. Flushing line as necessary for inspection.
 - 3. Safety measures and traffic control.
 - C. Payment:
 - 1. Payment shall be made once, regardless of the number of attempts.
 - D. Perform inspection before blasting to ascertain existing condition and after blasting operations to assess whether or not damage to those mains occurred. Payment will be made separately for these two occurrences.
- 1.22 NEUSE RIVER CROSSING (BID ITEM #22a AND #22b)
- A. Measurement: Measure by each crossing of the Neuse River identified in the bid form by plan sheet number and station to station references. Payment shall include all labor, material, equipment and accessories required to isolate flow, divert flow, contain and remove silt, remove dams and equipment, transport construction equipment and materials across the creek, and restore flow following installation of the utility line(s) as detailed on the Drawings.
 - B. Work: Cofferdams, concrete encasement, bank stabilization including rip-rap, liners, and planting/seeding, bypass pumping, silt collection devices, sumps for bypass pumps, diversion ditches, temporary piping, silt removal, temporary bridges and rip-rap ramps, and cleanup.
- 1.23 PERMANENT STREAM AND WETLAND CROSSINGS (BID ITEM #23)
- A. Measurement: Measure by each stream crossing tributary to the Neuse River or wetland crossing identified in the bid form by plan sheet number and station to station references. Payment shall include all labor, material, equipment and accessories required to isolate flow, divert flow, contain and remove silt, remove dams and equipment, transport construction equipment and material across the stream, cleanup and restore flow following installation of the utility line(s) as detailed on the Drawings.
 - B. Work: Cofferdams, fords, sills, bypass pumping, silt collection devices, sumps for bypass pumps, diversion ditches, temporary piping, silt removal, temporary bridges and rip-rap ramps, construction entrances/exits, cleanup and restoration. **Rip-rap and bank stabilization liner for creek crossings will be paid for separately under appropriate bid items.**
- 1.24 ANTI-SEEPAGE COLLAR (BID ITEM #24)
- A. Measurement: for each anti-seep collar provided.
 - B. Formwork and clay collar assembly where indicated on the Contract Drawings.

- 1.25 CONCRETE ENCASUREMENT FOR SANITARY SEWER PIPE AND CONNECTIONS AT MANHOLES (BID ITEM #25)
- A. Measurement shall be by the cubic yard of concrete encasement placed around the sewer pipe as indicated on the drawings. **Exceptions include concrete encasement for the 72-inch sewer installed as part of the Neuse River Crossings. This encasement work shall be included in the lump sum cost for the river crossings.**
 - B. Work: Excavation for encasement, formwork, and concrete.
- 1.26 POND FILL, RESTORATION AND SPILLWAY (BID ITEM #26)
- A. Measurement: for a single lump sum.
 - B. Work: shall include all labor, material, equipment and accessories required to dam the existing pond, restore the existing pond bank, and construct a permanent spillway across the permanent sewer easement. The Work shall include the coffer dams, isolation and diversion of flow, containment and removal of silt, installation of fill including clay layer, erosion control, stone, fabric, bypass pumping, sumps for bypass pumping, transporting of construction equipment and material across the work area, and cleanup and restore flow following installation of the utility line(s) and spillway, as detailed on the Drawings.
 - C. Payment: Payment will made for based on the percent completion of the lump sum total price as determined by review and acceptance by the Owner and in accordance with the Contractor's accepted schedule of values of the lump sum bid item.
- 1.27 ABANDONMENT OF EXISTING MANHOLE/STRUCTURE IN-PLACE (BID ITEM #27)
- A. Measurement: for each location indicated on the drawings and in accordance with the Contract Documents.
 - B. Work: shall include all labor, material, equipment, and accessories required to fully abandon the existing manhole or structure in place. This shall include removal of existing tops, backfill, grading, disposal of materials, cleanup, and restoration.
- 1.28 ABANDONMENT OF THE EXISTING RIVERVIEW PUMP STATION (BID ITEM #28a)
- A. Measurement: for a single lump sum.
 - B. Work: shall include all labor, material, equipment, and accessories required to abandon the existing Riverview Pump Station in accordance with the Drawings and Technical Specifications. The Work shall include all demolition work, earth work, removal and proper disposal of necessary liquids, material and equipment, hauling, disposal fees, coordination with the Owner, backfill and compaction, disconnection and termination of electrical power, erosion control, traffic control, restoration, and final cleanup.
 - C. Payment: Payment will made for based on the percent completion of the lump sum total price as determined by review and acceptance by the Owner and in accordance with the Contractor's accepted schedule of values of the lump sum bid item.
- 1.29 ABANDONMENT OF THE NEUSE RIVER LIFT STATION (BID ITEM #28b)
- A. Measurement: for a single lump sum.

- B. Work: shall include all labor, material, equipment and accessories required to abandon the existing Riverview Pump Station in accordance with the Drawings and Technical Specifications. The Work shall include all demolition work, earth work, removal and proper disposal of necessary liquids, material and equipment, hauling, disposal fees, coordination with the Owner, backfill and compaction, disconnection and termination of electrical power, erosion control, traffic control, restoration, and final cleanup.
 - C. Payment: Payment will be made for based on the percent completion of the lump sum total price as determined by review and acceptance by the Owner and in accordance with the Contractor's accepted schedule of values of the lump sum bid item.
- 1.30 EXISTING INVERTED SIPHON ABANDONMENT (BID ITEM #29)
- A. Measurement shall be by lump sum for the invert siphon being abandoned.
 - B. Work: shall include all labor, material, equipment and accessories required to abandon the existing inverted siphon in accordance with the Drawings and Technical Specifications. The Work shall include all demolition work, earth work, removal and proper disposal of necessary liquids, material and equipment, hauling, disposal fees, coordination with the Owner, backfill and compaction, cutting and plugging of pipes, restoration, and final cleanup.
- 1.31 DESIGNATED TEMPORARY CONSTRUCTION ACCESS ROADS (BID ITEM #30)
- A. Measurement: Measure by each location as indicated on the Bid Form and detailed on the Drawings. Payment shall include all labor, material, equipment, and accessories required to furnish, install, maintain, adjust, and remove all traffic control and construction access items. Payment shall also include preparation of detailed traffic control plans and schedules for review and approval by the Owner and Engineer and manual labor for traffic control operations.
 - B. Work: Furnishing, installing, maintaining, adjusting, removal and operations of signage, signals, erosion control, fencing, security gates, culvert pipes, stone, rip-rap, ramps, and temporary bridges.
 - C. Payment: The Contractor shall be paid 75% of the total unit price upon installation of the access road, including all erosion control and stormwater measures. The remaining 25% will be paid upon final use of the access road and prior to converting to a designated permanent access road where applicable.
- 1.32 DESIGNATED PERMANENT/FINAL ACCESS ROADS (BID ITEM #31)
- A. Measurement: for a lump sum at each location as indicated on the Bid Form and detailed on the Drawings. Payment shall include all labor, material, equipment, and accessories required to furnish, install, and adjust all traffic control and permanent access items. Payment shall also include preparation of detailed traffic control plans and schedules for review and approval by the Owner and Engineer and manual labor for traffic control operations.
 - B. Work: Furnishing, installing, maintaining, adjusting, removal and operations of signage, signals, erosion control, fencing, security gates, culvert pipes, stone, rip-rap, ramps, and temporary bridges.
 - C. Payment: The Contractor shall be paid the full unit price amount upon satisfactory completion of the access road and acceptance by the Owner for permanent use.

- 1.33 DESIGNATED TEMPORARY LAYDOWN AREAS (BID ITEM #32)
- A. Measurement: for a lump sum at each location as indicated on the Bid Form and detailed on the Drawings. Payment shall include all labor, material, equipment, and accessories required to furnish, install, maintain, adjust, and remove the laydown yard area.
 - B. Work: Furnishing, installing, maintaining, adjusting, removal and operations of signage, erosion control, fencing, security gates, culvert pipes, stone, rip-rap, and diversion ditches.
 - C. Payment: The Contractor shall be paid 75% of the total unit price upon installation of the laydown yard area, including all erosion control and stormwater measures. The remaining 25% will be paid upon final use of the laydown yard area and restoration of the area for transfer back to the property owner.
- 1.34 ANDERSON POINT PARK ACCESS AND TRAFFIC AND PEDESTRIAN CONTROL (BID ITEM #33)
- A. Measurement: Measure by the lump sum as indicated on the Bid Form and detailed on the Drawings.
 - B. Work: Furnishing, installing, maintaining, adjusting, and removal of all signage, flaggers, erosion control, asphalt, stone, and piping.
- 1.35 GREENWAY (PEDESTRIAN) CONTROL AND CLOSURES AT POOLE ROAD (BID ITEM #34)
- A. Measurement: Measure by the lump sum as indicated on the Bid Form and detailed on the Drawings.
 - B. Work: Furnishing, installing, maintaining, adjusting, and removal of all signage, erosion control, asphalt, stone, and piping.
- 1.36 TRENCH RESTORATION IN ASPHALT ROADWAY (BID ITEM #35)
- A. Measurement: by the square yard as follows for the various types and depth of material installed.
 - 1. Up to a maximum width of 10 feet centered over the sewer main.
 - 2. Up to a maximum width of 10 feet centered from manhole.
 - B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 - 1. Saw cutting to required offsets, excavation, removal and disposal of excess material, producing, transporting, placing and compacting, grading, furnishing material, furnishing and applying tack coat, maintaining each course, cleanup, treatments, pavement markings, adjustments to manholes, valves, inlet structures and all obstructions and making any repairs or corrections to the material that may become necessary.
 - 2. Compliance with NCDOT Standards.
 - C. Payment
 - 1. Payment shall not be made for repair of the trench or pavement required due to excessive open cut excavation or blasting caused by the Contractor, beyond the maximum widths specified. Loss of material due to inadequate backfill compaction shall be replaced at no additional cost to the Owner.

1.37 TRENCH RESTORATION IN ASPHALT DRIVEWAY AND PARKING LOT
(BID ITEM #36)

- A. Measurement: by the square yard as follows for the various types and depth of material installed.
 - 1. Up to a maximum width of 10 feet centered over the sewer main.
 - 2. Up to a maximum width of 10 feet centered from manhole.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 - 1. Saw cutting to required offsets; excavation; removal and disposal of excess material, producing, transporting, placing and compacting, grading, furnishing material, maintaining each course, cleanup, treatments, adjustments to manholes, valves, inlet structures and all obstructions and making any repairs or corrections to the material that may become necessary.
 - 2. Compliance with NCDOT Standards.
- C. Payment:
 - 1. Payment shall not be made for repair of the trench or pavement required due to excessive open cut excavation or blasting caused by the Contractor, beyond the maximum widths specified. Loss of material due to inadequate backfill compaction shall be replaced at no additional cost to the Owner.

1.38 ASPHALT REMOVAL AND REPLACEMENT – GREENWAY 6" ABC AND 2" ASPHALT
(BID ITEM #37)

- A. Measurement: by the square yard, as indicated by the Owner.
- B. Work shall include, but not limited to the following:
 - 1. Saw cutting, excavation, removal and disposal of excavated material, producing, furnishing, transporting, placing and compacting stone, grading, furnishing and applying asphalt, maintaining each course, and cleanup.
 - 2. Compliance with details in Drawings and meeting City of Raleigh Parks and Recreation Departments installation requirements.
- C. Payment: Payment will be made once the specified replacement section is complete, ready for service and approved by Owner.

1.39 GRAVEL DRIVEWAY REPAIR (BID ITEM #38)

- A. Measurement: Measure by the square yard along centerline times the pipe OD plus four (4) feet of stone placed and compacted to a depth of 6 inches. Loss of material due to inadequate backfill compaction shall be replaced at no additional cost. Engineer shall approve location and dimension of repair area to be used prior to placement. Payment shall not be made for pavement repair required due to excessive open cut caused by Contractor.
- B. Work: Stone, hauling, placement, and compacting.

- 1.40 TEMPORARY CONSTRUCTION ENTRANCE (BID ITEM #39)
 - A. Measurement: Measure by each location installed per the details and drawings.
 - B. Work: Grading; placing, maintaining and removal of stone; cleanup and restoration.
- 1.41 SILT FENCE (BID ITEM #40)
 - A. Measurement: Measure by the linear foot along the base of the silt fence installed.
 - B. Work: Posts, wire mesh, fabric, base trench, stone, and maintenance during construction, removal and clean up.
- 1.42 SUPER SILT FENCE (BID ITEM #41)
 - A. Measurement: Measure by the linear foot along the base of the super silt fence installed.
 - B. Work: Posts, wire mesh, fabric, base trench, stone, and maintenance during construction, removal and clean up.
- 1.43 COMBINATION SILT/TREE PROTECTION FENCING (BID ITEM #42)
 - A. Measurement: Measure by the linear foot along the base of the combination fence installed.

Work: Posts, signage, wire mesh, fabric, base trench, stone, and maintenance during construction, removal and clean up.
- 1.44 TREE PROTECTION FENCING (BID ITEM #43)
 - A. Measurement: Measure by the linear foot along the base of the tree protection fencing furnished and installed.
 - B. Work: Posts, fabric, signs, maintenance during construction, removal, and cleanup.
- 1.45 STONE RELIEF OUTLET (BID ITEM #44)
 - A. Measurement shall be for each installed per the details and locations shown on the drawings.
 - B. Work: Excavation, grading, fabric, stone, wire mesh, maintenance, removal and backfill, and cleanup and restoration.
- 1.46 ROCK CHECK DAM (BID ITEM #45)
 - A. Measurement shall be for each installed per the details and locations shown and noted on the drawings.
 - B. Work: Excavation, grading, fabric, stone, maintenance, removal and backfill, and cleanup and restoration.
- 1.47 CLEAN WATER DIVERSION DITCH (BID ITEM #46)
 - A. Measurement: Measure by the linear foot along the centerline of the ditch installed.
 - B. Work: Excavation, grading, lining, maintenance, removal and backfill, seeding, and cleanup.
- 1.48 SEDIMENT TRENCH (BID ITEM #47)
 - A. Measurement: Measure by the linear foot along the centerline of the trench installed.
 - B. Work: Excavation, grading, lining, spillways, maintenance, removal and backfill, seeding, and cleanup.

- 1.49 TEMPORARY SLOPE DRAIN AND DISSIPATOR PAD (BID ITEM #48)
- A. Measurement shall be for each slope drain and associated dissipator pad installed in accordance with the details and at the locations shown on the drawings.
 - B. Work: Excavation, grading, pipe, restraints/stakes, stone, matting, seeding, mulch, maintenance, replacement, removal, cleanup and restoration.
- 1.50 PIPE OUTLET PROTECTION (BID ITEM #49)
- A. Measurement shall be for each, no matter the stone size or overall dimensions, outlet protection location per the details and locations in the drawings.
 - B. Work: Excavation, grading, filter fabric under stone, stone, hauling, placement, maintenance, replacement, removal, cleanup, and restoration.
- 1.51 INLET PROTECTION (BID ITEM #50)
- A. Measurement shall be for each, no matter the stone size or overall dimensions, inlet protection location per the details and locations in the drawings.
 - B. Work: Excavation, grading, filter fabric under stone, stone, hauling, placement, maintenance, replacement, removal, cleanup, and restoration.
- 1.52 CLASS "X" RIP RAP (BID ITEM #51)
- A. Measurement shall be the length and width of rip rap actually installed.
 - B. Payment for rip rap shall be in accordance with the Contract unit price per square yard for the rip rap furnished and installed as required by the Contract Documents. Payment shall be for all the labor, material and accessories required for a complete installation including, but not be limited to, the cost of fine grading, bedding stone, and rip rap.
 - C. Work: Excavation, grading, filter fabric under stone, stone, hauling, placement, maintenance, replacement, removal, cleanup, and restoration.
- 1.53 DITCH LINER AND STABILIZATION MATTING (BID ITEM #52)
- A. Measurement: Measure by the square yard of the liner installed for each type of liner/matting as indicated in the Bid Form. The area shall be measured based on the average width x average length for the liner/matting actually installed.
 - B. Payment for the ditch liner shall be in accordance with the Contract unit price per square yard of liner installed. Payment shall be for the labor, material and accessories required for a complete installation including, but not limited to, fine grading of ditch, liner material, liner anchors, and maintenance during construction.
- 1.54 UNDERCUT PIPE TRENCH AND REPLACE WITH NO. 67 STONE FOR PIPE FOUNDATION (BID ITEM #53)
- A. Measurement: by the cubic yard as follows, as directed by Engineer:
 - 1. Pipes: Linear feet along the centerline of the trench, times the undercut depth below the pipe bedding as approved by Engineer, times the pipe bell OD plus four (4) feet.
 - 2. Manholes: The maximum basis is 1-foot greater diameter than the outside diameter of the manhole (excluding extended base) and a depth as approved by the Engineer.

3. Measurement shall be based on the actual quantities removed, but not exceeding the maximum specified trench dimensions.
 4. Take measurements in the presence of the Engineer.
 5. Maintain daily log sheets of measured quantities.
 6. Log sheets must be signed by Engineer and submitted with payment request.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. Complete removal and disposal of unstable soil including, but not limited to, excavating, stockpiling, loading, hauling, properly disposing of excavated material and No. 67 stone.
- C. Payment:
1. Payment shall not be made for quantities that have not been field verified by the Engineer.
- 1.55 REMOVAL OF UNSUITABLE MATERIAL EXCAVATION AND BACKFILL WITH SELECT MATERIAL (BID ITEM #54)
- A. Measurement: by the cubic yard as follows, as directed by Engineer:
1. Pipes: Linear feet along the centerline of the trench, times the depth removed as approved by Engineer, times the pipe bell OD plus four (4) feet.
 2. Manholes: The maximum basis is 1-foot greater diameter than the outside diameter of the manhole (excluding extended base) and a depth as approved by the Engineer.
 3. Measurement shall be based on the actual quantities removed, but not exceeding the maximum specified trench dimensions.
 4. Take measurements in the presence of the Engineer.
 5. Maintain daily log sheets of measured quantities.
 6. Log sheets must be signed by Engineer and submitted with payment request.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. Complete removal of unstable soil including, but not limited to, excavating, stockpiling, loading, hauling of excavated material, stockpiling on plastic sheeting at location shown on the Drawings, furnishing and installing the straw bales for the berm around the stockpile area, and covering of the stockpile material.
- C. Payment:
1. Payment shall not be made for quantities that have not been field verified by the Engineer.
 2. This pay item applies to material above the pipe bedding zone.
- 1.56 ROCK EXCAVATION BY BLASTING (BID ITEM #55)
- A. Measurement: by the cubic yard as follows:

1. Pipe: Measure along the centerline of the trench, times the depth from the top of rock profile to the bottom of the rock profile or specified depth below the pipe (whichever is encountered first), times the pipe bell OD plus four (4) feet.
 2. Structure: Measure two (2) feet beyond the outside wall of the structure (excluding extended base) and for a depth from the top of rock profile to the bottom of the rock profile or for one foot below bottom of structure (whichever is encountered first).
 3. Take measurements in the presence of the Engineer.
 4. Maintain daily log sheets of measured quantities.
 5. Log sheets must be signed by the Engineer and submitted with payment request.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. Complete removal and disposal of excavated rock material including, but not limited to, drilling, blasting, monitoring, excavating, loading, hauling, and properly disposing of excavated material.
 2. Providing specified material for backfilling shall include, but not be limited to, material, bedding material, loading, hauling, placing and compacting.
- C. Payment: Payment shall not be made for quantities that have not been field verified by the Engineer.

1.57 ROCK EXCAVATION MECHANICAL METHODS (BID ITEM #56)

- A. Measurement: by the cubic yard as follows:
1. Pipe: Measure along the centerline of the trench, times the depth from the top of rock profile to the bottom of the rock profile or specified depth below the pipe (whichever is encountered first), times the pipe bell OD plus four (4) feet.
 2. Structure: Measure two (2) feet beyond the outside wall of the structure (excluding extended base) and for a depth from the top of rock profile to the bottom of the rock profile or for one foot below bottom of structure (whichever is encountered first).
 3. Take measurements in the presence of the Engineer.
 4. Maintain daily log sheets of measured quantities.
 5. Log sheets must be signed by the Engineer and submitted with payment request.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
3. Complete removal and disposal of excavated rock material including, but not limited to, drilling, monitoring, excavating, loading, hauling, and properly disposing of excavated material.
 4. Providing specified material for backfilling shall include, but not be limited to, material, bedding material, loading, hauling, placing and compacting.
- C. Mechanical rock excavation shall be as described above with the exception of the blasting. Mechanical rock excavation shall only be paid for separately if it is the only means allowed for excavation due to restrictions against blasting. Restrictions may be due to location of adjacent utilities or other infrastructure, other factors described in the Contract Documents, or as determined by the Owner during construction. If

the Contractor chooses to utilize mechanical excavation as a means for rock removal where blasting is allowed, the Contractor will not be paid for the rock excavation under the bid item for Rock Excavation by Blasting.

- D. Payment: Payment shall not be made for quantities that have not been field verified by the Engineer.

1.58 TOPSOIL (BID ITEM #57)

- A. Measurement: By the square yard of topsoil placed, using a depth of 4" per square yard.
- B. Work: Hauling and placing of topsoil used for ground cover to help establish seed, brought from borrow site.

1.59 TEMPORARY SEWER BYPASS PUMPING (BID ITEM #58)

- A. Measurement: Bypass Pumping shall be a single lump sum price.
- B. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 - 1. Design, labor, materials, equipment, mobilization, demobilization, set up, testing, monitoring, fuel, oil, maintenance, diversion blocking/isolation, scour protection, permitting, cleanup, pumping systems, plugs, valves and piping required for diverting wastewater flow around the proposed work as defined in the Contract Documents.
- C. Payment:
 - 1. Any fines associated with sewer overflows, spills, or backups resulting from the wastewater diversion shall be paid for by the Contractor.

1.60 CLEANUP AND SEEDING ALONG UTILITY PIPELINES (BID ITEM #59)

- A. Measurement: Along pipe centerline.
- B. Work: Shall include the full width of the disturbed area for the cleanup and seeding along pipeline construction. Work shall include, but not be limited to, the following:
 - 1. Removal and proper disposal of debris and excess material.
 - 2. Grade disturbed areas to original surface profile prior to trench excavation.
 - 3. Cleaning of paved surfaces.
 - 4. Proper seeding of disturbed area including mulching.
 - 5. Obtain approval of cleanup from owner of right-of-way.
 - 6. Soil amendments (fertilizer/lime).

Total Contract Price of cleanup and seeding **must be equal to a minimum of ten (10) percent** of the total cost of pipeline work

1.61 TEMPORARY CONSTRUCTION BARRIER/SECURITY FENCING (BID ITEM #60)

- A. Measurement: Measure by linear feet along the centerline of the fencing installed. Payment shall include all labor, material, equipment and accessories to furnish, install, maintain, and remove.
- B. Work: Placement, supporting, and securing, maintaining, and removing.
- C. Payment: The fencing shall be located at the direction of the Owner and payment shall not be made unless the fencing is above by the Owner prior to installation.

1.62 ALLOWANCE FOR 3RD PARTY MATERIALS TESTING AND VIBRATION MONITORING (BID ITEM #61)

- A. Measurement shall not be made for this item.
- B. An allowance has been established for testing (i.e., soil compaction testing and vibration monitoring above normal monitoring by Contractor) as required in these contract documents. Allowance has also been established to defer selection of actual services to a later date when additional information is available for evaluation. This allowance shall only be utilized upon request by the Owner for these testing/monitoring services.
- C. Prior to testing, Contractor shall submit the contract between the testing firm and Contractor to the Owner for approval. Where services are requested by Owner, Contractor shall submit invoices to show actual cost of services for use in fulfillment of allowance.
- D. Payment for allowance shall be for actual invoices for third party services plus up to 5 percent of cost of the services as compensation for coordination of the work.

1.63 LOADING, TRANSPORT AND DISPOSAL OF NON-HAZARDOUS PETROLEUM CONTAMINATED TRENCH EXCAVATION MATERIALS (BID ITEM #64)

- A. This pay item applies to Section 02201- Special Construction Requirements only.
- B. Measurement shall be by the ton.
 - 1. Quantity of stockpiled non-hazardous contaminated material from above the groundwater table will be the actual number of tons of petroleum hydrocarbon non-hazardous contaminated material removed from the trench excavation and transported to the disposal facility.
 - 2. Measurement shall be made based upon the certified weight tabulation for each truckload of trench excavated material delivered to the disposal facility as authorized by OWNER in consultation with third party environmental consultant. A certified weigh ticket showing the gross, net and tare weight for each truck is required.
 - 3. Maintain daily log sheets of no. of trucks authorized for delivery to offsite disposal facility, along with signed manifests for each truck by third party environmental consultant, etc.
 - 4. Maintain daily field record of all field monitoring and field UVF based analytical monitoring results.
 - 5. Log sheets, certified weigh tickets, manifests and field records must be signed by Engineer and submitted with payment request.
- C. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 - 1. All labor, material and equipment associated with loading, hauling and disposing of non-hazardous contaminated materials excavated from the

trench at landfills specified in Section 02201- Special Construction Requirements.

2. Disposal to a NC DENR approved facility.

D. Payment:

1. Characterize the material prior to disposal to satisfy disposal facility permit requirements.

1.64 STOCKPILING OF NON-HAZARDOUS CONTAMINATED TRENCH EXCAVATION MATERIALS (BID ITEM NO. #62)

A. This pay item applies to Section 02201- Special Construction Requirements only.

B. Measurement shall be by the cubic yard.

1. Quantity of stockpiled non-hazardous contaminated material will be the actual number of cubic yard of non-hazardous contaminated material removed from the trench excavation and transported to a stockpile.

2. Measurement shall be made based upon the average length, width and height of the stockpile.

3. Take measurements in the presence of the Engineer.

4. Maintain daily log sheets of measured quantities.

5. Log sheets must be signed by Engineer and submitted with payment request,

C. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:

1. All labor, material and equipment associated with loading, hauling and placement of non-hazardous contaminated materials excavated from the trench in a stockpile within the temporary construction easement as specified in Section 02201- Special Construction Requirements.

D. Payment:

1. Characterize the material prior to disposal to satisfy disposal facility permit requirements.

1.65 COMPLIANCE WITH HEALTH AND SAFETY PLAN (BID ITEM #63)

A. This pay item applies to Section 02201- Special Construction Requirements only.

B. Measurement shall be lump sum.

C. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:

1. Preparation and execution of the Site-Specific Safety and Health Plan and shall include the cost associated with installing the new sewer pipe in full accordance with the Site-Specific Safety and Health Plan over and above that of earth excavation and trenching in other areas of the project absent of the conditions requiring the Plan.
- D. Where services are requested by Owner or required to meet Contract requirements, Contractor shall submit invoices to show actual cost of services for use in fulfillment of allowance.
- E. Payment:
1. Payment will be made for actual invoices from third party testing firm plus 5 percent of cost of the services as compensation for coordination of the work.
- 1.66 LOADING, TRANSPORT AND DISPOSAL OF STOCKPILED NON-HAZARDOUS PETROLEUM CONTAMINATED MATERIALS BY DIRECT LOAD & HAUL FROM TRENCH EXCAVATION (BID ITEM #64)
- A. This pay item applies to Section 02201- Special Construction Requirements only.
- B. Measurement shall be by the ton.
1. Quantity of non-hazardous contaminated material will be the actual number of tons of non-hazardous contaminated material removed from the trench excavation and directly transported to waste facility.
 2. Measurement shall be made based upon the certified weight tabulation for each truckload of trench excavated material, plastic and haybales delivered to the waste facility as authorized by OWNER in consultation with third party environmental consultant. A certified weigh ticket showing the gross, net and tare weight for each truck is required.
 3. Maintain daily log sheets of no. of trucks authorized for delivery to waste facility, along with signed manifests for each truck by third party environmental consultant, etc.
 4. Maintain daily field record of all field monitoring and field UVF based analytical monitoring results.
 5. Log sheets, certified weigh tickets, manifests and field records must be signed by Engineer and submitted with payment request.
- C. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. All labor, material and equipment associated with loading, hauling and disposing of non-hazardous contaminated materials excavated from the trench at waste facility specified in Section 02201- Special Construction Requirements.

D. Payment:

1. Payment will be made for actual invoices from environmental contractor plus 5 percent of the cost of the services as compensation for coordination of this work.
2. Characterize the material prior to disposal to satisfy disposal facility permit requirements.

1.67 LOADING, TRANSPORT AND DISPOSAL OF STOCKPILED NON-HAZARDOUS NON-PETROLEUM CONTAMINATED TRENCH EXCAVATION MATERIALS AT SUBTITLE D LANDFILL (BID ITEM #65)

A. This pay item applies to Section 02201- Special Construction Requirements only.

B. Measurement shall be by the ton.

1. Quantity of stockpiled non-hazardous contaminated material will be the actual number of tons of non-hazardous contaminated material removed from the trench excavation and transported to the Subtitle D Landfill.
2. Measurement shall be made based upon the certified weight tabulation for each truckload of trench excavated material, plastic and haybales delivered to the Subtitle D Landfill as authorized by OWNER in consultation with third party environmental consultant. A certified weigh ticket showing the gross, net and tare weight for each truck is required.
3. Maintain daily log sheets of no. of trucks authorized for delivery to Subtitle D Landfill, along with signed manifests for each truck by third party environmental consultant, etc.
4. Maintain daily field record of all field monitoring and field UVF based analytical monitoring results.
5. Log sheets, certified weigh tickets, manifests and field records must be signed by Engineer and submitted with payment request.

C. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:

1. All labor, material and equipment associated with loading, hauling and disposing of stockpiled non-hazardous contaminated materials excavated from the trench at Subtitle D Landfill specified in Section 02201-Special Construction Requirements.

D. Payment:

1. Payment will be made for actual invoices from environmental contractor plus 5 percent of the cost of the services as compensation for coordination of this work.

2. Characterize the material prior to disposal to satisfy disposal facility permit requirements.

1.68 ALLOWANCE FOR THIRD PARTY ENVIRONMENTAL CONSULTANT MONITORING & ANALYTICAL TESTING (BID ITEM #66)

- A. This pay item applies to Section 02201- Special Construction Requirements only.
- B. Measurement shall be by allowance for actual cost plus 5%.
- C. An allowance has been established for third party environmental consultant monitoring and analytical testing services.
- D. Prior to testing, submit the contract with testing firm to the Owner for approval.
- E. Payment:
 1. Payment will be made for actual invoices from third party Environmental Consulting Firm plus 5 percent of the cost of the services as compensation for coordination of this work.
- F. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
 1. Field observation of trench excavation and trench dewatering by Environmental Consultant working under the direction of a Professional Engineer or Professional Geologist.
 2. Field screening of trench excavation materials using field instrumentation called out in specifications;
 3. Sampling and analytical testing of trench excavation materials and trench dewatering effluent using field UVF based laboratory methods called out in specifications;
 4. Sampling and analytical testing of trench excavation materials and trench dewatering effluent using laboratory methods called out in specifications;
 5. Completion of brief summary reports for OWNER, CONTRACTOR, ENGINEER and disposal facility contacts summarizing results of field monitoring, field screening, laboratory results, etc.

1.69 PRETREATMENT OF CONTAINERIZED TRENCH DEWATERING EFFLUENT PRIOR TO DISCHARGE TO THE SANITARY SEWER (BID ITEM #67)

- A. This pay item applies to Section 02201- Special Construction Requirements only.
- B. Measurement shall be:
 1. Lump sum for Pretreatment Design.

2. By allowance for actual cost plus 5% for system operation prior to treatment.
 3. By allowance for actual cost plus 5% for setup and tear down.
- C. An allowance has been established for the pretreatment services.
- D. Prior to conducting any work, submit the contract with the pretreatment vendor/contractor to the Owner for approval
- E. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. All labor, material and equipment associated with design, fabrication, delivery, installation, operation and maintenance of pretreatment equipment to reduce contaminant concentrations prior to discharge of trench dewatering effluent to the sanitary sewer as specified in Section 02201- Special Construction Requirements.
- F. Payment:
1. Discharge to sanitary sewer must be coordinated and approved by OWNER.
 2. Daily flow measurements and all monitoring data requested by OWNER shall be provided with payment request.
 3. Lump sum payment will be made for design of trench dewatering pretreatment system.
 4. Payment for set up and tear down of dewatering effluent pretreatment equipment will be made for actual invoices from environmental contractor plus 5 percent of the cost of the services as compensation for coordination of this work.
 5. Payment for weekly operation of dewatering effluent pretreatment equipment will be made for actual invoices from environmental contractor plus 5 percent of the cost of the services as compensation for coordination of this work.
- 1.70 CONTAINERIZATION, SAMPLING AND SANITARY SEWER DISCHARGE OF TRENCH DEWATERING EFFLUENT (BID ITEM #68)
- A. This pay item applies to Section 02201- Special Construction Requirements only.
- B. Measurement shall be lump sum.
- C. Work shall include, but not be limited to (unless specifically noted otherwise on the Bid Form and this specification Section), the following:
1. All labor, material and equipment associated with permitting, containerization, sampling, laboratory analyses and reporting, for

discharge of trench dewatering effluent to the sanitary sewer as specified in Section 02201- Special Construction Requirements.

D. Payment:

1. Discharge to sanitary sewer must be coordinated and approved by OWNER.
2. Daily flow measurements and all monitoring data requested by OWNER shall be provided with payment request.
3. Lump sum payment will be made for application and negotiation of discharge permit.
4. Payment for set up and tear down of dewatering effluent storage and discharge equipment will be made for actual invoices from environmental contractor plus 5 percent of the cost of the services as compensation for coordination of this work.
5. Payment for weekly operation of dewatering effluent storage and discharge equipment will be made for actual invoices from environmental contractor plus 5 percent of the cost of the services as compensation for coordination of this work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01314
PROJECT MEETINGS

PART 1 GENERAL

1.01 MEETINGS

- A. Pre-construction conference shall be held prior to the beginning of the Work.
- B. Construction progress meetings shall be held monthly.
- C. Project close-out conference shall be held during the final phases of the Work.
- D. Engineer may schedule additional meetings.
- E. Meetings scheduled by the Engineer shall be held at the City of Raleigh or at the project site as set forth in the Pre-construction meeting.
- F. Contractor's project superintendent shall attend meetings.
- G. Notify suppliers and subcontractors to attend meetings as appropriate or as required by Engineer.
- H. Contractor shall schedule pre-installation conferences and material testing meetings as required in the individual specification sections.
- I. Notify Engineer of project meetings scheduled by the Contractor.
- J. Engineer will schedule and administer meetings throughout the progress of the Work, except for meetings held by the Contractor for normal coordination of the Work.
- K. Meeting agenda shall include, but not be limited to, the following: Project Administration, Submittals, Construction Schedules and Methods, Safety and Health Regulations, Project Coordination, Payment Application, Change Orders, and Site Inspections.
- L. Engineer will prepare agenda with copies to participants, preside at meetings, prepare minutes and distribute to participants for meetings scheduled by the Engineer.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01320

VIDEO AND PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.01 PRECONSTRUCTION VIDEO

- A. The Contractor shall engage a videographer to furnish color video recording, with audio, of the Project Site. The recording shall be performed by a qualified videography firm with prior experience in similar preconstruction video recordings. Prior to commencing construction activity at the Site, the Contractor shall accompany the Owner and the Engineer on a tour of the Site. On such tour, a high resolution digital recording shall be taken by the videographer. Video will include the entire area contained within the permanent and temporary easements plus 50 feet outside these easement boundaries. Video shall include, but not be limited to, all existing driveways, sidewalks, curbs, ditches, roadways, landscaping, trees, culverts, headwalls, and retaining walls, equipment, structures, pavements, manholes, vaults, handrails, etc. located within the defined boundaries. Video coverage shall extend to the maximum height of all structures within this zone.
- B. At the conclusion of the video the Contractor shall acknowledge on the video that, as of that time, the video is a complete and accurate record of the existing conditions within the defined boundaries.
- C. The Contractor shall provide two (2) copies of the video on DVDs to the Engineer prior to commencing work on the Project. The copies for the Engineer shall be a condition precedent to any obligation of the Owner to consider an Application for Payment.
- D. Engineer reserves the right to reject any recording because of poor quality, unintelligible audio or uncontrolled pan or zoom. Any recording rejected by Engineer shall be rerecorded at no cost to the Owner.
- E. All such video shall become the property of the Owner, and the Owner shall be permitted to reproduce such videotapes or DVDs and use the same for any purpose without limitation or claim of ownership or compensation from any party.

1.02 CONSTRUCTION PHOTOGRAPHS

- A. The Contractor shall engage a competent photographer to take color digital photographs at the locations and at such stages of the construction as directed by the Engineer.
- B. Preconstruction photographs – The Contractor shall submit a minimum of one photograph per one hundred feet of pipe alignment to document the existing condition of the project site. These photographs shall be taken prior to any land disturbing activities.

- C. Progress photographs – The Contractor shall provide, with each application for payment, a minimum of six (6) different photographs per day for the duration of construction activity. Photographs shall show various work items performed each day. Engineer may waive requirements for photographs during inactive construction periods.
- D. Project completion photographs. The Contractor shall submit a minimum of one photograph per one hundred feet of pipe alignment to document the final condition of the project site. These photographs should be taken at the same approximate location as the preconstruction photographs.
- E. Photographs shall be taken during time of day with adequate natural light such that a flash is not necessary and the photographs should be taken during favorable weather conditions.
- F. Submittal Requirements
 - 1. Photographs shall be submitted on compact disc or DVD in JPEG format. Photographs shall be minimum 5.0 megapixels and shall include a date stamp on the image showing the date and time the photograph was taken.
 - 2. The Engineer shall select two photographs for enlargement from each monthly series of photographs submitted under this Section. The Contractor shall furnish two (2) 8x10 color prints of each photograph.
 - 3. All enlargements shall have date, photographer's identification and description of subject permanently affixed to the back of the print.
 - 4. At completion of the work, all photography files shall be turned over to the Owner in CD or DVD format, on a thumb drive, or by electronic internet/email submittal. If used, discs shall be bound in specifically designed holders and identified as to date of exposure and subject matter.
- G. All photographs, whether submitted as prints or digitally, shall be accompanied by a photo log indicating the date and the location of the photograph referenced by the approximate Station Number or similar identifier.
- H. All such photographic records shall become the property of the Owner, and the Owner shall be permitted to reproduce such photographic records and use the same for any purpose without limitation or claim of ownership or compensation from any party.

PART 2 – PRODUCTS

PART 3 – EXECUTION

- 3.01 The Contractor shall coordinate access to the project site with the Owner prior to beginning of construction and receive permission to commence pre-construction videography.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes, but is not limited to, requirements for the following:
 - 1. Submittal procedures.
 - 2. Construction progress schedule.
 - 3. Schedule of values.
 - 4. Video and Photographic Inspection.
 - 5. Project record documents.
 - 6. Certificates of compliance.
 - 7. Catalog data.
 - 8. Shop drawings.
 - 9. Manufacturer's installation procedures.
 - 10. Samples.
 - 11. Testing and startup reports.
 - 12. Operation and maintenance instructions.
 - 13. Warranties.
 - 14. Spare parts and maintenance materials.
 - 15. Soil compaction testing and blast related testing results.

1.02 SUBMITTAL PROCEDURES

- A. Transmit each submittal with cover letter to Owner at City of Raleigh-Raleigh Water, One Exchange Plaza, Suite 620, Raleigh, NC 27602.
- B. Sequentially number transmittal forms. Re-submittals to have original number with an alphabetic suffix.
- C. Cover letter for each submittal package shall list the following:
 - 1. Contractors name:
 - 2. Owners name: City of Raleigh – Raleigh Water
 - 3. Project name:
 - 4. Engineer Job No.:
- D. Individual submittals shall each be listed by the following information:
 - 1. Submittal reference no.
 - 2. Specification section number.
 - 3. Drawing and detail number when appropriate.
 - 4. Equipment.
 - 5. Type submittal.
 - 6. Supplier.
 - 7. Manufacturer.
- E. Apply Contractor's stamp to each submittal, signed or initialed and dated, certifying that Contractor has reviewed submittal for conformance with requirements of Contract Documents, and has coordinated submittal with related work.
- F. Schedule submittals to expedite Project, and deliver to coordinate submission of related items. Allow a minimum of fifteen (15) working days for Owner/Engineer's review.

- G. Identify variations from Contract Documents and Product limitations as they relate to the satisfactory performance of the Project.
- H. Provide space for Contractor and Engineer review stamps.
- I. Revise and resubmit submittals as required; identify changes made since previous submittal.
- J. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report inability to comply with provisions.
- K. Work requiring submittal review by Engineer shall not be started until review has been obtained.
- L. Engineer's review of submittals shall not relieve Contractor of responsibility for complete compliance with Contract Documents.

1.03 ADMINISTRATIVE SUBMITTALS

- A. Construction Progress Schedule
 - 1. Submit four (4) copies of the initial progress schedule 15 days after date of Owner-Contractor Agreement. One copy shall be returned to the Contractor.
 - 2. Progress schedule shall be, as a minimum, a horizontal bar chart with a separate line for each major section of Work. Identify the first work day of each week.
 - 3. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
 - 4. Indicate the expected monthly pay requests.
 - 5. Submit revised schedule with each Application for Payment as required for updating, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission.
 - 6. Indicate submittal dates required for critical shop drawings, product data, samples, and product delivery dates
 - 7. Indicate specific work sequences and requirements as indicated in Section, Summary of Work.
- B. Schedule of Values (lump sum contracts only)
 - 1. Submit three (3) copies of the schedule of values at least three (3) weeks prior to the first partial payment request. Schedule shall divide the lump sum contract items into major work tasks. Use the table of contents as a guide for itemizing the schedule. Schedule will be used only as a basis for review of the Contractor's request for payment.
 - 2. Engineer may request additional delineation of work tasks and supporting data of the values, as he deems appropriate. Revise schedule and resubmit.
 - 3. Revise schedule to list approved Change Orders, with each request for payment.
- C. Video and Photographic Inspection
 - 1. Execution of all Video and Photographic Inspections shall be conducted in accordance with Section 01320-Video and Photographic Inspections.
 - 2. Conduct video and photographic inspection of the pre-construction conditions and post-construction conditions for the entire project area.
 - 3. Submit two (2) copies of all video and photographic inspection. Pre-construction inspections shall be submitted prior to beginning work and post-construction inspections shall be submitted with final Application for Payment.

- D. Project Record Documents
 - 1. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - a. Contract Drawings.
 - b. Project Manual.
 - c. Addenda.
 - d. Change Orders and other Modifications to the Contract.
 - e. Reviewed submittals.
 - 2. Store Record Documents separate from documents used for construction.
 - 3. Record information concurrent with construction progress.
 - 4. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 - a. Manufacturer's name and product model and number.
 - b. Product substitutions or alternates utilized.
 - c. Changes made by Addenda and Modifications.
 - 5. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
 - a. Measure elevations of structures in relation to bench mark datum.
 - b. Measure and reference horizontal and vertical locations of underground utilities and appurtenances to existing permanent surface improvements that are indicated on the Drawings.
 - 1) Provide top, invert, diameter and depth information on manholes.
 - c. Indicate on construction Drawings the pipe size, pipe material (including pipe class) and pipe length.
 - d. Field changes from construction Drawings.
 - e. Details not on original Contract Drawings.
 - f. Data on all utilities in the trench zone.
 - 6. Submit documents to City with final Application for Payment.

1.04 TECHNICAL SUBMITTALS

- A. General
 - 1. Submit the following as required by the individual sections of the technical specifications.
 - 2. Unless noted otherwise, submit the number of copies that Contractor requires, plus three (3) copies that will be retained by Engineer.
- B. Certificates of Compliance
 - 1. Certificates shall certify that the Products delivered to the project are in conformance with the specifications.
 - 2. Certificates may be recent or previous test results on Product, but must be acceptable to Engineer.
 - 3. Certification shall not relieve the Contractor of responsibility for complying with requirements of the specifications.
- C. Catalog Data
 - 1. When shop drawings are not required, the catalog data shall include the following as a minimum:
 - a. Parts schedule that identifies the materials to be used in each of the various parts.
 - b. Sufficient detail to serve as a guide for assembly and disassembly of the product and to serve as guide for ordering parts.

2. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Work in the Shop Drawing submittal.
- D. Shop Drawing
1. Shop drawings shall consist of drawings, diagrams, illustrations, schedules, performance charts, brochures and other data, prepared specifically for a portion of the Work.
 2. Shop drawings shall indicate the type, size, quantity, arrangement, location, mode of operation, component materials, utility connections, wiring and control diagrams, anchorage's, supports, factory applied coatings, and other information necessary to ensure satisfactory fabrication, installation and operation of the completed Work.
 3. Shop drawings shall establish the actual detail of manufactured or fabricated items, indicate proper relation to adjoining work, amplify design details of mechanical and electrical equipment in proper relation to physical spaces in the structure, and incorporate minor changes to design and construction to suit actual requirements.
- E. Manufacturer's Installation Procedures
1. Installation procedures should indicate manufacturer's recommendations for proper installation of Product.
- F. Test and Start-Up Reports
1. Submit three (3) copies of report to the Engineer within seven (7) days of performing the test.
 2. Report shall include the following as a minimum:
 - a. Owners name: City of Raleigh
 - b. Project name:
 - c. Engineer job number:
 - d. Firm performing work.
 - e. Individual performing work.
 - f. Specification section no.:
 - g. Product tested or started.
 - h. Date and time of work.
 - i. Type of test or start-up.
 - j. Specific location in the Project: (i.e. Structure name and location within the structure by a rough sketch.)
 - k. Results.
 - l. Opinion of firm doing the work as to the test or start-up being in compliance with the Contract Documents.
 3. When requested by Engineer, the testing or start-up firm shall provide additional interpretation of results.
- G. Samples
1. Submit samples as required by the individual specification sections. Samples shall be physical examples to illustrate the materials and workmanship. Submit in sufficient size and quantity to clearly illustrate the functional characteristics of the Product, with integrally related parts and attachment devices, and the full range of color to be provided.
- H. Operation and Maintenance Instructions
1. Submit three (3) copies of operation and maintenance instructions within 45 days after approval of the shop drawings.

2. Submit instructions in a navy blue vinyl, loose leaf binder containing the name of the equipment covered on the front and the spine of the binder. Provide tab dividers appropriately labeled.
 3. As a minimum, the submittal shall contain complete operation and maintenance instructions, drawings, and complete parts list.
 4. In addition, for equipment requiring periodic lubrication, provide two (2) lubrication charts; one shall be included in the binder, and the other shall be provided in weatherproof 10 mil. laminated plastic and shall be permanently affixed to the equipment. Charts shall contain pertinent information concerning the lubricating requirements including manufacturer's name, name of equipment, recommended service interval, and recommended lubricant, location of each of the points of lubrication.
- I. Warranties
1. Provide duplicate notarized copies.
 2. Assemble documents from Subcontractors, suppliers, and manufacturers.
 3. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.
 4. Submit prior to final Application for Payment.
 5. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.
- J. Spare Parts and Maintenance Materials
1. Provide recommended manufacturer's list of spare parts, maintenance, and extra material as specified in individual specification sections.
 2. Submit to Engineer.
- K. Soil Compaction and Blast Testing Results
1. Provide copies of field test reports and laboratory test reports for all soil compaction testing/analysis and blast testing/readings.
 2. Submit within 3 days of receiving test reports from geotechnical firm and/or laboratory with a cover letter summarizing the results and whether they are acceptable under the conditions of the Contract Documents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01450
QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. Inspection and testing laboratory services.
- C. References.
- D. Field samples.
- E. Manufacturers' field services and reports.

1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Manufacturer shall have the minimum number of years of proven successful experience required in each section in the design, manufacture, and servicing of Products specified.
- B. In lieu of the required experience, manufacturer may provide a cash deposit or bond equal to the cost of the Product, but pro-rated to the number of years of actual experience.
- C. Products from a manufacturer who does not meet the experience requirements must meet technical requirements.
- D. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- E. Comply fully with manufacturers' instructions, including each step in sequence.
- F. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- G. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- H. Perform work by persons qualified to produce workmanship of specified quality.
- I. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 INSPECTION AND TESTING LABORATORY SERVICES

- A. Provide the services of an independent firm to perform soil and material inspections, testing, vibration monitoring, and other services specified in the individual specification sections of this Contract Document.
- B. Testing laboratory shall be authorized to operate in North Carolina.
- C. Testing laboratory shall have a full-time registered Engineer on staff to review services.

- D. Testing equipment shall be calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards (NBS) standards or accepted values of natural physical constants.
- E. Prior to start of Work, submit testing laboratory name, address, and telephone number, names of full-time registered engineer, field inspector, and responsible project manager. Laboratory subject to the approval of the Engineer.
- F. The same independent firm shall perform retesting. Contractor shall pay for retesting required by the failure of the initial test to meet the requirements of the specifications.

1.04 LABORATORY RESPONSIBILITIES

- A. Testing Laboratory shall have the following responsibilities for the Project:
 - 1. Attend pre-construction conferences and progress meetings as required by the Engineer.
 - 2. Collect and test samples of mixes.
 - 3. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
 - 4. Perform inspection, sampling, monitoring, and testing in accordance with Contract Documents and specified standards.
 - 5. Ascertain compliance of soil compaction and material mixes with requirements of Contract Documents.
 - 6. Promptly notify Engineer and Contractor of observed irregularities or nonconformance of Work or Products.
 - 7. Perform additional inspections and tests required by Engineer when specified tests have failed.

1.05 LIMITS ON TESTING LABORATORY AUTHORITY

- A. The authority of the Testing Laboratory is limited as follows:
 - 1. May not alter requirements of Contract Documents.
 - 2. May not approve or accept any portion of the Work.
 - 3. May not assume duties of Contractor.
 - 4. Has no authority to stop the Work.

1.06 LABORATORY REPORTS

- A. After each inspection and test, the independent testing firm shall submit report(s) as specified in Section 01330, Submittal Procedures.

1.07 CONTRACTOR RESPONSIBILITIES

- A. Deliver to laboratory at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
- B. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer's facilities as specified.
- C. Provide incidental labor and facilities to provide access to Work to be tested, to obtain and handle samples at the site and at source of products to be tested, to facilitate tests and inspections, storage, and curing of test samples.
- D. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

1.08 FIELD SAMPLES

- A. Install field samples at site as required by individual specification sections for review.
- B. Acceptable samples represent a quality level for the Work.
- C. Remove field samples and clean area prior to final inspection unless specified otherwise in the individual specification sections.

1.09 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. Require suppliers and manufacturers to provide a qualified technician for required services as outlined by the individual equipment and material specification sections.
- B. Submit qualifications of technician to Engineer 30 days in advance of required work. Technician subject to approval of Engineer.
- C. Technicians shall report observations, site decisions, and instructions given to Contractor, installers, and Owner's staff that are supplemental or contrary to manufacturers' written instructions directly to the Engineer.
- D. Submit test and start-up report as specified in Section 01330, Submittal Procedures.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities: Electricity, lighting, telephone service, water, and sanitary facilities.
- B. Work on public right-of-way.
- C. Traffic control.
- D. Temporary Controls: Barriers, enclosures and fencing, water control, dust control, erosion and sediment control, and protection of the work.
- E. Construction Facilities: Access roads, parking, progress cleaning, project signage, and field offices.

1.02 TEMPORARY UTILITIES

- A. Electricity
 - 1. Provide and pay for required power service for construction from Utility source.
- B. Lighting
 - 1. Provide and maintain lighting for construction operations as required by Contractor.
 - 2. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes as required by Contractor.
- C. Telephone Service
 - 1. Provide, maintain and pay for telephone service to field office as required by Contractor.
- D. Water
 - 1. Provide, maintain, and pay for suitable quality water service required for construction operations.
 - 2. Where practical, Owner will provide water used for construction through a metered connection. Contractor shall be billed monthly at Owner's published water rates. Contractor shall follow procedure for obtaining metered connection as outlined in the City of Raleigh Public Utilities Handbook.
 - 3. Contractor shall be required to extend water lines or provide hauling as required for Contractor's use from existing hydrants as designated by the Owner.
- E. Sanitary Facilities
 - 1. Provide and maintain required facilities and enclosures as necessary to comply with the laws and ordinances of the authority having jurisdiction and the State of North Carolina.
 - 2. General Contractor shall provide the above sanitary facilities for all contractors, sub-contractors, Owner and Engineer at the Project Site.
 - 3. Existing facilities shall not be used.

1.03 WORK ON PUBLIC RIGHTS-OF-WAY

- A. Work on this Project crosses rights-of-way under jurisdiction of the following N.C. Department of Transportation (NC DOT) office:

Work in Wake County:
Division 5, District 1
Amy Neidringhaus, District Engineer
4009 District Drive, Raleigh, NC 27607 (919) 733-3213

- B. Work shall comply with requirements of the Encroachment Agreement(s) as attached to Project Manual.
- C. Post Bonds with NCDOT as required by Encroachment Agreement and provide a copy of the bonds to the Engineer.
- D. Prior to start of Work notify the Office of the N.C. Department of Transportation as indicated in the encroachment agreement. Also notify the Owner.
- E. Work shall conform to the requirements and be subject to the approval of the above agency(ies).
- F. Contractor shall be responsible to the Owner for the cost of all DOT inspection that is billed to the Owner by the NCDOT as indicated in the Special Provisions of the Encroachment Agreement. Such cost shall be deducted from the Contractor's pay request.
- G. Submit letter to the above District Engineer(s) when work is complete as required by the Encroachment Agreement.
- H. Submit letter of approval for completed Work from the above agency(ies) with Final Payment Request.
- I. Clean rights-of-way as work progresses and daily.
- J. Power broom existing pavement as work progresses.
- K. Work shall be in accordance with the latest edition of the N.C. Division of Highways, "Policies and Procedures for Accommodating Utilities on Highway Right-of -Way."
- L. Consult with the above agency(ies) in establishing public thoroughfares to be used for haul routes and site access.
- M. Confine construction traffic to designated haul routes.
- N. Provide traffic control along haul routes to regulate traffic, to minimize interference with public.
- O. Maintain access to fire hydrants, free of obstructions.

1.04 TRAFFIC CONTROL

- A. On public and private road rights-of-way provide traffic control devices when construction encroaches within the right-of-way. Devices shall include, but not limited to, cones, drums, flares, warning signs, temporary pavement marking, warning lights, and flagman.
- B. Traffic control devices shall provide the following:
 - 1. Protection of motorists, pedestrians and workers from accident hazards.
 - 2. Advance public information of proposed work sites.
 - 3. Establishment of an orderly and safe flow of traffic and to minimize traffic congestion.
 - 4. Provision of access for emergency vehicles.

- C. Traffic control devices shall be used in accordance with the latest edition of the NC DOT "Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)."
- D. Provide personnel trained in traffic control.
- E. Plan operations so that access to any dwelling, building or hospital is assured in case of fire or other emergency. Review with and obtain approval from local fire and police departments and school districts (for buses) regarding anticipated detours and obstructions to traffic flow which could hinder passage of fire apparatus, ambulance or otherwise.
- F. Not more than one block nor more than one cross-street intersection may be obstructed or closed to travel at one time without permission of the Owner. If the Project involves pipe-laying operations, and if more than one pipe-laying crew is operating at separate locations in the work area, this requirement shall apply to each crew's operation, but shall be consistent with traffic maintenance procedures required by the Owner.
- G. When the normal route of vehicular access to any property must be temporarily obstructed, notify the affected property owner at least 24 hours in advance of intended operations at the location. The route shall subsequently be re-opened not later than one day following the start of construction at that location, unless special arrangements have been made with property owner. Vehicular access to hospitals, schools, fire and police departments must be provided at all times. Note that in some cases, vehicular access to properties must be maintained continuously as indicated on the Drawings or note elsewhere in the Contract Documents.

1.05 TEMPORARY CONTROLS

- A. General
 - 1. Temporary controls shall be the responsibility of each Contractor for their respective work unless noted otherwise.
- B. Barriers
 - 1. Provide barriers to prevent unauthorized entry to construction areas for the safety of the public, the protection of the work, and to protect existing facilities and adjacent properties from damage from construction operations.
 - 2. Provide protection for plant life designated to remain. Replace damaged plant life.
 - 3. Protect vehicular traffic, stored materials, site, and structures from damage.
- C. Water Control
 - 1. Grade site to drain. Provide, operate, and maintain pumping equipment to maintain excavations free of water.
 - 2. Protect site from running water.
- D. Dust Control
 - 1. Execute Work by methods designed to minimize raising dust from construction operations.
 - 2. Provide positive means to prevent airborne dust from dispersing into atmosphere.

- E. Erosion and Sediment Control
 - 1. Provide Erosion and Sediment Control as indicated on the Drawings and specified in Section 02370, Erosion Control and Section 02230, Clearing and Grubbing.
- F. Protection of Installed Work
 - 1. Protect installed Work and provide special protection where specified in individual specification Sections.
 - 2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
 - 3. Prohibit traffic from landscaped areas.
- G. Duke Energy Coordination
 - 1. The Contractor shall coordinate all work affecting existing utilities owned by Duke Energy. The Contractor will be responsible for contacting Duke Energy and coordinating the construction schedule for the planned work. This coordination will need to take place well in advance of construction. The Contractor is responsible for all costs incurred from Duke Energy. The Duke Energy contact is Right-of-Way agent Bruce Pait 919-329-5928.

1.06 CONSTRUCTION FACILITIES

- A. General
 - 1. Construction facilities shall be the responsibility of each Contractor for their respective work unless noted otherwise.
- B. Access Roads/Drives
 - 1. Contractor shall construct and maintain temporary drives as necessary to access public thoroughfares and existing drives to serve the construction area.
 - 2. Provide means of removing mud from vehicle wheels before entering streets.
 - 3. Access roads shall be restored to a condition that equals or exceeds the condition that exists prior to construction activity.
- C. Parking
 - 1. When site space is not adequate arrange for temporary off site surface parking areas to accommodate construction personnel.
 - 2. Do not allow vehicle parking in existing right-of-way or to block existing drives.
 - 3. Do not allow vehicle parking on private property without prior approval.
- D. Progress Cleaning
 - 1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
 - 2. Remove waste materials, debris, and rubbish from site periodically and dispose off site.

1.07 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, and materials, prior to Final Inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS
Not Used

PART 3 EXECUTION
Not Used

END OF SECTION

SECTION 01520

TEMPORARY SEWAGE PUMPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing, installing, and testing temporary sewage pumping systems that divert wastewater around a work area.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:

- 1. Section 01100 Summary of Work
- 2. Section 01330 Submittal Procedures
- 3. Section 02315 Trenching for Utilities
- 4. Section 02530 Sanitary Sewer System

1.03 REFERENCES

- A. Publications are referred to in the text by basic designation only.

- 1. American Society for Testing and Materials (ASTM)
 - a. D1248 Polyethylene Plastics Extrusion Materials for Wire and Cable
 - b. D2657 Heat Fusion Joining of Polyolefin Pipe and Fittings
 - c. D3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

1.04 GENERAL

- A. Provide all materials, labor, equipment, power, maintenance, associated items and superintendence to implement temporary pumping systems for diverting flow as required to maintain continuous operation of existing facilities prior to completion. Section 01100 -, Summary of Work, identifies specified outages that may require temporary pumping. Provide all additional temporary pumping systems needed to meet Contractor's means and methods at no additional cost to Owner.

- B. Bypass pumping of existing sewer lines is required when blasting in proximity of the existing. See Section 02315 – Trenching for Utilities, in the Project Manual.

1.05 DEFINITIONS

- A. Bypass Pumping System - The bypass pumping system shall consist of all equipment, pipe, valves, plugs, power supplies and other appurtenances required to divert sewer flow from the sewer or sewage pumping station being rehabilitated or replaced and tributary sewers. The bypass pumping system shall be comprised of pumping setups in addition to all bypass pipe necessary to complete the work.
- B. Bypass Pipe - The bypass pipe shall consist of the pipe, valves and other appurtenances including, but not limited to, air relief valves and dewatering connections. The bypass pipe includes both the suction and discharge pipe for each bypass setup.
- C. Primary Pump(s) - The primary pump(s) is the main pump located at each setup. The primary pump(s) shall be capable of pumping the peak flow, be connected to the bypass pipe, have an isolation valve, have a check valve, and be complete with power supplies.
- D. Backup Pump(s) - The backup pump(s) is located at each primary setup. The backup pump(s) shall be capable of pumping peak flow, be operational, be connected to the bypass pipe, have an isolation valve, have a check valve, and be complete with power supplies.
- E. Standby Pump - The standby pump shall be located within 30 minutes of the project site. The standby pump shall have the capacity of the largest pump at each location. The standby pump shall be readily capable to be connected to the bypass pipe at each setup (i.e: given the nature of its potential emergency need, it should not require field fabrication/assembly of pipe in order to be connected to the header)..
- F. Discharge Connection - The discharge connection is where the pumped flow exits the bypass pipe and is introduced into a gravity sewer or force main.
- G. Peak Flow / Peak Wet Weather Flow - The peak flow that may occur in a sewer inclusive of wet weather flow produced by groundwater infiltration, precipitation and snow melt. This value shall also include peak infiltration and inflow.
- H. Operational test - The period of specified duration that the installed system is tested to verify operational integrity of a system prior to placing the system in service. Operational testing requires that representatives of the equipment manufacturer be on site for timely identification and resolution of system issues.
- I. Low Flow Period - The time of day when the wastewater system flow rate reaches the diurnal minimum. It typically occurs between the hours of 3 AM and 8 AM.

1.06 SUBMITTALS

- A. Submittals are to be in accordance with Section 01330 – Submittal Procedures
- B. Submit a Bypass Pumping Plan. No construction shall begin until all provisions and requirements have been reviewed by the Engineer. The submittal shall include, but not be limited to, the following:
 - 1. A written description of the bypass pumping plan for each location where bypass pumping may be used,
 - 2. Schedule,
 - 3. Address access and security of the pump system(s),
 - 4. Quantity, capacity and location of all pumping equipment,
 - 5. Pump performance curves and head capacity curves demonstrating the capability to meet all required flows,
 - 6. The size, type and routing of all suction and discharge pipe and the means of connecting the system,
 - 7. Calculations of static lift, frictional losses and flow velocity,
 - 8. Sewer plugging plan, including type, location and manufacturer of plugs with emergency release procedures,
 - 9. Thrust and restraint block sizes and locations, if necessary,
 - 10. Any temporary pipe supports, location and anchoring requirements,
 - 11. Description of controls, monitoring and emergency power source,
 - 12. Method of noise control for each pump and/or generator for overnight operation,
 - 13. Provide evidence that the bypass pipe material and thickness can withstand all normal operating and surge pressures with a safety factor of 2.0.,
 - 14. Denote any conditions that will cause pumps to lose suction lift (prime) and describe procedures to rectify,
 - 15. Show that the emergency switchover from primary to backup pumping will be automatic should primary pumps fail,
 - 16. Show emergency plan to be used if stream flooding occurs at work site. Provide evidence that Contractor is insured in the event of flooding resulting in the damage or loss of bypass pump and equipment,
 - 17. Show suction and discharge piping is protected from possible damage from varying stream flows and construction activities,

18. If identical bypass pumping setups are to be used as construction proceeds along the alignment (i.e.: regularly moving the same bypass pump setup along the alignment to divert wastewater around the work), indicate that that the setup is “typical in nature” in the plan.
- C. The plan must be signed and sealed by a North Carolina registered Professional Engineer.
- D. Engineer’s and/or Owner’s review will be limited to verification of compliance with performance requirements only.

1.07 TEMPORARY PUMPING COORDINATION MEETING

- A. After shop drawing approval, schedule a coordination meeting with the Owner, Engineer, Contractor, and Subcontractor or temporary pump Supplier, if applicable.
- B. The meeting shall occur at least 1 week prior to installing temporary bypass pumps.
- C. No temporary pumping shall take place until satisfactory completion of the associated coordination meeting.
- D. Demonstrate all temporary pumping systems to Owner and/or Engineer for conformance with the Contract Documents prior to use.

1.08 PERFORMANCE REQUIREMENTS

- A. Design the installation and operation of temporary pumping systems in accordance with Laws and Regulations, including local noise and light ordinances.
- B. The pump station bypass system must be designed by the Contractor and provide for uninterrupted service during system replacement and/or blasting.
- C. For all bypass pump setups, multiple pumps are necessary as follows.
 1. For each primary pump an identical backup pump shall be installed at each bypass pump location, ready for use in the event of primary pump failure. This approach results in full setup redundancy.
 2. The backup pump shall be provided with separate suction pipe and connected to the discharge header with controls that allow the pump to be automatically placed in service.
 3. One standby pump shall be required for each setup. If the standby pump is placed in operation, an additional standby pump of identical capacity shall be available within 30 minutes of the project site.
- D. **The table provided on Sheet G03 of the Drawings identifies bypass pump requirements.**

- E. Peak Wet weather flows are estimated and define the maximum system capacity required. In some instances, the Owner may have additional data that defines diurnal variations and this information can be made available to the Contractor, if requested.
- F. The temporary pumping system must be monitored continuously (24 hours per day, 7 days per week) during operation by a representative of the Contractor trained and certified by the pump supplier or by the pump supplier. The Contractor's representative shall walk the entire length of the bypass force main(s) every two (2) hours during active bypass operations and observe the condition of the pipe, supports, restraints, etc. and verify that the force main(s) remain in proper working order. The observed conditions shall be recorded in a written log noting the time of observation, observed conditions, concerns, repairs made, and name of representative making observations. The log shall be neatly documented and in a presentable format for submittal to the Owner upon request.
- G. Install, test and maintain telemetry to monitor operation of the pumps and manhole water levels. The telemetry system shall first notify the Contractor's local representative designated to monitor the pumps, then other individuals so designated by the Contractor and finally up to two individuals so designated by the Owner.
- H. Temporary pumping systems shall be equipped with noise reduction features that limit the noise output to 65 dbA within 50 feet of the equipment or to 60 dbA at the nearest property line of an occupied residential property, whichever is less.
- I. Provide pressure and vacuum gauges on the suction and discharge headers.

1.09 SPECIAL PRECAUTIONS

- A. Contractor is responsible for fines levied on Owner by State, Federal, and/or other agencies due to spills caused by failure of temporary pumping systems.
- B. Provide barriers in all locations where temporary pumps, pipe and other accessories are located in roadways, driveways and other vehicle-accessed areas.
- C. When overnight pumping is necessary, provide security fencing to prevent tampering when not located within a secured area or continuously monitored by Contractor personnel posted at the pump location.

PART 2 PART 2 - PRODUCTS

2.01 PUMPS

- A. The pumps and drives shall be rated for continuous duty and shall be capable of pumping the required flow ranges without surging, cavitation or vibration. Pumps shall not overload drivers at any point on the pump operating curve.
- B. Pumps shall be suitable for use with raw, unscreened sewage and have a minimum solids passing capability of 3-inches.
- C. Pumps shall be a self-contained units designed for temporary use.
- D. Pumps shall have fully automatic self-priming units that do not require the use of foot-valves, vacuum pumps or diaphragm pumps in the priming system. Alternatively, they can be submersible type.
- E. All pumps must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of flows.
- F. Provide the necessary start/stop/variable speed and level controls for each pump.
- G. The primary pumps shall be diesel powered.
 - 1. Contractor shall be responsible for providing and storing a sufficient quantity of diesel fuel on site to continually operate the primary pumps for at least 3 consecutive days.
 - 2. Contractor shall check the pump fuel levels and shall refill the tanks to full capacity on a daily basis.
- H. Each pump and driver shall be rated for continuous duty operation over the specified range of conditions without cavitating, overheating, excessive vibration and noise. In addition, each pump and driver shall be rated to operate intermittently at shut off head against a closed discharge valve for periods of not less than 5 minutes without excessive cavitation, overheating, or vibration.
- I. Furnish each pump with the necessary stop/start or variable speed controls.
- J. Contractor will not be permitted to stop or impede the main flows under any circumstances except as otherwise defined under the Sequence of Construction.
- K. All pumps are to be Godwin Dri-Prime Automatic self-priming pumps as manufactured by Godwin Pumps of America, Inc., or equal.

2.02 PIPE

- A. In order to prevent accidental spillage, all bypass pipe must be rigid or semi-rigid pipe with positive, leak proof connections. All pipe materials and joints for temporary pipe systems must be:
 - 1. High Density Black Polyethylene Pipe - ANSI/ASTM D1248, butt heat fusion type joint fittings shall conform to ASTM D2657 and D3261

2. Quick-disconnect galvanized steel pipe

- B. Lay flat flexible hose is not permitted, except for pumping wastewater from a single lateral when necessary.
- C. Quick-disconnect galvanized steel pipe is acceptable for bypass pipe diameters up to 8-inches and for applications lasting no longer than 5 consecutive calendar days (i.e.: allowable for temporary use only).
- D. If the Contractor elects to route pipe through box culverts or large diameter storm drains to traverse under roads, HDPE pipe is required regardless of bypass pipe diameter.
- E. If long-term pump operations last more than 5 consecutive calendar days, HDPE pipe is required regardless of bypass pipe diameter.
- F. To the maximum extent of available 3-inch solids passing pumps, the bypass pump pipe shall be rated for at least twice the operating pressure.

2.03 TEMPORARY PLUGS

- A. Provide temporary plugs, as required, for successful operation of the temporary pumping systems.
- B. Plugs shall be designed for the specific purpose of providing temporary plugging of active pipes.
- C. All plugs shall be firmly attached to a stationary object at ground level by a cable in order to prevent loss of plugs in pipelines.
- D. Sewer plugs shall be capable of accommodating the maximum allowable surcharge heads within the sewer system that may be experienced during construction.
- E. The plugs shall be readily removed from the system during emergency shutdowns.
- F. Sewer plugs shall be pneumatic.

2.04 PIPE SUPPORTS

- A. Pipe supports shall be provided for all pipe that is elevated above the ground.

2.05 TELEMETRY SYSTEM

- A. The telemetry system shall consist of high water float(s) and automatic dialer with a battery backup.
- B. The dialer system shall be provided with either cellular or satellite phone.

PART 3 EXECUTION

3.01 GENERAL

- A. Install, operate and maintain temporary pumping systems and appurtenances, including but not limited to, associated pipe, valves, instrumentation, controls and accessories, in accordance with the manufacturer's instructions.
- B. Provide all oil, fuel, grease, lubricants, tools and spare parts required for operation and maintenance of the temporary pumping systems for the duration of use.
- C. Adequate hoisting equipment for each pump and accessory shall be maintained on site.
- D. If the bypass pumping system is used to divert flow from an existing line and the flow will then be put in a new line then the bypass pumping shall remain operable until all components of new work requiring the temporary pumping have been completed and tested to the satisfaction of the Owner/Engineer.
- E. Some pipe types require deflection testing 30 days after completion of backfill (reference Section 02530 – Sanitary Sewer System). Temporary bypass pumping may be discontinued after successful completion of all testing except for the 30 day deflection test. Bypass pumping will be required during the 30 day deflection testing to eliminate flow on the new line during the testing. Bypass pumps for temporarily bypassing the flow of a new line for performing the deflection test may be sized for peak anticipated flow during the test period. Backup pumps and standby pumps are not required for this testing operation.
- F. If temporary bypass pumping is required due to blasting in the proximity of an existing sewer line then bypassing may be discontinued after meeting the requirements set forth on Section 02315 – Trenching for Utilities of the Project Manual.
- G. If temporary bypass pumping was required due to crossing under or within close proximity to an existing sewer then bypassing may be discontinued after backfilling has been completed.
- H. The design of the bypass pumping system must allow for prompt dewatering of the system during periods of non-use or if leakage occurs.
- I. The sewer system may be returned to gravity flow during periods when bypass pumping is not necessary for the installation of work.
- J. The Contractor will not be permitted to stop or impede the sewer flow under any circumstances without having the primary pumps operational.

3.02 SITING OF FACILITIES

- A. In all instances, traffic flow must be maintained to all businesses unless indicated otherwise on the Contract Drawings.

- B. Ramps may be installed to permit access to private driveways. Ramp slopes shall be appropriate for property owners' vehicles.
- C. The pipeline must be located off streets and sidewalks (when not closed to vehicle or pedestrian traffic).

3.03 PREPARATION

A. Precautions

1. The Contractor is responsible for locating any existing utilities in the area selected for installation of the bypass pumps and pipelines. The Contractor shall minimize the disturbance to existing utilities and shall obtain approval from the Owner for any relocation of the bypass pipeline. All costs associated with the relocation of utilities and obtaining approvals shall be paid by the Contractor.
2. During all bypass pumping operations, the Contractor shall protect the bypass pumping facilities and existing collection system from damage inflicted by equipment. The Contractor shall be responsible for all intentional or accidental physical damage to the bypass pumping system caused by human or mechanical failure or interference.
3. During installation of the bypass pumping pipes, the Contractor shall make every effort to minimize the disruption of private property and the inconvenience for neighborhood residents.
4. The Contractor shall protect all mature vegetation and structures or other obstacles in the path of the bypass pipe from damage through use of shields and buffering devices. All private property that must be relocated to construct the work must be stored at a location acceptable to the property owner.
5. In instances where fences must be disturbed for the construction of the bypass pipe the property owner shall be consulted to determine if the installation of temporary fencing shall be required.
6. The Contractor shall maintain sewer flow around the work area in a manner that will not cause surcharge or damage to tributary sewers and that will protect public and private property from damage.

3.04 INSTALLATION AND REMOVAL

- A. The temporary bypass pumping system shall be tested before placing the system in operation. Testing periods shall begin between the hours of 8:30 a.m. and 3:00 p.m., Monday through Thursday. Testing of bypass pumping system shall NOT be allowed Friday through Sunday, on the Owner's scheduled Holidays, or on the day immediately prior to an Owner's scheduled Holiday. In addition, testing of bypass pumping system shall only be performed during the Owner's normally scheduled work days. Testing shall include leakage testing, pressure testing, and operational testing.

1. Leakage and pressure test: Contractor shall perform leakage and pressure testing using clean water (potable or stream). Perform testing at the peak wet weather design flow condition when sufficient clean water is available. When sufficient clean water is not readily available to cause the setup to operate at the peak wet weather flow condition, perform testing using the maximum available clean water. Visually inspect the bypass pump setup and entire bypass pipe for leaks.
 2. Operation test: Contractor shall operate the temporary bypass pumping system for a continuous 2 hours to demonstrate reliable operation of the entire system, including but not limited to pumps and controls, to the satisfaction of the Owner, before removing existing sanitary sewer from service. Ensure consecutive pump operation occurs by activating each float/pressure sensor in the sequence intended.
- B. When plugging is no longer needed for performance of the work, the plugs are to be removed in a manner that permits the wastewater flow to slowly return to normal without surge, exceeding downstream pipe or pumping station capacity, or causing other major disturbances downstream.
- C. Once the new sewer successfully passes all acceptance testing, the bypass pump system can be removed from the project area.
- D. If the Contractor elects to route pipe through box culverts or large diameter storm drains to traverse under roads, to the maximum extent practical, the pipe shall be out of the stream flow path and to the side of the culvert where visible at all times.
- E. The Contractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access locations indicated on the Contract Drawings and as may be required to provide adequate suction or discharge pipe.
- F. When bypass pump operations affect areas outside of the alignment including private property, upon completion of the bypass pumping operations, the Contractor shall remove all pipe, restore all property to pre-construction condition or better, and shall restore all pavement and sidewalks. The Contractor is responsible for obtaining any approvals for placement of the bypass pipe within public right-of-ways.
- G. Upon system removal, all wastewater must be discharged into the wastewater collection system and temporary bypass pipes flushed with clean water.
- H. The Contractor may install new manholes on the existing sewer for the Contractor's convenience during temporary bypass pumping, if approved by the Owner. The Contractor will be required to provide a formal submittal to the Owner to document the plan for the proposed installation methods and bypass pumping during installation and include material submittals/shop drawings for the manholes. With review and approval of the submittal by the Owner in writing, the Contractor may proceed with ordering the necessary material and installing the additional manhole(s). The Contractor will be fully responsible for the cost of the

additional manhole(s) and the installation thereof and the Owner will not be required to pay the Contractor any amount greater than the bid price for bypass pumping.

3.05 QUALITY CONTROL AND MAINTENANCE

- A. Inspection during bypass pumping operations: When actively working at the project site, Contractor shall inspect the bypass pump setup and bypass pipe system every two (2) hours to ensure that the system is working correctly. When not actively working on site, Contractor shall provide continuous monitoring in accordance with Section 1.08 above.
- B. Logging of Inspections: Contractor shall maintain a written log of all inspections on a two (2) hour basis during all temporary bypass pumping operations.
- C. Maintenance service: Contractor shall ensure that the temporary pumping system is properly maintained and that a responsible and competent mechanic/operator shall be on call at all times.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Products.
- B. Transportation and handling.
- C. Storage and protection.
- D. Product options.
- E. Substitutions.

1.02 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work. Products may also include existing materials or components specified in the Contract Documents for reuse.

1.03 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Ship fabricated assemblies in largest sections permitted by carrier regulations and properly marked for ease of field erection.
- C. Promptly inspect shipments to assure that Products comply with specified requirements, quantities are correct, and Products are undamaged.
- D. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

- A. Keep on site storage of material to a minimum.
- B. Store and protect Products in accordance with manufacturer's instructions in unopened original packages, with seals and labels intact and legible. Store sensitive Products in weather-tight, climate-controlled enclosures.
- C. For exterior storage of fabricated Products, place on sloped supports, above ground.
- D. Provide off site storage and protection when site does not permit on site storage.
- E. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
- F. Store loose granular Products on solid flat surfaces in a well drained area. Prevent mixing with foreign matter.
- G. Arrange storage of Products to permit access for inspection. Periodically inspect to assure Products are maintained under specified conditions.

1.05 DAMAGED PRODUCTS

- A. Remove damaged Products from Project site.

1.06 PRODUCT OPTIONS

- A. Products Specified by Reference Standards: Product meeting standard and specific requirements of these specifications.
- B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming Three Manufacturers with an "or equal." Provision for Substitutions: Submit a request for substitution for manufacturer not named during the shop drawing submittal.

1.07 SUBSTITUTIONS

- A. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- C. Request constitutes a representation that Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Shall provide same warranty for Substitution as for specified product.
 - 3. Shall coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
 - 5. Shall reimburse Owner for review or redesign services associated with reapproval by authorities.
- D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- E. Substitution Submittal Procedure:
 - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to proposed product equivalence.
 - 3. Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01700

EXECUTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination.
- B. Cutting and patching.
- C. General installation provisions.
- D. Cleaning and protection.
- E. Final inspection and tests.
- F. Close out procedures.

1.02 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specifications sections.
- D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.03 CUTTING AND PATCHING

- A. General
 - 1. Do not cut, or alter the work of other contractors without written approval of the Engineer.
 - 2. Work removed shall be replaced or repaired by the Contractor who removed or damaged the work, and a craftsman, skilled in the trade that the particular replacement requires, shall do the work. (i.e.: A mason, not an electrician, shall replace masonry removed by the Electrical Contractor.)
 - 3. Conduct removal operations in a manner that will eliminate hazards to persons and property and prevent the release of dust and rubbish into the air. Existing work, which is to remain and is damaged by Contractor's operations shall be replaced with new materials at no additional cost to the Owner.
 - 4. For replacement of work removed, comply with specifications for type of work to be done.
- B. Inspection
 - 1. Inspect existing conditions of work including elements subject to movement or damage during cutting and patching, and excavating and backfilling.
 - 2. After uncovering work, inspect conditions affecting installation of new products.
- C. Preparation prior to cutting
 - 1. Provide shoring, bracing, and support as required to maintain structural integrity of project and in compliance with OSHA requirements.
 - 2. Provide protection for other portions of project.

3. Provide protection from elements.
- D. Performance
1. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, finishes.
 2. Execute cutting and demolition by methods to prevent damage to other work and provide proper surfaces to receive installation of repairs and new work.
 3. Execute excavating and backfilling as specified in excavating and Backfilling.
 4. Restore work, which has been cut or removed; install new products to provide completed work in accordance with requirements of contract documents.
 5. Refinish entire surfaces as necessary to provide an even finish.
 - a. Continuous Surfaces: To nearest intersections.
 - b. Assembly: Entire Refinishing.

1.04 GENERAL INSTALLATION PROVISIONS

- A. Require Installer of each major component to inspect conditions under which Work is to be performed. Clean substrate surfaces prior to applying next material or substance. Do not proceed until unsatisfactory conditions have been corrected.
- B. Comply with manufacturer's recommendations to the extent that they are more explicit or stringent than requirements contained in Contract Documents.
- C. Provide attachment and connection devices and methods necessary for securing Work. Secure Work true to line and level. Allow for expansion and building movement.
- D. Provide uniform joint widths in exposed Work. Arrange joints in exposed Work to obtain the best visual effect. Refer questionable choices to the Engineer for final decision.
- E. Check dimensions before starting each installation.
- F. Install each component during weather conditions and Project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration.
- G. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.
- H. Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Engineer for final decision.

1.05 CLEANING AND PROTECTION

- A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration.
- B. Clean and maintain completed construction as frequently as necessary through the construction period. Adjust and lubricate components as required to ensure proper operation.
- C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, or dangerous exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessive static or dynamic loading.
 2. Excessive internal or external pressures.
 3. Excessively high or low temperatures.
 4. Thermal shock.
 5. Air contamination or pollution.
 6. Water or ice.
 7. Abrasion.
 8. Heavy traffic.
 9. Misalignment.
 10. Improper shipping or handling.
 11. Theft.
 12. Vandalism.
- D. Clean Project prior to final inspection. Project clean up shall include, but not be limited to, the following:
1. Clean surfaces exposed to view as recommended by manufacturer.
 2. Remove temporary labels.
 3. Clean debris from drainage systems.
 4. Sweep paved areas.
 5. Rake clean landscaped surfaces.
 6. Remove waste, and surplus materials.
 7. Remove temporary construction facilities.

1.06 FINAL INSPECTION AND TESTS

- A. Complete punch list items within 30 days of receipt from Engineer. Owner may have work not completed within 30 days performed by others with the cost deducted from Contractor's final payment. Additional engineering and inspection services required as a result of Contractor not completing punch list within 30 days shall be at Contractor's expense.

1.07 CLOSE OUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and is complete in accordance with Contract Documents and ready for Engineer's inspection.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Submit set of Record Documents indicating changes during construction as required in Section 01330, Submittal Procedures.
- D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and final amount due.
- E. Submit the following with final Application for Payment:
1. Contractor's Affidavit of Release of Liens to Owner
 2. Consent of Surety for Final Payment
 3. Affidavit of Payment of Debts and Claims
 4. Final Certified Payroll Information
 5. Affidavits of Release of Liens from Subcontractors and Suppliers to Contractor.
 6. As-built Drawings
 7. Certified statement that all final punchlist items have been completed with punchlist attached.

8. Written releases of liability and claims from property owners, for which the Contractor negotiated temporary easements/right-of-entry with for laydown, staging and/or access.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01900

SPECIFIC PROJECT CONDITIONS

This section forms a part of the Contract Documents and modifies the technical specifications as necessary for the project. Documents with changes are as noted below.

A. Division 2

1. Add the following Technical Specification Sections to Division 2:

- a. 02201 Special Construction Requirements
- b. 02422 Temporary Excavation Support Systems
- c. 02425 Initial Tunnel Support
- d. 02426 Installation of Carrier Pipe in Tunnels
- e. 02431 Tunnel Grout
- f. 02432 Low Density Cellular Concrete
- g. 02445 Utility Hand Tunneling

2. Section 02300, Earthwork

- a. 1.02 A, Delete "4. Section 02410 Microtunneling" and "5. Section 02446 Bore and Jack of Conduits" and replace with "4. Section 02422 Temporary Excavation Support Systems" and "5. Section 02425 Initial Tunnel Support"
- b. 1.02 A, Add "7. Section 02445 Utility Hand Tunneling"
- c. 3.05 C, Add the following sentence, "Explosives need to be stored in a manner to prevent damage from moisture."
- d. 3.05 D, Add the following, "A minimum of four seismographs shall be used at each individual structure (such as a single-family dwelling or similar size business) unless the structure is larger (such as a building complex, bridge, etc.) in which case additional seismographs shall be installed based upon the blasting specialist's recommendations. Seismographs shall be equipped with remote monitors that are capable of transmitting readings directly to the Contractor, Owner, and "third

party” testing firm immediately following the recordings. Seismographs shall also be equipped with visual and audible alarms at each installation.”

- e. 3.05 E, Change the fourth sentence to, “No blasting using electronic blast caps shall be allowed unless a galvanometer is employed to check cap circuits. Non-electric blasting caps shall be utilized in accordance with all manufacturer’s instructions and safety requirements.”

- f. 3.05G, Add the following;

"1. The personnel responsible for conducting the blasting including transporting of explosives, storage and maintenance of explosives, drilling, installation of explosives and charge equipment, and detonation shall meet the minimum qualifications listed below. The contractor will be required to submit documentation to confirm the personnel assigned to the work meet these requirements as specified in Section 01450 – Quality Control.

- a. Personnel must have at least five years of experience with use of explosives for underground rock blasting.

- b. The person in charge of the blasting operation should have:

- 1) At least three years of experience as the blasting superintendent.

- ii. Performed a supervisory role for blasting operations on at least ten similar type projects (water and/or sewer utility line construction).

- c. Provide a list of OSHA violations (related to blasting) and associate fines issued on projects that the proposed superintendent was involved with.

- d. Provide a list of at least five references for projects with blasting completed in the five years.”

- f. 3.05 K.3.a, Delete paragraph a. in its entirety and replace with the following;

"1. The third party testing firm shall monitor vibrations at no less than four locations along the perimeter of the project and in accordance with paragraph 3.07D above during all blasting

activities. The locations shall be based on the location of construction activities and their relative position to offsite structures. Prior to construction, a plan showing the proposed monitoring locations shall be submitted to the Engineer and Owner for approval. Adjustments may be made to the locations upon approval. The sensitivity range of the seismograph shall be selected such that the recording is initiated below the maximum allowable particle velocity as recommended by the U.S. Bureau of Mines with a twenty percent reduction factor applied. Refer to Exhibit 1 at the end of this section for a chart developed by the U.S. Bureau of Mines with the modified vibration requirements for the project and extends above the highest expected intensity. Specific activities of the vibration source (i.e., blasting) shall be indexed in time to allow correlation with the arrivals on the vibration.”

- g. 3.05 K.3.b, Delete the first sentence in its entirety.
- h. 3.05 O, Delete paragraph O in its entirety and replace with the following, “O. The Contractor shall provide as contingency, on-site, by-pass pumping capability when blasting within 100 feet of existing sanitary sewer infrastructure or where required otherwise as noted on the Drawings or specified in other sections of the project manual.”
- i. 3.05, P, Add the following as paragraph “P”. “The contractor shall be responsible for notifying property owners that own any portion of property within a 1,000-foot radius of the proposed blast location. Notifications shall be made by use of door hangers with wording to be coordinated with the Engineer and Owner. Initial notifications shall be in-place once construction activities are within 1,500 linear feet of the proposed blast location measured along the proposed pipe center line. Notifications should also be made to local jurisdictions such as NCDOT, City/Town, etc. In no case shall initial notifications be made later than five days prior to blasting. Follow-up notifications in the same format shall be made between 24 and 48 hours of the intended start of the blasting for property owners with any portion of property within the 1000-foot radius.”
- j. 3.05, Q, Add the following as paragraph “Q,” “The Contractor shall provide as contingency, on-site by-pass pumping capability when blasting within 100 feet of existing sanitary sewer infrastructure. The bypass pumping and piping equipment shall be connected and in-place for immediate use in the event bypass pumping becomes needed.”

- k. 3.08, B, Change sentence to, "Structures shall have a compacted crushed stone subgrade as shown on the drawings or to the depth of 12 inches."
- l. 3.10, B, Add the following as paragraph "B," "Rock shall be initially identified and defined in accordance with the definition of rock contained herein. Following initial encounter of rock material, the Contractor may utilize test drilling along the pipeline alignment to further identify the extent and volume of rock for removal. Payment for rock removal shall be based upon the conditions set forth in Section 01270 – Unit Prices."
- m. 3.13, A, Add the following to the end of Paragraph A, "Surplus materials shall be disposed in an Owner-approved facility. A list of approved facilities is available from City of Raleigh Public Utilities Department. The Contractor may submit an alternate facility for Owner approval, prior to utilization, in accordance with the Contract Documents."

3. Section 02315, Trenching For Utilities

- A. 1.02, C, Change "Owner" to "Owner and Engineer."
- B. 3.07, C, Add the following after the last sentence, "Explosives need to be stored in a manner to prevent damage from moisture."
- C. 3.07, D, Add the following after the last sentence, "A minimum of four seismographs shall be used at each individual structure (such as a single-family dwelling or similar size business) unless the structure is larger (such as a building complex, bridge, etc.) in which case additional seismographs shall be installed based upon the blasting specialist's recommendations. Seismographs shall be equipped with remote monitors that are capable of transmitting readings directly to the Contractor, Owner, and "third party" testing firm immediately following the recordings. Seismographs shall also be equipped with visual and audible alarms at each installation."
- D. 3.07, E, Change the fourth sentence to, "No blasting using electronic blast caps shall be allowed unless a galvanometer is employed to check cap circuits. Non-electronic blasting caps shall be utilized in accordance with all manufacturer's instructions and safety requirements."
- E. 3.07, G, Add the following as the second sentence, "The personnel responsible for conducting the blasting including transporting of explosives, storage and maintenance of explosives, drilling, installation of explosives and charge equipment, and detonation shall meet the minimum qualifications listed below. The contractor will be required to

submit documentation to confirm the personnel assigned to the work meet these requirements as specified in Section 01450 – Quality Control.

1. Personnel must have at least five years of experience with use of explosives for underground rock blasting.
 2. The person in charge of the blasting operation should have:
 - a. At least three years of experience as the blasting superintendent.
 - b. Performed a supervisory role for blasting operations on at least ten similar type projects (water and/or sewer utility line construction).
 3. Provide a list of OSHA violations (related to blasting) and associated fines issued on projects that the proposed superintendent was involved with.
 4. Provide a list of at least five references for projects with blasting completed in the last five years.
- F. 3.07, K, 3, a, Change the first sentence to, “The third party testing firm shall monitor vibrations at no less than four locations along the perimeter of the project and in accordance with paragraph 3.07D above during all blasting activities.”
- G. 3.07, K, 3, a, Change the fourth sentence to, “The sensitivity range of the seismograph shall be selected such that the recording is initiated below the maximum allowable particle velocity as recommended by the U.S. Bureau of Mines with a twenty percent reduction factor applied. Refer to Exhibit 1 at the end of this section for a chart developed by the U.S. Bureau of Mines with the modified vibration requirements for the project.”
- H. 3.07, K, 3, b, Delete the first sentence.
- I. 3.07, L, Add the following as paragraph L, and re-letter paragraphs L, M, N and O as paragraphs M, N, O and P, respectively, “The contractor shall be responsible for notifying property owners that own any portion of the property within a 1,000- foot radius of the proposed blast location. Notifications shall be made by use of door hangers with wording to be coordinated with Engineer and Owner. Initial notifications shall be in-place once construction activities are within 1,500 linear feet of the proposed blast location measured along the proposed pipe center line.

Notifications should also be made to local jurisdictions such as NCDOT, City/Town, etc. In no case shall initial notifications be made later than five days prior to blasting. Follow-up notifications in the same format shall be made between 24 and 48 hours of the intended start of the blasting for property owners with any portion of property within the 1,000-foot radius.

- J. 3.07, P, Replace the entire paragraph with the following, “The Contractor shall provide as contingency, on-site, by-pass pumping equipment when blasting between 50 and 100 feet of existing sanitary sewer infrastructure of where require otherwise as noted on the Drawings or specified in other sections of the project manual. The bypass pumping equipment shall be sized for the potential bypass volume required for the section of existing sewer in question and stored on the site with all necessary items required for assembly of a completed bypass system in the event of a main break.”
- K. 3.07, Q, Add the following as paragraph Q, “If blasting will occur within 25 feet of any existing sewer line that is less than 24” in diameter or 50 feet of any existing sewer line that is 24” or larger in diameter, then comply with the following:
 - 1. Provide bypass pumping in accordance with Section 01520-Temporary Bypass Pumping, and
 - 2. Provide cleaning of the existing sewer line and pre- and post-blasting CCTV inspection in accordance with Section 02560-Sewer Line Cleaning and TV Inspection.”
- L. 3.07, R, Add the following as paragraph R, “Electronic Messaging Boards shall be installed with road right-of-way during blasting operations to inform the general public and motorist of planned and on-going blasting activities. The messaging boards shall be located approximately 1000 feet from the starting point(s) of the blasting activities. The messaging boards shall be in place and operational with the Owner’s approval, a minimum of 2 business days prior to the scheduled blasting activities for each location. All cost associated with furnishing, operating, maintaining and removal of the messaging boards shall be included in the bid price for rock excavation.”
- M. 3.08I, Add the following after the last sentence, “The contractor shall completely backfill or cover trench excavations or excavations of any other kind at the end of each workday to avoid open excavations during non-work hours.”

- N. 3.09, C, 2, b, Replace b with the following, "Gravity Sewer Lines, Rigid pipe (ductile iron with liner and reinforced concrete pipe)
1. Depth of cover 0 to 20 ft (Type 4 laying condition with modifications): Provide Class I material for bedding and 1/8 pipe diameter (min 4 inches) up from bottom of pipe.
 2. Backfill with Class I, II, or III material in remainder of haunching zone and initial backfill. Refer to details on Drawings for additional requirements."
- O. 3.09, C, 2, c, Replace c with the following and delete d and e, "Gravity Sewer Lines, Flexible (Fiberglass Reinforce Pipe – FRP)
1. Depth of cover 0 to 40 ft:
 - a. Provide Class I material for bedding and through embedment zone to 6" above the top of pipe. The maximum stone size shall be 1.5" or to 1 times the pipe wall thickness, whichever is smaller. Backfill remaining 6" of initial backfill with Class I, II or III material.
 - b. Where indicated on Drawings or required by soil conditions, as determined by the geotechnical engineer during construction, the Contractor shall include geofabric lining around embedment zone as detailed on the Drawings."
- P. 3.09, D, 1, Delete Item 1 in its entirety and replace with the following, "Backfill materials shall not contain stones and debris larger than the dimensions listed below for each area type. The Contractor may use rock crushing equipment on-site to reduce the dimensions of shot rock for placement in the trench, provided the dimensions of the crushed material meet the backfill requirements herein. Backfill shall be placed in lifts not exceeding the thickness specified in item 2 and compacted to the minimum densities specified in item 2.
1. Undeveloped areas (i.e. forests, fields, and croplands): 12 inches
 2. Lawns: 12 inches except for last top 12 inches of backfill shall be free of material with a dimension over 2 inches.
 3. Paved surfaces (including areas within 20 feet); greenways (including areas within 10 feet); and existing utilities (including areas within 10 feet): 6 inches except for areas where backfill is

directly beneath any portion of a paved surface or greenway, in which case the materials shall be free of stones and debris larger than 2 inches.

4. Within 20 feet of foundations: 6 inches”

Q. 3.09, D, 2, c, Replace c in its entirety with the following, “Paved surfaces (including areas within 20 feet); greenways (including areas within 10 feet); and existing utilities (including areas within 10 feet): Backfill in 6 inch lifts compacted to 95 percent. Compact final 8 inches to at least 100% of soil’s Standard Proctor maximum dry density within 2% of optimum moisture.”

4. **Section 02530, Sanitary Sewer System**

a. 1.03, A, 1, Add the following as uu. through iii.;

"uu. D6783 Standard specification for polymer concrete pipe.

vv. C579 Standard test methods for compressive strength of chemical-resistant mortars, grouts, monolithic surfacings, and polymer concrete.

ww. A648 - Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe

xx. A569 – Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

yy. A1011 – Standard Specification for Steel, Sheets and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

zz. A1011 – Standard Specification for Steel, Sheets and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

aaa. A611 Grades C or D - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Structural Quality

bbb. A635 Grades 1012 through 1020 – Standard Specification for Steel, Sheet, and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled

ccc. A659 - Standard Specification for Steel, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial Quality

- ddd. A1018 – Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
- eee. C969 Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
- fff. C990 Standard specification for joints for concrete pipe and manholes using flexible joint sealant
- ggg. C1417 Standard Specification for Manufacture of Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe for Direct Design
- hhh. C1479 Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
- iii. D6793 Standard Specification for Polymer Concrete Pipe”
- b. 1.03, A, add the following item 7;
 - “7. American Association of State Highway and Transportation Officials (AASHTO)”
- c. 1.03, A, add the following item 8;
 - “8. American Concrete Institute
 - a. 440.1R-15 Guide for the Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars
 - b. 548.6R-96 Polymer Concrete-Structural Applications State-of-the-Art Report”
- d. 1.04, A, 1, a, 1), Add “with restrained joints” after “Ductile iron”.
- e. 1.04, A, 1, c, Replace paragraph c with the following;
 - “c. Polymer Concrete Manholes
 - i) For polymer concrete manholes and structures, the manufacturer shall provide shop drawings for each manhole. Drawings shall include manhole number, location, rim, and invert elevations, dimensions, reinforcing details, joint details, and component parts.

- ii) Submit calculations signed by a Professional Engineer in the state of North Carolina demonstrating the manhole meets the design criteria established in this section.
 - iii) Submit manufacturer's certification for each type of cast iron frame, grate, and cover."
- f. 1.04, A, 2, d, Delete paragraph d.
- g. 2.01, A, 5, Change, "smaller than 12 inches" to, "12 inches and smaller."
- f. 2.01, A, 6, Change," 12 inches and larger" to, "larger than 12 inches."
- g. 2.01, F, Delete 1, including a and b, and re-number 2 to "1."
- h. 2.02, A, 1, Replace sentence with, "The interior wall of all ductile iron sewer pipe shall be protected by the Protecto 401 Ceramic Epoxy liner."
- i. 2.03, Replace 2.03 with "Not in this Contract."
- j. 2.07, A, 2, Replace sentence with, "Pipe shall be supplied in nominal lengths no less than 20-foot long and not greater than 40-foot long."
- k. 2.07, A, 8, Add the following as 8, "The minimum inside diameter for the nominal 72-inch diameter pipe shall be 72.0 inches and the minimum inside diameter for the nominal 66-inch diameter shall be 66.0 inches."
- l. 2.07, B, 2, Change the second sentence to, "The pipe shall meet the following cell limits; Type 1, Liner 1 and Grade 1, according to the parameters of ASTM D3262."
- m. 2.07, B, 9, Change the first sentence of 9 to, "Interior of pipe shall be manufactured using a glass reinforced thermoset liner."
- n. 2.07, B, 10, Change 10 to, "Exterior pipe surfaces shall be comprised of non-structural layer of glass reinforced resin to provide UV protection to the exterior.
- o. 2.07, E, Delete paragraph, E and re-number paragraphs F, G, and H to "E", "F", and "G", respectively.
- p. 2.07, H, Add the following as paragraph H, "The filament wound fiberglass pipe manufacturer shall provide a three-year extended warranty on all pipe for the project."

z. 2.09, A, 1, b., replace paragraph b with, “Manholes shall be internally coated with a flexible polyurethane, modified polymer, or polyurea coating. Coating shall be Sherwin Williams Sherflex Polyurethane Liner, Duramer 1030 as manufactured by SewerKote, SpectraShield as manufactured by CCI Spectrum, or approved equal. Coatings shall be applied per the manufacturer requirements and applied as summarized below.

1. Sherwin Williams Sherflex Polyurethane Liner shall be installed as follows:

- a. Primer coat shall be a 68% solids, moisture tolerant phenalkamine epoxy applied to 3.0-5.0 mils dry film thickness.
- b. Lining shall be a 100% solids flexible polyurethane lining applied to 80-125 mils dry film thickness.

2. Duramer 1030 Coating shall be provided in three separate parts; primer, intermediate coat, and top coat and installed as follows:

- a. Primer coat shall be a 20% solids, deeply penetrating, dual-component polyuria primer applied to 0.5 – 1.0 mils dry film thickness (150ft/2gal).
- b. Intermediate coat shall be a dual component polyuria applied at 80 -100 mils dry film thickness (50ft/2gal).
- c. Top coat shall be a 65% solids, two-part polyuria applied at 7.5 – 10 mils dry film thickness (125ft/2gal).

3. SpectraShield lining system shall be a multi-component “stress skin panel” liner system as described below:

a. Liner

<u>Installation</u>	<u>Liner</u>
Moisture Barrier	Modified Polymer (Silicone Modified Polyurea)
Surfacer	Polyurethane/Polymeric Blend Foam
Final Corrosion Barrier	Modified Polymer (Silicone Modified Polyurea)

b. The Modified polymer (silicone modified polyurea) shall be sprayable, solvent free, two-component polymeric,

moisture/chemical barrier specifically developed for the corrosive wastewater environment.

- c. The Polyurethane Rigid Structure Foam shall be low viscosity two-component, containing flame retardants.
 - d. Total thickness of multi-component liner system shall be minimum of 500 mils.
- aa. 2.09, A, 1, d, replace paragraph e with “ T-series manholes as manufactured by Tindall Concrete Products or approved equal shall be used at locations indicated on the Drawings and as specified herein. The T-series shall be the appropriate size for accommodating the pipes as shown on the Drawings and shall meet all applicable requirements of the specifications.”
 - bb. 2.09, A, 1, f, add, the following as paragraph f, “Round manholes shall be an acceptable substitute to the T-series manholes. The round manholes shall be the diameter and configuration as required for the pipes shown on the Drawings and shall meet all applicable requirements of the specifications. Risers may be reduced in size per the Drawings and in accordance with ASTM C478.
 - cc. 2.09, A, 1, g, add the following as paragraph g, “Polymer concrete manholes and structures shall be used where shown on the Drawings and shall comply with the specifications in paragraph A.7.
 - dd. 2.09. A, 7 add the following paragraph 7;
 - "7. Polymer Concrete Manholes and Structures
 - a. Departure from and return to true vertical from the established manhole alignment shall not exceed ½ inch per 10 feet, up to 2 inches for the total manhole depth.
 - b. Manufacturing tolerances shall be per ASTM C 478.
 - c. Materials:
 - 1. Resin: The manufacturer shall use only polyester or vinyl ester resin systems designed for use with this particular application. Resin content shall be a minimum of 7% by weight.

2. Filler: All aggregate, sand and quartz powder shall meet the requirements of ASTM C 33, where applicable.
 3. Additives: Resin additives, such as curing agents, pigments, dyes, fillers and thixotropic agents, when used, shall not be detrimental to the manhole.
 4. Elastomeric Gaskets: Gaskets shall be suitable for the service intended. All gaskets shall meet the requirement of ASTM C 443. Joint sealant, if used, shall meet the requirements of ASTM C990.
- d. Manholes and Structures: Manholes and Structures shall be reinforced per ASTM C 478 if utilizing steel or ACI 440 if utilizing FRP rebar. Manholes and Structures shall have monolithic base slabs. Cold joints are not permitted. Cast in lifting devices shall not fully penetrate the wall or require sealing.
 - e. Joints: The manhole components shall be connected with an elastomeric sealing gasket as the sole means to maintain joint water-tightness and both the gasket material and the manhole joints shall meet the requirements of ASTM C443. Round manholes shall utilize spigot and bell type joints incorporating either a confined o-ring or single step profile joint. Square and custom structures shall utilize a ship-lap joint and be sealed with a butyl rope sealant per ASTM C990 as recommended by the structure manufacturer.
 - f. Pipe to Manhole Connections: Pipes shall be directly connected to all structures using resilient flexible pipe to manhole connectors per ASTM C 923 or casting in pipe couplers during the initial pour. Cold joint pipe stub grouting shall not be allowed unless shown on plans as such. In cases where ASTM C 923 connectors cannot be used due to pipe diameter, the pipe shall be grouted into the manhole wall using a corrosion resistant grout and rubber water stop grout ring.
 - g. Invert Channels: Invert channels shall be factory precast with polymer concrete or shipped separately and inserted during installation by the installer.

- h. Acceptable manufacturer: Manufacturer of manholes and structures shall have been actively producing manholes and structures under current name for a minimum of 7 years with no more than one year between manhole and structure projects. 10 project references listing owner, consulting engineer, and contracting meeting this requirement shall be submitted for review.
- i. Polymer concrete manholes and structures shall be manufactured by U.S. Composite Pipe, Inc. (Thompson Pipe Group), Armorock, or pre-approved equal.
- j. Manholes and structures shall be designed to withstand all live loads and dead loads as described in project plans and specifications. Live loading shall be H-20 rating (minimum 16,000 pounds dynamic wheel load). Dead loads shall include overburden load, soil side pressure and hydrostatic loading conditions. Structural design calculations shall use the reinforcement as the sole means of carrying the tensile loading and the polymer concrete shall only be used for the compression loading. Manhole and structure shop drawings shall be sealed by a licensed Professional Engineer in the state of North Carolina.
- k. Manholes wall thickness shall be designed to resist hydrostatic pressures with a minimum safety factor of 2.0 for full depth conditions from grade to invert. In no cases shall the wall thickness be less than 3 inches for 60" diameter and larger and 4" for 72" through 96" diameter.
- l. Manholes and structures shall be designed with sufficient bottom anchorage and side friction to resist buoyancy. Field cast floatation collars addressed with cementitious concrete are acceptable.
- m. The manhole and structure shall be manufactured in one class of load rating. This class shall be H-20 wheel load (minimum 16,000 pounds dynamic wheel load).
- n. Testing:
 - 1. Manholes and Structures: Polymer Concrete
Manholes and structures shall be manufactured in accordance with ASTM C 478.

2. Joints: Joints shall meet the requirements of ASTM C 443. The rubber gasket shall be the sole means of sealing the joint.
 3. Compressive strength: Polymer concrete shall have a minimum unconfined compressive strength of 9,000 psi when measured in accordance with ASTM C 579.
 4. Manhole Leakage: Manhole shall be tested in accordance with ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
- o. The Owner or other designated representative shall be entitled to inspect manholes/structures and witness the manufacturing process.
 - p. Handling and shipping shall be performed in accordance with the Manufacturer's instructions.
 - q. Installation: The installation of manholes and structures shall be in accordance with the project plans and specifications and the manufacturer's recommended practices.
 - r. Handling: Properly rated slings and spreader bar shall be used for lifting. The type of rigging used shall be per the manufacturer's recommendation.
 - s. Jointing:
 1. Sealing surfaces and joint components shall be inspected for damage and cleaned of all debris.
 2. Apply joint lubricant to elastomeric seals. Use only lubricants approved by the manufacturer.
 3. Use suitable equipment handle and set manholes.
 4. Placement and compaction of surrounding backfill material shall be applied so as to provide sufficient and equal side pressure on the manhole."
- ee. 2.09, Add the following paragraph B;

B. Fiberglass Tee Manholes

1. Provide prefabricated fiberglass manholes which conform in shape, size, dimensions, and details shown on Drawings. Unless modified by Drawings, use manhole sections conforming to ASTM D 3753.
2. Mark date of manufacture and name or trademark of manufacturer in 1-inch high stenciled letters on inside of barrel.
3. Unless larger size is required, provide 48-inch-diameter riser barrel for fiberglass manholes. The riser barrel shall be comprised fiberglass reinforced polymer mortar pipe with a minimum stiffness of 72 psi (SN 72). Provide wall section thickness equivalent to the minimum wall thickness for 48-inch SN 72 (FRP) pipe manufactured in accordance with ASTM D3263 (Type 1, Liner 2, Grade 3), and stiffness class measured in accordance with ASTM D2412.
4. Provide fabricated riser top bonded at factory to form one continuous unit at top of manhole barrel to accept high strength nonmetallic fiber reinforced polymer/composite grade rings and frame and cover. The riser top frame and cover shall be of sufficient strength to safely support M306 proof test loading in accordance with AASHTO.
5. Provide manhole tee base fabricated from fiberglass reinforced polymer mortar pipe provided by the sanitary sewer pipe manufacturer for the project. The pipe used to fabricate the tee base shall match the stiffness class and requirements of the pipe for the riser barrel and consist of a filament wound coupling (FWC) on one end. The coupling shall also be provided by the pipe manufacturer.
6. The manhole tee base shall be cut and mitered by the manhole manufacturer to provide the necessary angles for the manhole inlet and outlet points.
7. All welds and lamination of the mitered joints shall conform with the pipe manufacturer's recommendations.

8. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.
9. Branch pipe connections shall be fabricated in the factory with the tee base fabrication and shall be made in the “neck” of the tee base or main horizontal section of the tee as required per the manhole invert elevations indicated in the Drawings. The tee bases shall be structurally designed and fabricated for these connections without compromising the ability of the tee base to support the loads imposed by the installed conditions.
10. Composite frame and covers shall be integrally molded into the riser tops and shall be in accordance with Subpart 2.11 COMPOSITE FRAME AND COVERS.
11. Vent Outlet Assembly: Provide vent outlet assembly as shown on Drawings, constructed of following specified materials:
 - a. Provide fiberglass reinforced pipe conforming to ASTM D 2997. Seal cut ends in accordance with manufacturer's recommendations
 - b. Joints and Fittings: Provide epoxy bodied fittings and join pipe to fittings with epoxy adhesive, according to pipe manufacturer's instructions
 - c. Flanges: Provide socket-flange fittings for epoxy adhesive bonding to pipe ends where shown on Drawings. Flanges shall meet bolt pattern and dimensions for ANSI B16.1, 125-pound flanges. Flange bolts shall be hot-dip zinc coated, conforming to ASTM A 307, Class A or B.
11. Acceptable manufacturer: Manufacturer of fiberglass tee manholes shall employ manufacturing methods and material formulation in use for a minimum of 5 years. Manufacturer of manholes and structures shall have been actively producing manholes and structures under current name for a minimum of 7 years with no more than one year between manhole projects. References demonstrating this requirement shall be submitted for review.

12. Fiberglass tee manholes shall be manufactured by Pomona Pipe Products, Inc. or approved equal.
12. All components of the manholes shall be designed to withstand all live loads and dead loads as described in project plans and specifications.
13. Dead loads shall include riser and top, overburden material, precast concrete bearing ring, attachments to the riser and top, soil side pressure and hydrostatic loading conditions.
13. Manholes wall thickness shall be designed to resist hydrostatic pressures with a minimum safety factor of 2.0 for full depth conditions from grade to invert.
14. The manhole shall be manufactured in one class of load rating. This class shall be H-20 wheel load (minimum 16,000 pounds dynamic wheel load).
15. Manholes shall be designed with sufficient bottom anchorage and side friction to resist buoyancy. Field cast floatation collars are acceptable.
16. Manhole shop drawings and calculations shall be sealed by a licensed North Carolina Professional Engineer.
17. Testing:
 - a. Manhole Leakage: Manhole shall be tested in accordance with ASTM C 1244 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
18. The Owner or other designated representative shall be entitled to inspect manholes/structures and witness the manufacturing process.
19. Handling and shipping shall be performed in accordance with the Manufacturer's instructions.
20. Installation: The installation of manholes and structures shall be in accordance with the project plans and specifications and the manufacturer's recommended practices. Select backfill material shall be placed and

compacted around the manhole base and riser as shown on the Drawings and the material shall be encapsulated with geotextile fabric matching the specifications for the geotextile material used for encapsulating the trench and backfill material for the fiberglass reinforced polymer (FRP) pipe.

21. Handling: Properly rated slings and spreader bar shall be used for lifting. The type of rigging used shall be per the manufacturer's recommendation.
22. Jointing:
 - a. Sealing surfaces and joint components shall be inspected for damage and cleaned of all debris.
 - b. Apply joint lubricant to elastomeric seals. Use only lubricants approved by the manufacturer.
 - c. Use suitable equipment to handle and set manholes.
 - d. Placement and compaction of surrounding backfill material shall be applied to provide sufficient and equal side pressure on the manhole."

ff. 2.11, Replace Subpart 2.11 in its entirety as follows:

" 2.11 COMPOSITE FRAME AND COVERS

A. General

1. All composite moldings shall consist of a thermosetting resin matrix blended and/or combined with reinforcing fiber roving, fiber filaments, or equivalent nonmetallic reinforcing structure(s). The thermosetting resin matrix shall be a polyester, vinyl ester, other thermosetting resin recommended for water resistance. Orthophthalic polyester is not allowed. The moldings shall be true to pattern in form and dimension and free from cracks, pores, knit-lines, or other defects in locations affecting their strength and value for the service intended.

B. Manhole Ring and Cover

1. All rings and covers units shall be made from high strength nonmetallic fiber reinforced polymer/composite materials. The material shall be a resin thermoset matrix that can be reinforced with continuous filament engineered fabrics, fiber roving, fiber filaments, or equivalent nonmetallic reinforcing structure(s). Sealing gaskets shall be bonded to the frame continuously at the interface with the cover.
2. Rings and covers intended for traffic service shall be capable of withstanding AASHTO M306: Proof Testing (includes items such as frames, covers etc.).
3. Fabricate rings and covers to conform to shapes, dimensions, and with wording or logos shown on Utility Drawings as required.

C. Molding Process

1. Before the moldings are removed from the molding operation, they shall be thoroughly deflashed and cleaned at the parting lines, holes, notches and all exposed edges.
2. If using a lock, or latch, these must be independent of the method used to open the cover to ensure the cover can be opened in the event of lock or latch failure.
3. Covers and frames shall be compression molded under high pressures (>0.5 tons/sq. inch of x-y surface area) and high temperatures (>200 degrees F).
4. Metal reinforcements or metal hinges molded within the composite shall not be permitted. Small non-stress bearing pieces of metal may be encapsulated or attached.

D. All rings and covers shall be molded and assembled in the United States in accordance with the requirements of AASHTO M306.

E. Covers shall be provided with a positive sealing mechanism by means of four (4) austenitic 316 stainless-steel one-half inch (1/2") nuts and bolts # 11 National Coarse Thread. Nuts shall be molded in or attached at pre-molded designated points of the frame and

shall be PTFE Coated. For bolted manhole covers a thin film of an Bolts shall be threaded by hand prior to the use of wrenches. Other equivalent locking mechanisms must be approved by the Utility.

- F. Composite covers shall be detectable by metal detectors.
- G. Markings: Covers and Frames shall have the following molded into the substrate of the cover;
 - 1. Name (or abbreviation) of molder
 - 2. Country of Origin (where transformed by molding process) on the top in font at least 3/4 inch in size.
 - 3. Molding Date
 - 4. Indication that material is non-metallic
- H. Composite frame and covers shall be Composite Access Products, L.P., McAllen, Texas or pre-approved equal as documented by the Utility.
- I. Testing and Performance Requirements
 - 1. Testing shall be performed in accordance with the following inspection criteria unless otherwise specified in the contract or purchase order. The manufacturer/supplier shall be responsible for carrying out all the required tests and inspections. All testing shall be conducted in the United States using purchaser approved reliable facilities. The manufacturer/supplier shall maintain complete records of all such tests and inspections. All testing shall be paid for by the manufacturer/supplier.
 - 2. Frames and Covers shall be "Proof Tested" in accordance with AASHTO M306.
 - 3. Heavy Duty: A load of 50,000lbs shall be concentrated on a 9" x 9" block with rubber or fiber backing pad for one minute. When load is removed, Permanent Set (Deflection) of more than 1/8" (.125") measured at center of load area will be cause for rejection. All testing shall be conducted on a NIST calibrated and Certified load test machine.
 - 4. Ultraviolet resistance: ASTM G154 Cycle 1 for 1000 hrs. Specimens shall be tested for ultimate flexural strength,

retaining at least 75% of control values for load and deflection at failure.

5. Coefficient of Friction: Shall be greater than 0.6 when tested in accordance to ASTM C1028.

6. At the request of the Project Manager, the quality process manual shall be available for review. Manufacturing facility shall also be available for inspection to ensure quality standards are met along with EPA and OSHA standards.

J. Installation

1. Install composite frames and covers according to approved shop drawings, instructions in related specifications and details, and written installation instructions from manufacturer.

2. Set units accurately at required locations to proper alignment and elevation. Keep units plumb, level, true, and free of trash. Measure location accurately from established lines and grades. Brace or anchor frames temporarily in form work until permanently set.

gg. 2.13 through 2.15 change to "Not in this Contract."

hh. 2.16, Add the following as 2.16, "SERVICE PIPE. Service pipe shall be 4 or 6-inch PVC Schedule 40 or Ductile Iron Class 350 and shall be installed on a constant grade from the saddle to the combination wye for the cleanout stack."

ii. 2.17, Add the following as 2.17, "GEOTEXTILE WRAP FOR FRP SANITARY SEWER

A. Provide geotextile fabric wrap for use as FABRIC FOR SOIL STABILIZATION. The fabric shall:

1. Consist of strong, rot-proof synthetic fibers formed into a woven fabric.

2. Be free from any treatment or coating which might significantly alter its physical properties before or after installation.

3. Contain stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from ultraviolet or heat exposure.
4. Be a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other.
5. Be free from defects or flaws which significantly affect its physical and/or filtering properties.
6. Meet the physical properties and classification as a Type 4, Fabric for Soil Stabilization in accordance with NCDOT Table 1056-1."

jj. 2.18, Add the following as 2.18, "MANHOLE RISER GUARDS

A. Provide manhole riser guards around all fiberglass pipe tee and riser manhole tops. The guards shall consist of the following items:

1. 96" N.A.D. Liner Plates shall be fabricated from Weathering Steel conforming to ASTM A606, Type 04. Plates shall be 10 gage (0.1270" thick) and shall be curved to a 96" neutral axis diameter (N.A.D.).
2. All plates shall be punched for bolting in both longitudinal and circumferential seams and shall be so fabricated as to permit complete ring assemblies. The longitudinal seam shall be of the lapped type, with an offset equal to the gage of metal for the full width of the plate to allow the cross section of the plate to be continuous through the seam. Circumferential bolt hole spacing shall be 6 ¼".
3. Bolts and nuts shall be 5/8" in diameter and length recommended by the manufacturer. Bolts shall conform to ASTM A 449, Type 1 or ASTM A 307. For longitudinal seams, bolts shall be A 449, Type 1, for plate thickness equal to or greater than .209". For plate thickness less than .209", the bolts shall be A3 307, Grade A. All circumferential bolts may be A 307, Grade A. Nuts shall conform to ASTM A 563, Grade A, Hex.
4. Galvanizing, when and if required, shall be in accordance with the requirements of ASTM B-695, Class 50.

5. Each 96" N.A.D. Manhole Guard will have 6 EA – 5'-9" long, W6 x 9 Weathering Steel Posts conforming to ASTM A-588, Grade 50.
 6. Manhole Riser Guards shall be installed per the details in the Drawings and per the manufacturer's recommendations."
- kk. 3.06, Change 3.06 to, "Not in this Contract".
- ll. 3.07, A, 16, Add the following as paragraph 16, "Fiberglass reinforced pipe shall be aligned and joined in accordance with each manufacturer's recommendations. Joining of pipe shall not exceed the maximum allowable misalignment for each manufacturer's installation requirements. Contractor shall inspect the joint of each section of pipe throughout the circumference of the joint prior to backfilling to determine offset or misalignment of the joint and measure. Any offset greater than the maximum allowable for the specified pipe material shall be field adjusted, re-inspected, and re-measured prior to backfilling of the pipe section."
- mm. 3.07, A, 17, Add the following as Paragraph 17, " Geotextile shall be utilized for filtration and stabilization of stone bedding, haunching, and initial backfill when loose, non-cohesive soils are encountered. Contractor is responsible for identifying potential locations for geotextile bedding wrap and confirming with Owner's geotechnical representative. Geotextile wrap shall be installed in accordance with AASHTO M288-06, Appendix X1 and manufacturer's installation recommendations. Prior to covering, the geotextile material shall be inspected for damage during installation. Damaged geotextiles shall be replaced or repaired immediately at no additional cost to the Owner. Sheets of fabric may be sewn or bonded together with a fungus resistant material in accordance with AASHTO M288-06, Appendix X1.1.4. No deviation from any physical requirements will be permitted due to the presence of the seam. When anchor pins are necessary, fabricate them of steel, 3/16" in diameter, at least 18" long, pointed at one end, and have a head that will retain a steel washer having an outside diameter of no less than 1.5". When wire staples are necessary, provide staples made of No. 11 gage new steel wire formed into a "U" shape. The size when formed must not be less than 6" in length with a throat of not less than 1" in width. Fabric will be rejected if more than 72 hours has elapsed between the time the protective wrapping has been removed and the fabric is covered up during installation. Replacement fabric will be obtained by the Contractor at no additional cost to the Owner. Construction vehicles shall not be allowed directly on geotextile. If placement of backfill

material causes damage to the geotextile, the damaged area shall be repaired or replaced at no additional cost to the Owner.”

- nn. 3.07, A, 19, Add the following as Paragraph 19, “When CCFRPM pipe is stored in an area where it is exposed to sunlight or other sources of UV radiation, the ends of each pipe shall be covered to protect the inner liner from exposure in accordance with the manufacturer’s recommendations.”
- oo. 3.10, Change 3.10 to, “Not in this Contract.”
- pp. 3.11, J, Add the following as paragraph J, “Manhole coatings shall be installed at specified mil thickness per the manufacturer requirements and tested in accordance with the specifications. The coating shall be free of uncured material, inadequate thickness, pinholes, blisters, delamination, foreign matter, and unspecified materials. The manhole surfaced shall be prepped in accordance with the following to ensure proper adhesion of the coating materials.
 1. The NACE/SSPC Joint Surface Preparation Standards for concrete surface preparation are incorporated in and made part of this specification. All references to SSPC SP-13NACE No 6 designate the definitions and other requirements in these documents. The International Concrete Repair Institute (ICRI) Technical Guideline #03732. Guide to Surface Preparation of Concrete to Receive Sealers, Coatings and Polymer Overlays shall be used to visually evaluate the concrete surface profile.
 2. Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile CSP-3 to CSP-5.”
- qq. 3.15, C, 1, Replace Paragraph 1 with, “Test gravity sewer between manholes using low-pressure air. Each pipe joint/coupling shall be individually tested with a internal joint tester following installation and prior to the next joint/coupling of pipe being installed. The joint/coupling of pipe being tested shall be retested after the next upstream joint/coupling of pipe is tested, to insure that the upstream pipe connection has not caused the initial pipe joint/coupling to lose its seal.”
- rr. 3.15, C, 4, e, 7, Add the following as 7, “Internal joint testers shall be manufactured by Lansas Products, Plug-It Products, or Cherne Industries, Inc.”
- ss. 3.15, C, 4, f, 7, Add the following as 7, “Air pressure applied through the internal joint testers shall be in accordance with item 2) above.

- tt. 3.15, C, 5, Delete Paragraph 5. Re-number Paragraph 6 to Paragraph "5."
- uu. 3.15, C, 7, Delete 7.
- vv. 3.15, E, Add the following as Paragraph E, "Manhole coatings shall be tested as follows. Coatings that do not meet the minimum requirements shall be repaired or replaced at no additional cost to the Owner.
 - 1. During application, a wet film thickness test in accordance with ASTM D4414 to ensure a monolithic coating and uniform thickness. Wet film thickness shall be in accordance with manufacturer requirements.
 - 2. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment per NACE SP0188. All detected holidays and voids shall be marked and repaired per the coating manufacturer's recommendations."
- ww. 3.15, F, Add the following as Paragraph F, "Pipe Slope Verification. 1. The Contractor shall be responsible for coordinating as-built survey of the gravity sewer line with the Engineer. As-built survey will be conducted by the Engineer's office. Each manhole shall be surveyed following installation to confirm the depth, rim elevation, and downstream pipe invert elevation prior to the pipe downstream being accepted. The Contractor shall not install gravity sewer upstream of the manhole being surveyed until survey is complete, elevations and depth have been confirmed, and the downstream pipe slope is determined to be acceptable to the Owner."
- xx. Add Subpart 3.17 as follows:

3.17 ABANDONMENT OF EXISTING UTILITIES

A. Existing underground utility pipes designated to be abandoned on the Drawings shall be abandoned in accordance with the following guidelines;

- 1. The entire internal cavity of the existing pipe shall be filled with flowable fill. The mix design shall be submitted to the Owner and Engineer for approval prior to initiating the Work.
- 2. Use grout to plug the end of the existing utility lines, including the ends of sanitary sewer mains at manhole

entrances/exits. Make the grout flush and contoured to match the interior wall of the existing manhole.

3. All abandoned existing utility lines shall meet the requirements of the NCDOT 2012 Standard Specifications for Abandoning Pipe (Section 01530-3 A. and all referenced specification sections).

B. Existing manholes designated to be abandoned on the Drawings shall be abandoned in accordance with the following guidelines;

1. Remove the top of the manhole to 2 feet below existing grade where possible.

2. Plug connecting utility pipes connected to the manhole before filling the manhole.

3. Completely fill the interior of the manhole with select backfill material approved by the Owner. Fill the remaining excavated area with select backfill material to the existing grade elevation and compact as required in Section 02510 Trenching for Utilities.

4. All abandoned manholes shall meet the requirements of the NCDOT 2012 Standard Specifications for Abandoning Manholes (Section 01530-3 B. and all referenced specification sections).

5. Section 02560, Sewer Line Cleaning and TV Inspection

a. 1.01, A, Change the first sentence to, "Provide labor, materials, and equipment required to clean the sewer lines designated on the drawings, including manhole walls, of dirt, grease, sand, sludge, roots and other solid or semi-solid materials and perform a TV inspection."

b. 1.02, A, Change the second sentence to, "Based on the TV inspection, recommend to the Owner and Engineer, in report form, the location of the service laterals."

c. 1.02, B, Add the following paragraph after Subpart 1.02A, "Clean the lines and perform a TV inspection when sanitary sewer is shown to be lined on the Contract Drawings. Based on the TV inspection recommend to the Owner

and Engineer, in writing, if any sanitary sewer lines shown to be lined have obstructions that may hinder liner installation. Also give location of service laterals. The memo will be completed and submitted to the Owner and Engineer along with an IT pipe database. If there are any potential obstructions, a two week review will be conducted by the Owner and Engineer. The Engineer will then modify the Contract Documents, if required.”

- d. 3.08, A, Replace paragraph A in its entirety with the following, “Take precautions to protect the sewer lines from damage by the improper use of cleaning equipment. Extreme care shall be taken during pre-rehabilitation cleaning and inspection. Cleaning and inspection shall only be performed while flow is bypassed. The existing pipe is extremely deteriorated and fragile.”
- e. 3.08, B, Add the following sentence add the end of the current sentence, “ Where CCTV inspection is required for pre and post blasting operations, the inspections performed after completion of the blasting must be completed and submitted to the Engineer. Engineer will review and provide approval to place existing sewer back into service within 5 days of receipt of an acceptable submittal.”
- f. 3.08, I, Add paragraph I as follows, “Where CCTV inspection of existing sewers is required, regardless of size or necessity for bypass, CCTV inspection shall be performed while the sewer main is being bypassed.”

6. Section 02920, Lawns and Grasses

- a. 2.01, D, Replace with the following: “Seeding, mulching and fertilizing shall be as specified in the Erosion Control details on the Drawings.”

B. Division 3

1. **Add the following Technical Specification Sections to Division 3:**

- a. 03100 – Concrete Formwork
- b. 03200 – Reinforcing Steel
- c. 03250 – Concrete Accessories
- d. 03290 – Joints in Concrete
- e. 03300 – Cast-in-Place Concrete
- f. 03350 – Concrete Finishes

- g. 03370 – Concrete Curing
- h. 03400 – Precast Concrete
- i. 03600 - Grout

C. Division 5

1. Add the following Technical Specification Sections to Division 5:

- a. 05010 – Metal Materials
- b. 05035 – Galvanizing
- c. 05050 – Metal Fastening
- d. 05061 – Stainless Steel
- e. 05500 – Metal Fabrications
- f. 05531 – Gratings, Checkered Floor Plates, and Access Doors
- g. 05540 - Castings

D. Division 7

1. Add the following Technical Specification Sections to Division 7:

- a. 07900 – Joint Fillers, Sealants, and Caulking

E. Division 9

1. Add the following Technical Specification Sections to Division 9:

- a. 09801 - MIC Coating System
- b. 09900 – Painting

F. Division 11

1. Add the following Technical Specification Sections to Division 11:

- a. 11000 Equipment General Provisions

G. Division 15

1. Add the following Technical Specification Sections to Division 15:

- a. 15200 Gate Operator and Electrical Gate Actuators
- b. 15204 Slides Gates
- c. 15390 Schedules

H. Division 16

1. Add the following Technical Specification Sections to Division 16:

- a. 16000 Basic Electrical Requirements
- b. 16111 Conduit
- c. 16118 Underground Electrical
- d. 16123 Low Voltage Wire and Cable
- e. 16123 Boxes
- f. 16141 Wiring Devices
- g. 16170 Grounding and Bonding
- h. 16190 Supporting Devices
- i. 16195 Electrical Identification
- j. 16470 Panelboards

END OF DOCUMENT 01900

SECTION 02201

SPECIAL CONSTRUCTION REQUIREMENTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The OWNER has determined through targeted subsurface investigation the presence of certain volatile and semi-volatile organic compounds in soil and groundwater are present within certain portions of the work area.

Limits of Special Requirements

1. Should excavation or ground water dewatering be required, the provisions for the following paragraph shall apply and be paid for under the appropriate line item of the bid.
 2. The provisions of this specification for trench excavated material and groundwater shall apply to the area of the alignment between:
 - a. Station 205+50 through 209+00
 3. The OWNER may increase the area of coverage if other areas of contamination are encountered along the alignment.
- B. A copy of selected excerpts of the OWNERs environmental assessment results related to the site is included in the Appendices of the Project Manual.
- C. CONTRACTOR shall take special precautions and provide special construction as outlined herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01330 – Submittal Procedures
- B. Section 02230 – Clearing and Grubbing
- C. Section 02300 - Earthwork
- D. Section 02315 – Trenching for Utilities

1.03 SUBSURFACE CONDITIONS

- A. Information on subsurface conditions is referenced under Division 1, General Requirements.
- B. Attention is directed to the fact that concentrations of certain volatile and semi-volatile organic compounds have been detected in soil and /or groundwater on the site in specific areas of proposed trenching.

1.04 REFERENCE STANDARDS

- A. 29 CFR Part 1910.120
- B. NC General Statute 143-215.1(a)
- C. NC Administrative Code, Title 15A, Chapter 2, Subchapter H
- D. NC Administrative Code, Title 15A, Chapter 2, Subchapter L

1.05 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, the CONTRACTOR shall submit the following:
 - 1. Written Safety and Health Program in compliance with 29 CFR 1910.120 (b) for informational purposes only.
 - 2. Certificates to show that all employees at the site, including all employees of all subcontractors, comply with the training requirements of 29 CFR 1910.120 (e).
 - 3. Proof of medical surveillance for all appropriate employees in accordance with 29 CFR 1910.102 (f).

1.06 HEALTH AND SAFETY

- A. CONTRACTOR is solely responsible for the health and safety of his employees and the employees of all his subcontractors. Portions of the alignment included in the special conditions include potentially flammable and combustible hydrocarbon residues typical of petroleum motor fuels in soil and groundwater the CONTRACTOR is responsible for completion of full-time atmospheric monitoring of trench and work zone conditions.
- B. OWNER will not review the Written Safety and Health Program for conformance with Federal and State Regulations.

1.07 ENVIRONMENTAL CONSULTANT

CONTRACTOR shall obtain the services of an ENVIRONMENTAL CONSULTANT working under the direction of a Professional Engineer or Professional Geologist to conduct the field monitoring described in this specification. The CONTRACTOR'S ENVIRONMENTAL CONSULTANT shall complete the following work:

- A. Conduct full time observation and field screening of soils and groundwater removed from the trench in the areas subject to special conditions;
- B. Maintain constant communication with the CONTRACTOR and OWNER concerning the field screening observations;

- C. Use the results of field screening in keeping with the requirements of this Section as the basis to instruct the CONTRACTOR to conduct one of the following actions for trench excavated material generated along the alignment:
 - 1. Remove for offsite disposal or reuse as trench backfill in keeping with the requirements for trench excavated material generated outside the limits of this section;
 - 2. Remove for offsite disposal as a petroleum contaminated non-hazardous waste at a local permitted land application facility under an active permit issued by the NC Department of Environmental Quality;
 - 3. Remove for placement within a stockpile in an area approved by the OWNER for completion of additional testing because of field observations (chemical odor or staining, debris, etc.) that suggest that the trench excavated material may contain contaminants other than petroleum hydrocarbons in a quantity that would subject it to disposal requirements outside the limits of the NC Department of Environmental Quality permitted land application facility.

- D. Use the results of field screening in keeping with the requirements of this Section as the basis to instruct the CONTRACTOR to conduct the following actions for trench removed water / groundwater:
 - 1. Discharge in keeping with the requirements for trench removed water or groundwater generated outside the limits of this section;
 - 2. Discharge to OWNER's closest downstream sanitary sewer system manhole after completion of pretreatment specified by the OWNER;
 - 3. Pump and haul to offsite destination for treatment and disposal as a non-hazardous contaminated liquid;

- E. Provide a daily written log of field monitoring results to CONTRACTOR and OWNER;

PART 2 - PRODUCTS

2.01 SITE-SPECIFIC SAFETY AND HEALTH PLAN

- A. Provide a written Safety and Health Plan in conformance with 29 CFR 1910.120 (b) (4).

PART 3 - EXECUTION

3.01 SITE-SPECIFIC SAFETY AND HEALTH PLAN

- A. Follow all provisions of the Site-Specific Safety and Health Plan.
 - 1. Implement appropriate site control procedures in accordance with 29 CFR 1910.120 (d).

2. Use appropriate engineering controls, work practices, and personal protection equipment in accordance with 29 CFR 1910.120 (g).
3. Monitor air quality in accordance with 29 CFR 1910.120 (h).
4. Provide appropriate sanitation in accordance with 29 CFR 1910.120 (n).

3.02 FIELD SCREENING OF TRENCH EXCAVATED MATERIAL

The following SPECIAL CONDITIONS will apply between Station 205+50 through 209+00:

- A. ENVIRONMENTAL CONSULTANT will be required to provide full time field screening of excavated trench material with a portable organic vapor analyzer fitted with a Flame-Ionization Detector (FID) and Photo-Ionization Detector (PID) and observe for obvious odor or staining consistent with a petroleum hydrocarbon or chemical release.
- B. Trench excavated material shall be conducted to environmental field screening with FID/PID measurements completed on a basis of a minimum of one grab sample for every 25 cubic yards of trench excavated material.
- C. One sample per every 100 cubic yards of trench excavated material shall be subjected specific testing for a range of petroleum hydrocarbon constituents by a trained operator using a QED Ultraviolet Fluorescence Petroleum Analyzer.
- D. Maintain log of all calibration and field screening activities;

3.03 CRITERIA FOR TRENCH EXCAVATED MATERIAL WITH NO DISPOSAL RESTRICTIONS

Trench excavated material is subject to the same requirements as the portions of the project outside this area of SPECIAL CONDITIONS when all of the conditions (a., b and c.) apply or when conditions b. and c. discount a FID/PID reading over 10 ppm as an obvious source of petroleum contamination:

- A. FID / PID readings are less than 10 ppm (above background);
- B. No obvious indications of petroleum or chemical odor or staining are observed.
- C. The results of UVF testing confirms that no petroleum hydrocarbon contamination is present in the soil at levels above 10 mg/kg.
- D. OWNER may direct that low level petroleum contaminated soil be retained for reuse as backfill for the sewer interceptor within the portion of the alignment where it was generated.

3.04 CRITERIA FOR TRENCH EXCAVATED MATERIAL WITH REQUIREMENT FOR DISPOSAL AT A LOCAL PERMITTED LAND APPLICATION FACILITY UNDER AN

ACTIVE PERMIT ISSUED BY THE NC DEPARTMENT OF ENVIRONMENTAL QUALITY

Trench excavated material is subject to disposal as a petroleum contaminated non-hazardous waste at a local permitted land application facility under an active permit issued by the NC Department of Environmental Quality when:

- A. FID / PID readings are greater than 10 ppm (above background); and
- B. Obvious indications of petroleum hydrocarbon odor or staining are observed; or
- C. The results of UVF testing confirms that petroleum hydrocarbon contamination is present in the soil at levels above 10 mg/kg.

3.05 CRITERIA FOR STOCKPILING TRENCH EXCAVATED MATERIAL WITH REQUIREMENT FOR ADDITIONAL TESTING PRIOR TO DISPOSAL

- A. Trench excavated material suspected to contain contaminants other than petroleum hydrocarbons shall be placed within a stockpile in an area approved by the OWNER for completion of additional testing. Field screening conditions that would prompt this action include:
 - 1. Elevated PID / FID readings;
 - 2. Obvious pungent chemical odor or staining;
 - 3. Debris mixed in soil matrix of trench excavated material suspected to be consistent with contamination (drums, oil filters, batteries, etc.).
- B. CONTRACTOR shall notify OWNER and obtain concurrence with plan to stockpile and test material prior to initiation of stockpiling.
- C. Stockpile suspected contaminated trench excavated material in a location within the construction easement in such a manner that it will not obstruct the flow of runoff, streams, endanger Work, impair the use or appearance of existing facilities, or be detrimental to the completed Work.
- D. The maximum size of any stockpile shall be 250 cubic yards.
- E. Separate stockpiles shall be constructed for clean soils and those suspected to be contaminated.
- F. Place 10-mil plastic containment barrier (underliner) over area of the ground to receive stockpiled material. Barrier thickness may be achieved through use of multiple layers of thinner plastic sheeting.
- G. Place berm around the perimeter of the underliner and drape underliner over berm.
- H. Fully cover stockpiled material with 10-mil plastic containment barrier (top liner) at the end of each workday. Barrier thickness may be achieved through use of multiple layers of thinner plastic sheeting.

- I. Place weights on top of the top liner to secure top liner and prevent stormwater from contacting the stockpiled material.
- J. CONTRACTOR will test stockpiled material for characterization by a North Carolina Certified Laboratory by Methods 8015/3550 and 8015/5030, EPA Method 8260, EPA Method 8270, EPA Methods for Pesticides, PCBs and 8 RCRA Metals. The samples will be analyzed on a 48-hour turnaround time by the analytical laboratory.
- K. If laboratory analyses detects contamination in the samples the CONTRACTOR shall submit the analytical results to the permitted disposal facilities outlined in 3.05 for review to determine if the material is suitable for disposal as a contaminated non-hazardous waste.
- L. Disposal of trench excavated material as a non-hazardous contaminated waste shall be in keeping with the requirements of 3.05.
- M. Stockpiled soil with no detections of contaminants above regulatory limits shall be used as backfill or removed from the site for disposal with no restrictions.

3.06 TRENCH DEWATERING ACTIVITIES

- A. See Section 02315 – Trenching for Utilities; for typical dewatering requirements throughout the work area with the exception of the following area where the following SPECIAL CONDITIONS will apply between Stations 205+50 through 209+00:
- B. DISCHARGE PERMIT FROM RALEIGH WATER
 - 1. CONTRACTOR shall obtain a permit to discharge trench dewatering effluent to the sanitary sewer system prior to the initiation of work in the SPECIAL CONDITIONS area. The permit is expected to specify the following limits:
 - a. No sheens or free phase oil, petroleum or chemical product;
 - b. Total suspended solids less than 0.500 mg/l;
 - c. pH between 6 and 9;
 - d. Total VOCs less than 0.500 mg/l;
 - e. Instantaneous flow rate of a maximum of 100 GPM.
- C. CONTAINERIZATION OF TRENCH DEWATERING EFFLUENT
 - 1. The CONTRACTOR shall provide three 18,000 gallon Rain for Rent or equivalent open top weir tanks to store trench dewatering effluent. The tanks shall be connected in series in order to allow sediment and any large solids to be removed by the first tank and equalization of flow between the second and third tanks.
 - 2. The final effluent tank shall be equipped with a pump capable of transferring water to the nearest sanitary sewer manhole. The tank and

pump arrangement shall be equipped with a totalizing flow meter from which to confirm the volume of water discharged to the sanitary sewer.

3. Trench dewatering activities shall be supervised at all times by the CONTRACTOR.

D. TESTING OF TRENCH DEWATERING EFFLUENT

1. CONTRACTOR shall initially test water in keeping with requirements of the OWNER prior to discharge of the containerized effluent to the sanitary sewer system. Testing should be completed once the initial tank is 50% full. It is anticipated that the testing will include a grab sample from the initial tank for analyses of:
 - a. Field measurement of pH and conductivity using a calibrated field meter;
 - b. Laboratory measurement of volatile organics by EPA Method 8260;
 - c. Field measurement of petroleum hydrocarbons using the QED Petroleum Analyzer;
 - d. Total Suspended Solids
2. CONTRACTOR will provide written summary and laboratory reports describing the above referenced testing data and obtain permission from OWNER to begin discharge of effluent to the sanitary sewer prior to the assumption of full time discharge of water to the sewer.
3. CONTRACTOR shall perform the following sampling and analyses of samples when full time discharge of dewatering effluent to the sanitary sewer is authorized by the OWNER on the basis of 1 sample per every 24 hours from the final tank in series:
 - a. Field measurement of pH and conductivity using a calibrated field meter;
 - b. Laboratory measurement of volatile organics by EPA Method 8260;
 - c. Field measurement of petroleum hydrocarbons using the QED Petroleum Analyzer;
 - d. Total Suspended Solids
4. If the OWNER does not allow for the disposal of the containerized water within their system, the captured water will need to receive pretreatment or offsite disposal. See Section 3.07 for offsite disposal requirements.

5. The above referenced elements apply to final cleaning of the tanks and disposal of tank cleaning rinseate.

E. PRETREATMENT OF TRENCH DEWATERING EFFLUENT

1. CONTRACTOR shall provide pretreatment of containerized trench dewatering effluent if testing reports concentrations of contaminants over the concentrations established by the OWNERs sanitary sewer discharge permit and OWNER concurs that the pretreatment is preferable than offsite disposal. Although final design of the system will be dependent on the effluent parameter(s) that are in excess of the permit limits, it is anticipated that the pretreatment system shall include:
 - a. Bag filtration to reduce TSS;
 - b. Carbon filtration to reduce VOCs;
 - c. Treatment capacity to accommodate flow rate of up to 100 gallons per minute (GPM).

3.07 DISPOSAL OF CONTAMINATED TRENCH EXCAVATED MATERIAL AND DEWATERING EFFLUENT

- A. Dispose of material in a means consistent with the laboratory testing results.
- B. Dispose of stockpiled trench excavated material by removing from site and transporting to an approved facility only after receipt of laboratory analyses of soil sample and classification (hazardous, non-hazardous, etc.).
- C. Using transporting equipment that prohibits leakage of any material, including water in material.
- D. Maintain manifests and certified weigh tickets showing net and tare weights for all trench excavated materials transported offsite for disposal.
- E. Maintain manifests showing volumes for all trench dewatering effluent transported offsite for disposal.
 1. Approved facilities for non-hazardous petroleum contaminated material (soil) include:
 - a. Soil Works / Selma, NC
 - b. Earthtec Environmental / Sanford, NC
 - c. OWNER must approve any alternate facility prior to removal of material from site.
 2. Approved facilities for non-hazardous contaminated material (soil) other than petroleum hydrocarbons include:
 - a. Republic Services Subtitle D Landfill, Rougemont, NC

- b. Waste Industries Subtitle D Landfill, Sampson County, NC
 - c. OWNER must approve any alternate facility prior to removal of material from site.
- 3. Approved facilities for hazardous material (soil, groundwater) include:
 - a. Chemical Waste Management / Emelle, AL
 - b. Wayne Disposal, Inc. / Belleville, MI
 - c. CONTRACTOR must approve any alternate facility prior to removal of material from site.
- 4. Approved facilities for non-hazardous contaminated groundwater include:
 - a. HOH, Inc., Winston Salem, NC.
 - b. Shamrock Environmental Corporation, Greensboro, NC.
 - c. GARCO, Inc., Asheboro, NC.
 - d. OWNER must approve any alternate facility prior to removal of material from site.
- F. The CONTRACTOR will obtain an EPA ID number if the material is characterized as hazardous.

3.08 DECONTAMINATION

- A. When leaving the work area, decontaminate personnel and equipment in accordance with 29 CFR Part 1910.120 (k).

END OF SECTION

SECTION 02230

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Perform clearing and grubbing. Work shall include, but not be limited, to the following:
 - 1. Access roads.
 - 2. Clearing and grubbing.
 - 3. Removal of surface debris.
 - 4. Demolition and removal of existing paving and structures.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 02370 Erosion Control
 - 2. Section 02920 Lawns and Grasses.

1.03 WARRANTY AND FINES

- A. Contractor is liable for damages to public and private property and fines as may be placed on the Project by the governing agencies due to failure to provide erosion control devices in accordance with the approved erosion control plan and as may become necessary due to actual site conditions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROTECTION

- A. Take reasonable care during construction to avoid damage to vegetation outside of the construction limits. Temporarily tie back ornamental shrubbery and tree branches, where appropriate, to minimize damage. Trees that receive damage to branches shall be trimmed of those branches to improve the appearance of the tree. Treat tree trunks damage by equipment with a tree dressing.
- B. Locate and protect property corners and survey control monuments and stakes prior to start of clearing operations. Disturbed property corners or survey control monuments shall be surveyed and reset by a Professional Land Surveyor licensed in the State of North Carolina. The Contractor shall be responsible for the cost to survey and reset.
- C. Provide temporary gates and fences as necessary to prevent unauthorized vehicular access to the site.
- D. Mark clearing limits (e.g., flag right-of-way, easements, etc.).
- E. Provide tree protection fencing at the outer edge of easements and rights-of-way as indicated on the plans or as directed by the Engineer/Owner. Tree protection

fencing along easements and rights-of-way shall be placed around individual vegetation or groupings of vegetation (e.g., large tree, flower bushes, etc.), and along entire easement (both sides) where clearing through woods. Tree protection fencing shall also be provided where vegetation, within easement and rights-of-way, is indicated as not to be disturbed on Drawings. Where silt fence is provided, it may serve as tree protection fencing if indicated as combination fencing on the drawings. The fencing shall be as detailed on the drawings.

- F. Refer to paragraph 4.04 of the General Conditions and 4.04.A.2 of the Supplementary Conditions concerning the protection of Underground Facilities.

3.02 ACCESS ROADS AND STAGING AREA

- A. Clear for access roads.
- B. Limit clearing and grubbing for access roads to a maximum width for two-way traffic of 30 feet for 20-foot drive and 5 foot shoulders. Contractor shall flag the clearing limits on access roads for the Engineer and Owner to review in the field prior to clearing.
- C. Access roads shall have the following:
 - 1. Provide "Temporary Construction Entrance" per the standard detail on the Drawings at connection to State Roads or other roads as shown on the drawings.
 - 2. 6 inches of ABC stone unless shown otherwise on the drawings.
 - 3. Provide temporary seeding of shoulders as access drives are installed.
 - 4. Provide storm pipes under drives at points of concentrated water flow.
 - 5. Tire wash rack at locations and as detailed on the drawings.
- D. Clear for a staging area as indicated on the Drawings. Total area to be cleared shall be approved by the Engineer. Area for parking and storage of material shall have 6 inches of ABC stone.
- E. Allow reasonable use of access drive by other Contractors, Owner, Engineer, and others authorized to be on the site by the Owner.
- F. When no longer required remove stone and restore access drives and staging area to original contours. Scarify and seed access drives and staging areas.

3.03 INSTALL EROSION CONTROL DEVICES

- A. Clear areas required to install erosion control devices, which shall be in place and operational prior to other land disturbing activity. Install erosion control devices in accordance with Section 02370, Erosion Control.

3.04 STAGING, BORROW, AND DISPOSAL AREAS

- A. Obtain and pay for erosion control permit for staging, borrow, and disposal areas as required by Contractor and not already permitted by Owner.
- B. Install and maintain erosion control devices in accordance with Contractor's approved plan.

3.05 CLEARING AND GRUBBING

- A. Clear and grub the total width of permanent easement and right-of-way unless indicated otherwise on the Drawings. Clear and grub within temporary construction easement only as necessary for construction. Avoid disturbance to vegetation in temporary construction easements where possible, and as noted on the Drawings.

- B. Clearing shall consist of cutting, grinding and removal of vegetation to the existing ground surface and removal of debris. Debris shall include, but not be limited to, fences, steps, walls, chimneys, footings, foundation slabs, basements, signs, junked vehicles, and other rubble.
- C. Grubbing shall consist of the removal of roots over 3 inches in diameter, matted roots, stumps, and other vegetable matter to 12 inches below existing grade.
- D. For areas outside of the right of way and outside of residential yards, grinding of stumps and roots in place is acceptable.
- E. Fill holes and depressions and bring cleared and grubbed area to a uniform contour to match existing grade. Provide positive drainage.
- F. Remove and properly dispose of cleared and grubbed material from the site. Make reasonable effort to channel timber resulting from clearing operations into a beneficial use.
- G. Burning shall not be permitted at the site.
- H. All material from clearing and grubbing shall be maintained within designated limits of disturbance/construction in accordance with the approved Erosion Control Plan until such material is removed and taken offsite for disposal or another use.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Provide labor, equipment, and material to perform site preparation and earthwork as specified herein and indicated on the Drawings. Work shall include, but is not limited to, the following:
 - 1. Survey staking as required for construction.
 - 2. Topsoil stripping and stockpiling.
 - 3. Dewatering.
 - 4. Protection of existing facilities.
 - 5. Site grading.
 - 6. Excavation, trenching, and backfilling for structures and foundation including stone base as indicated on the Drawings.
 - 7. Borrow material including, but not limited to, material, excavating, hauling, placing, and compacting.
 - 8. Maintenance and stability of site.
 - 9. Disposal of waste and surplus material.
 - 10. Soil testing.
 - 11. Tunneling for pipeline installations.
- B. Examine the site to determine the extent of excavating, grading, and related items necessary to complete the work.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 02230 Clearing and Grubbing
 - 2. Section 02315 Trenching for Utilities
 - 3. Section 02370 Erosion Control
 - 4. Section 02410 Microtunneling
 - 5. Section 02445 Bore and Jack of Conduits
 - 6. Section 02920 Lawns and Grasses

1.03 REFERENCES

- A. The latest revision, at the time of bidding, of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. American Society of Testing Materials (ASTM)
 - a. C33 Concrete Aggregates.
 - b. D698 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49 Kg) Rammer and 12-inch Drop (Standard Proctor).
 - c. D1556 Density of Soil in Place by the Sand-Cone Method.
 - d. D1586 Penetration Test and Spilt-Barrel Sampling of Soils.
 - e. D2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

- f. D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
- g. D2487 Classification of Soils for Engineering Purposes.
- h. D2922 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.04 DEFINITIONS

- A. Backfill: A specified material used in refilling a cut, trench, or other excavation, placed at a specified degree of compaction.
- B. Capillary Water Barrier: A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity, which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of water to the area immediately below the slab.
- C. Compaction: Process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of compaction" shall be expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D698 (Standard Proctor).
- D. Excavation: The removal of soil or rock to obtain a specified depth or elevation.
- E. Fill: Specified material placed at a specified degree of compaction to obtain an indicated grade or elevation.
- F. Lift: Layer of soil placed on top of a previously prepared or placed soil.
- G. Rock: Solid, homogeneous material which cannot be removed without the systematic drilling and blasting exceeding 1 cubic yard in volume. Material having a standard penetration resistance as determined by ASTM D1586 greater than 150 blows per foot is defined as "rock." Rock is further defined as materials and obstructions encountered that cannot be practically excavated with a large track mounted backhoe, such as a CAT-325 or larger, equipped with new rock teeth. Practical excavation is defined as the ability to remove at least 10 cubic yards during one (1) hour of continuous digging. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.
- H. Soil classification shall be in accordance with ASTM D2487.
 - 1. Satisfactory materials: Soils classified as GW, GP, GC, GM, SP, SC, SM, SW, ML, and CL.
 - 2. Unsuitable materials: Soils considered as unsatisfactory shall be materials that do not comply with the requirements of satisfactory above and include, but shall not be limited to, the following:
 - a. Soil containing organic matter, debris, stones larger than 12 inches, or frozen material. Stones greater than 4 inches will not be permitted in the top 12 inches.
 - b. Soils classified as Pt, CH, MH, OH, and OL.
 - 3. Cohesionless: Classified as GW, GP, SW, and SP. Soils classified as GM and SM shall be classified as cohesionless only when the fines have a plasticity index of less than 10.
 - 4. Cohesive: Classified as GC, SC, ML, CL, MH, and CH. Soils classified as GM and SM shall be classified as cohesive only when the fines have a plasticity index greater than 10.

- I. Subgrade: Lowest elevation upon which fill or other work will be placed in the absence of unsuitable material.
- J. Topsoil: Natural, friable soil, representative of productive soils in the vicinity of the site. Topsoil shall be free from roots, stones larger than 1 inch, objectionable weed seeds, toxic substances, and materials that hinder grading, planting, and maintenance operations.
- K. Tunnel: Confined excavation below ground generally a horizontal direction for the installation of a structure or pipeline by means of manual excavation or by specific equipment designed to penetrate soil or rock and remove material.

PART 2 PRODUCTS

2.01 MATERIAL

- A. Capillary water barrier: A clean crushed stone, crushed gravel, or uncrushed gravel conforming to ASTM C33 coarse aggregate grading size 57, 67, or 78M.
- B. Stone Base: A clean crushed stone, crushed gravel, or uncrushed gravel conforming to ASTM C33 coarse aggregate grading size ABC
- C. Structural Fabric: Provide structural fabric specifically designed and manufactured to stabilize soft soils under an aggregate base for roads and parking areas. Fabric shall provide a permeable layer, planar flow, and tensile reinforcement for retaining the soil matrix. Fabric shall be inert to commonly encountered chemicals, hydrocarbons, resistant to mildew, rot, and ultraviolet light exposure, and meet or exceed the following test standards:

1. Test	ASTM	
2. Fabric weight (oz / sq yd)	D-1910	6
3. Grab tensile strength (lbs.)	D-1682	200
4. Mullen burst strength (psi)	D-3786	320
5. Puncture strength (lbs.)	D-751	80

PART 3 EXECUTION

3.01 GENERAL

- A. Provide erosion control measures as specified in Section 02370, Erosion Control, clearing and grubbing as specified in Section 02230, Clearing and Grubbing and seeding as specified in Section 02920, Lawns and Grasses.
- B. Protect existing structures and features designated to remain.
- C. Dispose of excavated material in such a manner that it will not obstruct the water flow, endanger existing improvements or Work in progress, impair the use or appearance of the existing facilities, or be detrimental to the completed Work.
- D. Weather Limitations: Proceed with fill and backfill operations based on the following weather conditions:
 - 1. Temperature must be above freezing.
 - 2. In windy, hot, or arid conditions with a high rate of evaporation add moisture to the material to maintain the optimum moisture content.
 - 3. Do not proceed in rain or on saturated subgrade.

- E. Repair or undercut and backfill soils that become damaged by construction activity or unsuitable due to being left exposed to the weather at no additional cost.
- F. Do not place material on surfaces that are muddy, frozen, or contain frost.
- G. Excavation carried below the elevation indicated on the Drawings shall be backfilled and compacted in accordance with these specifications.
- H. Remove and properly dispose of unsatisfactory and excess material from the site.

3.02 CONSTRUCTION STAKING

- A. Provide construction staking as indicated in paragraph 4.05 of the General Conditions. Engineer will only provide electronic design files for Contractor's surveyor and key reference points and benchmarks as shown on the Drawings.
- B. Contractor shall report to Engineer whenever a reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations. Contractor shall be responsible for the accurate replacement or relocation of such reference points or property monuments by a registered professional surveyor in the State of North Carolina.

3.03 PROTECTION OF UNDERGROUND FACILITIES

- A. Approximate locations of existing underground facilities at the site are indicated on the Drawings based on information available to the Engineer. Engineer and Owner do not take responsibility for the accuracy of the information.
- B. Prior to beginning any excavation work or boring, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that an interference exists that was not apparent from the Contract Documents, or could not have been identified during a site visit during bidding, he shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. An interference shall be defined for these purposes as a conflict with an existing utility or structure that prevents the proposed utility from being installed where shown or specified after existing utilities and structures are adequately supported by the Contractor. In the event the Contractor fails to complete adequate field evaluations to identify conflicts, or bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project and could have been avoided with diligent utility location efforts shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the Owner. Repair damage to existing facilities at no additional cost to the Owner.
- C. A change in conditions may be considered due to the location of the existing facilities as allowed in the General Conditions. This does not include the cost for repair of damaged facilities not properly located in advance of construction.

3.04 WATER CONTROL

- A. Inspect the site prior to mobilizing to determine the appropriate equipment for site grading and foundation work.

- B. Perform work to prevent surface water from accumulating in excavations, tunnels and unfinished fill areas. Perform grading and excavation so the work area and affected operations shall be continually and effectively drained.
- C. Install a dewatering system prior to excavating beneath the ground water table. Maintain the water table approximately 2 feet below the bottom of the excavation.
- D. Maintain dewatering until backfilling has proceeded above the natural ground water level and the structural weight is sufficient to prevent "floating" of the structure. Provide a job superintendent experienced in dewatering work.
- E. Water from dewatering operations must be disposed of in accordance with the North Carolina Sedimentation Pollution Control Act.

3.05 USE OF EXPLOSIVES

- A. Blasting is allowable for the removal of rock, as defined herein unless specifically prohibited by the Owner, Engineer or a Utility Owner with an existing utility within the proximity of the proposed blast site. The contractor shall review the Drawings for specific areas where blasting is prohibited..
- B. Obtain required permits for blasting (e.g., from City of Raleigh Fire Marshall's Office) prior to blasting, 24 hours minimum.
- C. Store, handle, and use explosives in accordance with all applicable local, state, and federal regulations and in accordance with the provisions of the "Manual of Accident Prevention and Construction" of the Associated General Contractors of America, Inc. Federal regulations include, but are not limited to, Title 27, Chapter 11, Part 555 of the Code of Federal Regulations (CFR) and OSHA Standards – Part 1926, Subpart U.
- D. Provide seismographic monitoring during progress of blasting operations.
- E. Take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden. Keep the explosive materials that are on the job site in specially constructed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion or falling rock, keep a blasting log containing the following information for each and every shot. This log shall be kept in an orderly manner and made available to the Engineer and Owner upon request.
 1. Date of shot
 2. Time of shot
 3. Crew supervisor
 4. Number and depth of holes
 5. Approximate depth of overburden
 6. Amount and type of explosive used in each hole
 7. Type of caps used (instant or delay)
 8. The weather
 9. Seismograph instrument and readings
- F. Use explosives in such a way to minimize vibration to existing utilities and structures.

- G. Provide only experienced personnel for blasting in accordance with accepted practices.
- H. Contractor is responsible for safety of life and damage to property resulting from the use of explosives. The Owner and Engineer shall be made aware of all blasting activities prior to their occurrence.
- I. Provide services of a testing firm experienced in monitoring vibrations resulting from blasting operations as specified in Section 01450, Quality Control.
- J. In addition to the above testing/monitoring requirements required, Contractor shall provide the services of a "third party" geotechnical testing firm experienced in monitoring vibrations resulting from blasting operation as specified in Section 01450, Quality Control. The firm selected shall be evaluated by the Engineer and Owner for approval as the official "third party".
- K. Third Party testing/monitoring as related to blasting operations shall include the following:
 - 1. Pre-Construction Condition Assessment
 - a. Prior to beginning construction, the third party testing firm shall perform a pre-construction condition assessment to document the conditions of buildings and other sensitive structures within 500 feet of the proposed blasting area. The assessment shall be performed on all adjacent properties and any other properties as directed by the Engineer or Owner. The assessment should include video and photographic documentation of all exteriors including building foundations, and installation of crack monitors on cracks that might occur or expand due to construction vibrations. Provide all documentation described above to the Owner and Engineer prior to construction.
 - 2. Crack Monitoring During Construction:
 - a. During construction, the third party testing firm shall perform periodic readings of the crack monitors installed prior to construction. Provide readings to the Engineer and Owner within 48 hours of taking the reading. If crack readings monitoring confirm that vibrations are not contributing to crack width, crack monitors may be read once per week. More frequent readings may be required by Owner or Engineer if construction activities could result in greater earthborne vibrations. Testing firm shall notify the Engineer and Owner immediately if monitoring indicates that construction operations have contributed to crack widening. The testing firm shall prepare a detailed plan for repaired the structure and the Contractor shall repair the structure at no cost to the Owner. Contractor shall submit a plan for review that proposes alternate construction methods to address the vibration problems and minimize further damage.
 - 3. Vibration Monitoring During Construction:
 - a. The third party testing firm shall monitor vibrations at no less than four locations along the perimeter of the project during all blasting activities. The locations shall be based on the location of construction activities and their relative position to offsite structures. Prior to construction, a plan showing the proposed monitoring locations shall be submitted to the Engineer and Owner for approval. Adjustments may be made to the locations upon approval. The sensitivity range of the seismograph shall be selected such that the recording is initiated below the maximum allowable particle velocity of 1 in/sec and extends above the highest expected

- intensity. Specific activities of the vibration source (i.e., blasting) shall be indexed in time to allow correlation with the arrivals on the vibration.
- b. The maximum allowable particle velocity is 1 in/sec. The contractor shall notify the Engineer and Owner immediately if monitors indicate that the vibrations are above the criteria established. Activities causing the vibrations shall be suspended until a revised construction plan has been developed by the testing firm to alleviate the problem. The problem shall be resolved by the Contractor at no additional cost to the Owner.
 - c. The vibration monitors shall consist of digital seismographs that display the particle velocities and associated frequencies plotted against the criteria established for this project. Each seismograph shall contain geophones with response capability in three mutually perpendicular axes or components; one vertical and two horizontal (radial and transverse). The frequency response of the geophones shall be linear from at least 4 Hz to more than 200 Hz. The sensitivity shall range from less than 0.02 in/sec to more than 5.0 in/sec. The BlastMate III by InstanTel is one type of seismograph that is suitable for this project.
 - d. Vibration monitors shall be field calibrated by the testing firm before each recording period. The transducer shall be positioned with the longitudinal axis toward the vibration source. Transducers must be adequately coupled with the ground. Operation and calibration of all equipment shall be per manufacturer's recommendations. Vibration records shall be collected in waveform plot or strip chart plot. The peak vector sum of the particle velocity in longitudinal, transverse, and vertical planes shall be shown along with the respective dominant or principle frequencies. The highest recorded particle velocity (i.e., the vector sum of the three orthogonal directions), when indexed to a particle vibration event, shall be reported as the peak particle velocity. The recorded peak particle velocity shall be compared to criteria appropriate for the subject of concern.
 - e. The Engineer and Owner shall be notified immediately of any complaint received by the Contractor. The Contractor shall immediately review those construction activities inducing the vibration and prepare a report documenting all relevant data such as the time and date of the complaint, a description of the construction activities, data from the monitoring instruments for the subject time/date, complaint information (including photographs, if possible) of the alleged damage. The Contractor shall submit for review a detailed plan for repair and revised construction plan to address the vibration problems to minimize further damage and complaints. The Contractor shall perform necessary repairs at no additional cost to the Owner.
 - f. The testing firm shall provide monthly reports containing the results of the crack monitors and vibration monitors during those activities that generate earthborne vibrations, including but not limited blasting operations. The reports shall document that the firm is provided the work described herein.
- L. Submit monitoring reports in accordance with Section 01450, Quality Control.
 - M. Allowance established in Section 01270, Unit Prices, shall be utilized to pay for costs of the third party monitoring.
 - N. The Owner reserves the right to require the removal of rock by other means if blasting operations result in possible hazardous conditions.

3.06 TOPSOIL

- A. Where indicated on the drawings, strip topsoil from areas to be disturbed to a depth of 8 inches or greater and stockpile separate from other excavated material. Locate topsoil so that the material can be used readily for the finished grading. Protect and maintain topsoil until needed. Place topsoil after completion of work in accordance with Section 02920, Lawns and Grasses. If topsoil cannot be stockpiled due to limited construction work area, offsite topsoil may be placed as indicated in the bid.

3.07 SITE GRADING

- A. Proofroll exposed soils following topsoil stripping with a partially loaded tandem axle dump truck to identify unsuitable subgrade areas as determined by the Engineer. Unsuitable areas will be repaired in place or undercut to firm soils as directed by the Engineer. Payment for in place repair or undercutting and backfilling of unsuitable areas shall be as indicated in Section 01270, Unit Prices.
- B. Perform undercutting of unsuitable soils with appropriate equipment defined in soils report or approved by engineer. Backfill undercut areas immediately.
- C. At the direction of the Engineer provide a structural fabric for stabilization of unsuitable soil areas. Install fabric in accordance with the manufacturer's recommendation and the following minimum requirements.
 - 1. Provide a fabric overlap of 24 inches.
 - 2. Back dump and spread aggregate over fabric at the aggregate specified thickness.
 - 3. Compact aggregate with vibratory roller prior to allowing additional construction traffic.
- D. Site grading shall be unclassified except as specifically indicated otherwise. Perform grading within the limits of the Project. Finished surface shall conform to the grades and cross sections indicated on the Drawings and be uniformly sloped for a positive drainage away from structures.
- E. Excavate rock encountered in cut sections to a depth of 6 inches below finished subgrade and backfill with satisfactory material.
- F. Scarify the existing subgrade surface to a minimum depth of 6 inches and recompact if subgrade density is less than the degree of compaction for the proposed fill material. Plow or bench existing ground surfaces steeper than one vertical to four horizontal in such a manner that the fill material will bond with or be keyed to the existing surface. Use compaction equipment suitable for the soil being compacted. Moisten or aerate material as necessary to obtain the optimum moisture content within plus or minus one percent to obtain specified compaction.
- G. Soils used for fill and backfill shall be satisfactory soils classified SP, SM, or SW as shown in soils report in accordance with ASTM D2487. Dry or wet soil as necessary to maintain optimum moisture.
- H. Place backfill and fill material in accordance with the following:
 - 1. Maximum uniform loose lifts: 8 inches
 - 2. Optimum moisture content: 11 - 14 percent
 - 3. Percent compaction at optimum moisture content:
 - a. From ex. grade to within one (1) foot of struc. subgrade: 95
 - b. Final foot to subgrade under floor slabs and pavements: 98
 - c. Under sidewalks 90
 - d. Grassy Areas 85

- I. Approved compacted subgrade that is disturbed by construction or adverse weather shall be scarified and re-compacted as specified previously. Re-compaction over utilities shall be by hand tamping.

3.08 FILL AND BACKFILL

- A. Place and compact fill and backfill material adjacent to structures in a manner that prevents wedging and eccentric loading on or against structures. Do not use equipment adjacent to structures that may overload structure. Backfill against structure only after concrete has attained the specified 28-day compressive strength.
- B. Stone Base: Structures shall have a compacted crushed stone subgrade to the depth of 12 inches.

3.09 EXCAVATION FOR STRUCTURES

- A. Provide shoring or side slopes of excavations as necessary to protect workmen, and existing and new structures. Use, install, and remove shoring in accordance with State and Federal OSHA regulations.
- B. Furnish, erect, and maintain required guardrails at exposed boundaries of excavation.
- C. Perform excavation for utilities in accordance with Section 02315, Trenching for Utilities. Install utilities to a minimum distance of five (5) feet beyond the face of the structure.
- D. Make excavation to the dimensions and elevations for the structures as indicated on the Drawings. Extend excavation a sufficient distance from walls and footings to allow for placing and removal of forms.
- E. Remove unsatisfactory material below required grade and replace with select backfill material as directed by Engineer.
- F. Excavation carried below the depths indicated, without specific directions, shall be backfilled and compacted as specified herein to the proper grade. In excavations for footings the concrete shall be extended to the bottom of the over excavation. Work caused by over excavation that has not been approved shall be at the Contractor's expense.
- G. The upper 9-inches of the subgrade after excavating for each structure should be compacted in place to at least 98% standard Proctor maximum dry density. The subgrade should be proof-rolled using a vibratory roller weighing a minimum of 10 tons (static load) until settlement from the last four complete passes does not exceed 1/8 inch. Any soft, unsuitable or unacceptable soils encountered in the subgrade should be replaced with structural fill placed and compacted to 98% of the standard Proctor maximum dry density.

3.10 ROCK EXCAVATION

- A. Notify Engineer immediately in the event that rock is encountered when the Contract requires payment by the unit price.

3.11 BORROW MATERIAL

- A. Provide borrow material required for fill and backfill to bring the site to the elevations indicated on the Drawings. Borrow material shall be subject to the approval of the Engineer. Notify Engineer as to the site selected for inspection and approval prior to transporting borrow material to the site.

- B. Obtain erosion control permit as necessary for borrow pit grading operations.
- C. Provide soil analysis for each type of material from proposed borrow pit(s) for Engineer's approval prior to placing borrow material. Contractor shall do necessary work to bring the borrow material to within plus or minus 1-1/2 percent of the optimum moisture content. A minimum of one sample per structure shall be obtained for analysis.

3.12 MAINTENANCE AND STABILITY

- A. Maintain fills and embankments to the grade and cross section indicated on the Drawings until the final completion and acceptance of the Project. Repair areas that are damaged.

3.13 DISPOSAL OF SURPLUS MATERIAL

- A. Dispose of surplus material not required or unsuitable for filling, backfilling, or grading in an approved spoil area in accordance with local ordinances.
- B. Obtain erosion control permit as necessary for disposal site(s).

3.14 SOIL TESTING

- A. Provide the services of a soil-testing firm as specified in Section 01450, Quality Control.
- B. The testing laboratory soil specialist, as a minimum, shall be at the project site, upon request of the Owner, to perform the following:
 - 1. Monitor proofrolling of existing soils to determine requirements for undercutting unsuitable soils
 - 2. Monitor grading for the separation and wasting of unacceptable soils.
 - 3. Providing tests in accordance with the following schedule:
 - a. Optimum moisture and laboratory maximum density: Provide one (1) test per type of material to determine optimum moisture and maximum density values in accordance with ASTM D698.
 - b. Moisture content: Provide two (2) tests per day per type of material in accordance with ASTM D2216.
 - 4. Provide in-place field density in accordance with ASTM D1556 or other approved test and the following schedule:
 - a. Provide a minimum of one (1) in-place bearing capacity test for every 1,200 sq ft of subgrade area under structures prior to the start of foundation work.
 - b. While filling activities are in progress for structures and paved areas. Provide a minimum of one (1) in-place density test for every 1,200 sq ft of lift with a minimum of one (1) test for every lift.
 - c. Provide a minimum of one (1) in-place bearing capacity test for every 100 feet of foundation trench.

END OF SECTION

SECTION 02315

TRENCHING FOR UTILITIES

PART 1 GENERAL

1.01 SCOPE

- A. Provide labor, equipment, and material to perform required excavating, backfilling, and compacting for utilities and related structures as specified herein and indicated on the Drawings. Work shall include, but not be limited to, the following:
1. Survey staking as required for construction.
 2. Protection of existing improvements.
 3. Location of existing utilities.
 4. Use of explosives.
 5. Dewatering.
 6. Excavating, backfilling, and compacting for utilities.
 7. Installation of warning / identification tape and tracer wire.
 8. Borrow material.
 9. Disposal of surplus material.
 10. Demolition and removal of existing structures.
 11. Soil Testing.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
1. Section 02230 Clearing and Grubbing
 2. Section 02370 Erosion Control
 3. Section 02510 Water Distribution System
 4. Section 02530 Sanitary Sewer System
 5. Section 02540 Reclaimed Water System
 6. Section 02920 Lawns and Grasses
- B. The City of Raleigh Public Utilities Handbook, as it relates to this Section, shall be used in conjunction with this specification. All aspects of the project construction shall conform to this handbook unless specifically noted otherwise herein. It is the Contractors responsibility to obtain this document from Raleigh Water. It can be obtained by phone at 919-857-4540 or on the internet at <http://www.raleigh-nc.org/> under Departments and Water.
- C. In the event of a discrepancy between this specification and the Handbook, the Contractor shall use the more stringent of the two documents. Notify the Owner immediately of the discrepancy.

1.03 REFERENCED STANDARDS

- A. The latest revision, at the time of bidding, of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
1. N.C. Department of Transportation - Standard Specifications for Roads and Structures (NCDOT).
 2. American Society of Testing Materials (ASTM)

- a. D698 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5-lb (2.49 Kg) Rammer and 12-inch Drop (Standard Proctor).
- b. D1556 Density of Soil in Place by the Sand-Cone Method.
- c. D1586 Penetration Test and Spilt-Barrel Sampling of Soils.
- d. D2049 Test for Relative Density of Cohesionless Soils.
- e. D2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures.
- f. D2487 Classification of Soils for Engineering Purposes.
- g. D3839 Standard Guide for Underground Installation of "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe and Fittings.
- 3. American Water Works Association (AWWA)
 - a. Fiberglass Pipe Design Manual of Water Supply Practices M45
 - b. PVC Pipe Design and Installation Manual for Water Supply Practices M23
 - c. Ductile Iron Pipe and Fittings Manual for Water Supply Practices M41
- 4. Uni-Bell PVC Pipe Association
 - a. B-5-89 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Sewer Pipe.
- 5. Ductile Iron Pipe Research Association (DIPRA)
 - a. 8-08/5M Design of Ductile Iron Pipe

1.04 DEFINITIONS

- A. Backfill: A specified material used in filling the excavated trench and placed at a specified degree of compaction.
 - 1. Materials: Materials listed herein include processed materials plus the soil classifications listed under the Unified Soil Classification System, (USCS) (Method D2487 and Practice D2488). The soil materials are grouped into five broad categories according to their suitability for this application.
 - a. Class I: Angular, 6 to 40-mm (1/4 to 1-1/2-in), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shell.
 - b. Class II: Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 in.), including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.
 - c. Class III: Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.
 - d. Class IV: Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials shall not be used for bedding, haunching, or initial backfill.
 - e. Class V: This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rock larger than 40 mm (1 1/2 in.) in diameter, and other foreign materials. These materials shall not be used for bedding, haunching, or initial backfill.
 - 2. Backfill Zones: Each backfill zone shall extend the full width of the trench bottom.
 - a. Foundation: Extending down from the bottom of bedding zone as defined below.

- b. Pipe Embedment
 - 1) Bedding: Extending from 4 inches below the pipe bottom to the pipe bottom for 30-inch diameter and smaller and 6 inches below the pipe bottom for pipes larger than 30 inches in diameter.
 - 2) Haunching: Extending from the bedding (bottom of the pipe) to the pipe spring line.
 - 3) Initial Backfill: Extending from the haunching (pipe spring line) to 1 foot above the top of the pipe.
 - c. Final Backfill: Extending from the initial backfill to the finish ground elevation.
- B. Laying Conditions:
- 1. Type 1: Flat bottom trench with loose backfill.
 - 2. Type 2: Flat bottom trench with backfill lightly consolidated to centerline of pipe.
 - 3. Type 3: Pipe bedded in 4 inches minimum of loose soil and backfill lightly consolidated to top of pipe.
 - 4. Type 4: Pipe bedded on Class I material to 1/8 pipe diameter (4 inch minimum) Backfill compacted to top of pipe a minimum of 80 percent of standard proctor.
 - 5. Type 5: Pipe bedded in compacted Class I material to pipe centerline with 4-inch minimum under pipe. Backfill to top of pipe with Class I, II, or III and compact to 90 percent of standard proctor.
- C. Compaction: Process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of compaction" shall be expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D698 (Standard Proctor).
- D. Excavation: The removal of soil or rock to obtain a specified depth or elevation.
- E. Lift: Layer of soil placed on top of a previously prepared or placed soil.
- F. Rock: Solid, homogeneous material which cannot be removed without the systematic drilling and blasting exceeding 1 cubic yard in volume. Material having a standard penetration rate less than 1-inch of penetration over 50 blows across continuous materials is defined as "rock." Rock is further defined as materials and obstructions encountered that cannot be practically excavated with a large track mounted backhoe, such as a CAT-325 or larger, equipped with a 42-inch rock bucket and new rock teeth. Practical excavation is defined as the ability to remove at least 10 cubic yards during one (1) hour of continuous digging. Removal of "hard material" will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.
- G. Pipe Springline: A line running horizontally through the center of the pipe.
- H. Topsoil: Natural, friable soil, representative of productive soils in the vicinity of the site. Topsoil shall be free from roots, stones larger than 1 inch, objectionable weed seeds, toxic substances, and materials that hinder grading, planting, and maintenance operations.

1.05 SUBMITTALS

- A. Submit the following in accordance with Section 01330, Submittal Procedures:
- 1. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Clearly indicate equipment to be furnished for the Project including options to be provided.
 - a. Warning / Identification tape.

- b. Geofabric for trench stone wrap.
- 2. Test Reports: Submit for the following:
 - a. Moisture-density relations of soils.
 - b. Field moisture content.
 - c. Soil classification.
 - d. In-place field density.
 - e. Geotechnical engineer's daily field reports.
 - f. Third-party test reports for pre-construction condition assessments, crack monitoring and vibration monitoring per Section 02300, Earthwork.

PART 2 PRODUCTS

2.01 STONE

A. Class I material shall be #67 or #78M stone in accordance with NCDOT specifications Section 1005, General Requirements for Aggregate.

B.

2.02 WARNING AND IDENTIFICATION TAPE

A. Tape shall be a minimum 3-inch wide polyethylene plastic tape manufactured specifically for identification of buried utilities with means of enabling detection by a metal detector to a minimum depth of 3 feet. Tape shall be color coded and continuously imprinted with warning and identification markings in bold black letters to read "CAUTION - BURIED (utility) LINE BELOW." Color and printing shall be permanent, unaffected by moisture or soil and shall be as follows:

Utility	Color	Marking
1. Reclaimed Water	Purple	Caution – Buried Reclaimed Water Line Below
2. Sewer	Green	Caution - Buried Gravity Sewer Main Below Buried Pressure Sewer Line Below
3. Water	Blue	Caution – Buried Water Line Below

B. Tape shall be by Blackburn Manufacturing, Joseph G. Pollard Co., or Reef Industries Inc or approved equal.

C. Warning tape shall only be installed for pressure mains constructed of PVC materials.

2.03 TRACER WIRE AND INDICATION POSTS

A. All non-ferrous pressure mains shall be provided tracing wire and test ports in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.

B. Tracer wire shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.

C. Test ports with marker posts shall be located at bends and no further than 500 feet apart. The test port shall consist of a standard valve box (as specified in Section 02530), shall be H-20 traffic load rated flush with grade in non-paved areas and flush with final asphalt or concrete pavement elevation and shall be located over the

downstream or outgoing main. The valve box shall be equipped with a lid stamped "TS" and painted green for sewer mains, blue for water mains, and Pantone 522C for reuse mains. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three feet.

2.04 TRACER WIRE FOR NONMETALLIC WATER SERVICE PIPE

- A. Where nonmetallic water service pipe is allowed, all new nonmetallic water service pipes shall be provided tracing wire in such a manner as to be able to properly trace all mains and service laterals without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.
- B. Tracing shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity.
- C. The meter box at or near the right of way and or easement shall serve as the test port with the tracing wire brought up into the meter box with the service lateral and looped in the meter box. The loop wire inside the meter box shall be a minimum of three feet.
- D. For new nonmetallic water service laterals where no tracer is installed on the main, provide an anode (1 pound minimum) for the tracing wire termination at the point of the new tap on the main.
- E. For nonmetallic service lateral installations less than 8 feet, the tracing wire shall be attached to the pipe. For nonmetallic service lateral installations deeper than 8 feet, the tracing wire shall be installed at a depth of 7 to 8 feet. For nonmetallic service laterals that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.
- F. For nonmetallic service lateral that installed by directional drilling, the tracer wire shall be attached to and pulled through with the service pipe.
- G. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Spliced connections shall only be allowed between the main liner tracer wire (if applicable) and the lateral tracer wire. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
- H. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at his own expense.
- I. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire.

2.05 TRACER WIRE FOR GRAVITY SEWERS AND LATERALS AND MANHOLE MARKERS

- A. In accordance with General Statute 87-121(g), gravity sewers and laterals installed after October 1, 2014 shall be electronically locatable.
- B. All new gravity sewer main and sanitary sewer lateral shall be provided tracing wire in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.

- C. Tracing shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.
- D. For gravity mains, test ports shall be provided at frequency of 500 feet or at every manhole, whichever is the shorter of the distance. The test port shall consist of a standard valve box (as specified in Section 02530), shall be H-20 traffic load rated flush with grade in non-paved areas with concrete collar as shown on Detail W-17, and flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main. The valve box shall be equipped with a lid stamped "TS" and painted green. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three feet. All tracing wire for branch mains and laterals that terminate into the manhole shall be routed around the circumference of the manhole and spliced to the main tracing line.
- E. For sanitary sewer laterals, the cleanout at the right of way and or easement shall serve as the test port with the tracing wire brought up outside the cleanout assembly and wrapped around the assembly stack twice at a depth of approximately 12-inches below grade. Extend a loop of the wire to the top of cleanout.
- F. For new sanitary sewer laterals where no tracer is installed on the main, provide an anode (1 pound minimum) for the tracing wire termination at the point of the new tap on the existing main.
- G. For gravity main and or lateral installations less than 8 feet, the tracing wire shall be attached to the pipe. Tracer wire shall be laid flat and securely affixed to the pipe at 10 foot intervals. Where lateral taps are made by service saddles, the tracer wire shall not be allowed to be placed between the saddle and main. For gravity main and or lateral installation deeper than 8 feet, the tracing wire shall be installed at a depth of 7 to 8 feet. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted.
- H. Spliced connections shall only be allowed between the main line tracer wire and branch main and lateral tracer wire. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
- I. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at their own expense.
- J. Where existing branch mains are reconnected to a main line that is replaced or realigned, tracing wire is not required for the section of branch main that is reconnected unless it is replaced from manhole to manhole. All main lines that are replaced or realigned shall be provided tracing wire.
- K. For gravity sewer mains and laterals that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.
- L. Manhole markers shall be placed adjacent to manholes at the discretion of Owner or Owner's representative.

2.06 TRACER WIRE FOR REUSE MAINS

- A. Tracer wire to be installed on all PVC reuse pipe in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the trace wire.
- B. Tracer wire shall be #12 gauge solid (bare) copper and continuous to the greatest extent possible. Copper clad steel tracer wire (#12) as manufactured by Copperhead Industries, or approved equal is an approved alternative to #12 bare solid copper tracer wire. The tracer wire shall be securely bonded together at all wire joints with an approved industrial crimp connector to provide electrical continuity. It shall be accessible at all tracer wire test ports.
- C. Test ports with marker posts shall be located at bends and no further than 300 feet apart. The test port shall consist of a standard valve box with a concrete collar, shall be H-20 traffic load rated flush with grade in non-paved areas with concrete collar as shown on detail W-17, and flush with final asphalt or concrete pavement elevation and shall be located over the downstream or outgoing main. The valve box shall be equipped with a lid stamped "TS" and painted Pantone 522C for reuse mains.
- D. At each test port, a loop of wire shall be brought up and looped inside the box. The loop of wire inside the box shall be a minimum of three feet.
- E. The wire shall be protected from damage during the execution of the work. No breaks or cuts in the tracer wire shall be permitted. Industrial crimps shall be used to provide electrical continuity and the crimps shall be similar metal to eliminate galvanic corrosion.
- F. Contractor shall perform a continuity test on all tracer wire in the presence of the Owner or Owner's representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of wire at their own expense.
- G. All main lines that are replaced or realigned shall be provided tracing wire.
- H. For reuse mains that are installed in encasement pipe, the tracing wire shall be routed through the encasement pipe.

PART 3 EXECUTION

3.01 PROJECT SAFETY

- A. Contractor is responsible for Project safety.
- B. Perform work in conformance with applicable State and Federal safety regulations including, but not limited, to the following:
 - 1. North Carolina Safety and Health Standards for the Construction Industry (29CFR 1926 Subpart P and U).
 - 2. NC OSHA Industry Guide No. 14, Excavations.
 - 3. NC OSHA Industry Guide No. 20, Crane Safety.
- C. Provide barriers, warning lights, and other protective devices at excavations as necessary for safety of workers and the public.
- D. Provide sloping of bank, shoring, sheeting, or other means of maintaining the stability of the trench in accordance with the requirements of the Associated Contractor's Manual of Accident Prevention OSHA, Part 1926.P.

- E. In trench depths of 22 feet or greater, provide certification sealed by Structural Engineer certifying that trench box, sheeting and shoring meets OSHA requirements.

3.02 VIDEO AND PHOTOGRAPHIC INSPECTIONS

- A. Provide pre and post construction video inspections of the project area in accordance with Section 01320, Video and Photographic Documentation.
- B. Submittal shall be in accordance with Section 01330, Submittal Procedures.

3.03 PROTECTION OF UNDERGROUND FACILITIES

- A. Refer to paragraph 4.04 of the General Conditions and SC-4.04.A.2 of the Supplementary Conditions concerning the protection of Underground Facilities.
- B. Prior to beginning any excavation work or boring, the Contractor shall, through field investigations, determine any conflicts or interferences between existing utilities and new utilities to be constructed under this project. This determination shall be based on the actual locations, elevations, slopes, etc., of existing utilities as determined in the field investigations, and locations, elevation, slope, etc. of new utilities as shown on the Drawings. If an interference exists, the Contractor shall bring it to the attention of the Engineer as soon as possible. If the Engineer agrees that an interference exists that was not apparent from the Contract Documents, or could not have been identified during a site visit during bidding, he shall modify the design as required. Additional costs to the Contractor for this change shall be processed through a Change Order as detailed elsewhere in these Contract Documents. An interference shall be defined for these purposes as a conflict with an existing utility or structure that prevents the proposed utility from being installed where shown or specified after existing utilities and structures are adequately supported by the Contractor. In the event the Contractor fails to complete adequate field evaluations to identify conflicts, or bring a potential conflict or interference to the attention of the Engineer prior to beginning excavation work, any actual conflict or interference which does arise during the Project and could have been avoided with diligent utility location efforts shall be corrected by the Contractor, as directed by the Engineer, at no additional expense to the Owner.
- C. A change in conditions may be considered due to the location of the existing facilities as allowed in the General Conditions. This does not include the cost for repair of damaged facilities not properly located in advance of construction.
- D. Separation distances shall be in accordance with utilities requirements.

3.04 CONSTRUCTION STAKING

- A. Provide construction staking as indicated in paragraph 4.05 of the General Conditions. Engineer will only provide electronic design files for Contractor's surveyor and key reference points and benchmarks as shown on the Drawings.
- B. Contractor shall report to Engineer whenever a reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations. Contractor shall be responsible for the accurate replacement or relocation of such reference points or property monuments by a registered professional surveyor in the State of North Carolina.

3.05 LOCATION OF INSTALLED UTILITIES

- A. Contractor shall be responsible for locating contract installed utilities as requested by third parties proposing to dig in the contract area until the date that the entire contract is recommended for final payment by Engineer to Owner.

3.06 WATER CONTROL

- A. Prevent surface water from entering the trench.
- B. When trench bottom is below the existing ground water table, install a dewatering system to maintain water table a minimum of two (2) feet below trench bottom. Provide personnel experienced in dewatering work at the job site.
- C. Maintain dewatering until backfilling has proceeded above the existing ground water level.
- D. Dispose of water from dewatering operations in accordance with the North Carolina Sedimentation Pollution Control Act.
- E. In no case shall trench water or groundwater be pumped into or allowed to enter the sanitary sewer system.

3.07 USE OF EXPLOSIVES

- A. Blasting is allowable for the removal of rock, as defined herein, unless specifically prohibited by the Owner, Engineer or a Utility Owner with an existing utility within the proximity of the proposed blast site. The contractor shall review the drawings for specific areas where blasting is prohibited.
- B. Obtain required permits for blasting (e.g., from City of Raleigh Fire Marshall's Office) prior to blasting, 24 hours minimum.
- C. Store, handle, and use explosives in accordance with all applicable local, state, and federal regulations, and in accordance with the provisions of the "Manual of Accident Prevention and Construction" of the Associated General Contractors of America, Inc. Federal regulations include, but are not limited to, Title 27, Chapter 11, Part 555 of the Code of Federal Regulations (CFR) and OSHA Standards – Part 1926, Subpart U.
- D. Provide seismographic monitoring during progress of blasting operations.
- E. Take all necessary precautions to protect life and property, including the use of an approved blasting mat where there exists the danger of throwing rock or overburden. Keep the explosive materials that are on the job site in specially constructed boxes provided with locks. Failure to comply with this specification shall be grounds for suspension of blasting operations until full compliance is made. No blasting shall be allowed unless a galvanometer is employed to check cap circuits. Where blasting takes place within 500 feet of a utility, structure, or property which could be damaged by vibration, concussion or falling rock, keep a blasting log containing the following information for each and every shot. This log shall be kept in an orderly manner and made available to the Engineer and Owner upon request.
 - 1. Date of shot
 - 2. Time of shot
 - 3. Crew supervisor
 - 4. Number and depth of holes
 - 5. Approximate depth of overburden
 - 6. Amount and type of explosive used in each hole

7. Type of caps used (instant or delay)
 8. The weather
 9. Seismograph instrument and readings
- F. Use explosives in such a way to minimize vibration to existing utilities and structures.
 - G. Provide only experienced personnel for blasting in accordance with accepted practices.
 - H. Contractor is responsible for safety of life and damage to property resulting from the use of explosives. The Owner and Engineer shall be made aware of all blasting activities prior to their occurrence.
 - I. Provide services of a testing firm experienced in monitoring vibrations resulting from blasting operations as specified in Section 01450, Quality Control.
 - J. In addition to the above testing/monitoring requirements required, Contractor shall provide the services of a "third party" geotechnical testing firm experienced in monitoring vibrations resulting from blasting operation as specified in Section 01450, Quality Control. The firm selected shall be evaluated by the Engineer and Owner for approval as the official "third party".
 - K. Third Party testing/monitoring as related to blasting operations shall include the following:
 1. Pre-Construction Condition Assessment
 - a. Prior to beginning construction, the third party testing firm shall perform a pre-construction condition assessment to document the conditions of buildings and other sensitive structures within ***Distance for Blast Assesment*** feet of the proposed blasting area. The assessment shall be performed on all adjacent properties and any other properties as directed by the Engineer or Owner. The assessment should include video and photographic documentation of all exteriors including building foundations, and installation of crack monitors on cracks that might occur or expand due to construction vibrations. Provide all documentation described above to the Owner and Engineer prior to construction.
 2. Crack Monitoring During Construction:
 - a. During construction, the third party testing firm shall perform periodic readings of the crack monitors installed prior to construction. Provide readings to the Engineer and Owner within 48 hours of taking the reading. If crack readings monitoring confirm that vibrations are not contributing to crack width, crack monitors may be read once per week. More frequent readings may be required by Owner or Engineer if construction activities could result in greater earthborne vibrations. Testing firm shall notify the Engineer and Owner immediately if monitoring indicates that construction operations have contributed to crack widening. The testing firm shall prepare a detailed plan for repaired the structure and the Contractor shall repair the structure at no cost to the Owner. Contractor shall submit a plan for review that proposes alternate construction methods to address the vibration problems and minimize further damage.
 3. Vibration Monitoring During Construction:
 - a. The third party testing firm shall monitor vibrations at no less than four locations along the perimeter of the project during all blasting activities. The locations shall be based on the location of construction activities and their relative position to offsite structures. Prior to construction, a plan

showing the proposed monitoring locations shall be submitted to the Engineer and Owner for approval. Adjustments may be made to the locations upon approval. The sensitivity range of the seismograph shall be selected such that the recording is initiated below the maximum allowable particle velocity of 1 in/sec and extends above the highest expected intensity. Specific activities of the vibration source (i.e., blasting) shall be indexed in time to allow correlation with the arrivals on the vibration.

- b. The maximum allowable particle velocity is 1 in/sec. The contractor shall notify the Engineer and Owner immediately if monitors indicate that the vibrations are above the criteria established. Activities causing the vibrations shall be suspended until a revised construction plan has been developed by the testing firm to alleviate the problem. The problem shall be resolved by the Contractor at no additional cost to the Owner.
- c. The vibration monitors shall consist of digital seismographs that display the particle velocities and associated frequencies plotted against the criteria established for this project. Each seismograph shall contain geophones with response capability in three mutually perpendicular axes or components; one vertical and two horizontal (radial and transverse). The frequency response of the geophones shall be linear from at least 4 Hz to more than 200 Hz. The sensitivity shall range from less than 0.02 in/sec to more than 5.0 in/sec. The BlastMate III by InstanTel is one type of seismograph that is suitable for this project.
- d. Vibration monitors shall be field calibrated by the testing firm before each recording period. The transducer shall be positioned with the longitudinal axis toward the vibration source. Transducers must be adequately coupled with the ground. Operation and calibration of all equipment shall be per manufacturer's recommendations. Vibration records shall be collected in waveform plot or strip chart plot. The peak vector sum of the particle velocity in longitudinal, transverse, and vertical planes shall be shown along with the respective dominant or principle frequencies. The highest recorded particle velocity (i.e., the vector sum of the three orthogonal directions), when indexed to a particle vibration event, shall be reported as the peak particle velocity. The recorded peak particle velocity shall be compared to criteria appropriate for the subject of concern.
- e. The Engineer and Owner shall be notified immediately of any complaint received by the Contractor. The Contractor shall immediately review those construction activities inducing the vibration and prepare a report documenting all relevant data such as the time and date of the complaint, a description of the construction activities, data from the monitoring instruments for the subject time/date, complaint information (including photographs, if possible) of the alleged damage. The Contractor shall submit for review a detailed plan for repair and revised construction plan to address the vibration problems to minimize further damage and complaints. The Contractor shall perform necessary repairs at no additional cost to the Owner.
- f. The testing firm shall provide monthly reports containing the results of the crack monitors and vibration monitors during those activities that generate earthborne vibrations, including but not limited to blasting operations. The reports shall document that the firm is provided the work described herein.

- L. Submit monitoring reports in accordance with Section 01450, Quality Control.

- M. Allowance established in Section 01270, Unit Prices, shall be utilized to pay for costs of the third party monitoring.
- N. The Owner reserves the right to require the removal of rock by other means if blasting operations result in possible hazardous conditions.
- O. The Contractor shall provide as contingency, on-site, by-pass pumping capability when blasting within 100 feet of existing sanitary sewer infrastructure or where required otherwise as noted on the Drawings or specified in other sections of the project manual.

3.08 EXCAVATING

- A. Excavation shall be by open cut, unless otherwise indicated on the Drawings or specified herein. Other than where specifically indicated on the Drawings, short sections of trench may be tunneled or direct bored with the approval of the Engineer.
- B. Stockpile excavated material in such a manner that it will not obstruct the flow of runoff, streams, endanger Work, impair the use or appearance of existing facilities, or be detrimental to the completed Work.
- C. Contractor shall segregate excavated material so as to maintain material suitable for backfill separate from material that is unsuitable.
- D. Trench dimensions at the pipe embedment and foundation zone, shall be as detailed on the drawings.
- E. Shape trench bedding to provide uniform bearing for the full pipe length. Bottom shall be free of protrusions that could cause point loading on pipe. Provide bell holes as required for properly making pipe joint.
- F. Do not over excavate. Excavation below grade without approval of Engineer shall be backfilled with Class I material at no additional cost.
- G. Undercut soils that become unsatisfactory by construction activity or by being left exposed to the weather shall be replaced with Class I backfill material at no additional cost.
- H. Remove shoring, bracing, and sheeting, unless otherwise noted, as the trench is backfilled. Engineer shall have the authority to require that the sheeting be left in place. Once the trench box has been removed to the top of the pipe (or initial backfill zone), the stone shall be replenished to have the required stone over the pipe for the entire width of the excavation. This includes area displaced by the trench boxes and any voids outside the box.
- I. Excavation of trench shall not advance more than 100 feet ahead of the installation. In no case should the excavation extend beyond that which can be backfilled by the end of the workday.
- J. Correct unstable soil conditions encountered at trench foundation by the following method:
 - 1. Excavate below grade as approved by Engineer and backfill with Class I material or approved substitute material at unit price bid as indicated in Section 01270, Unit Prices.
- K. Rock and Hard Material
 - 1. Excavate rock and hard material to a minimum depth of 6 inches below the pipe. Excavation shall be backfilled with Class I material.

2. Mechanical removal of rock (i.e., no blasting) may be necessary along portions of the project, as noted on the Drawings or as required by the applicable regulatory agencies, where blasting could result in complications with surrounding infrastructure. This method of rock excavation will be used only when approved by the Owner, as the blasting method shall be the typical method.
- L. Pressure Lines:
1. Provide a minimum 3 feet of cover, unless indicated otherwise on the Drawings.
 2. Excavate trenches to provide vertical curve chords that will not exceed the pipe manufacturer's recommended joint deflection.
 3. Provide concrete thrust blocks having a compressive strength of 3,000 psi at 28 days at change in horizontal and vertical direction and reduction in the pipe size, unless other restraint systems are indicated otherwise on the Drawings. Cut trench sides vertical and square to receive concrete. Provide bearing area against trench wall as indicated on the Drawings.
- M. Gravity Lines:
1. Excavate trench to the alignment and grade indicated on the Drawings.
- N. Utility Structures: Provide a minimum of 9 inches below subgrade and backfill with Class I compacted to 95 percent maximum density. If the soil conditions are found to be unsuitable for structural stability of the structure, Engineer may require additional depth of Class I material. The additional Class I material will be paid for under the appropriate bid item as indicated in the Bid Form.

3.09 BACKFILLING

- A. Weather Limitations: Proceed with backfill operations based on the following weather conditions:
1. Temperature must be above freezing and rising.
 2. In windy, hot, or arid conditions with a high rate of evaporation add moisture to the material to maintain the optimum moisture content.
 3. Do not proceed in rain or on saturated subgrade.
 4. Do not place material on surfaces that are muddy, frozen, or contain frost.
- B. General
1. Maintain backfill operation within 100 feet from pipe laying operation.
 2. Backfill trench to existing ground surface with select excavated material at the specified compaction.
 3. If excavated material is unsuitable to obtain specified compaction, provide suitable off-site borrow material for backfill as approved by Engineer.
 4. Re-excavate trenches improperly compacted. Backfill and compact as specified.
 5. Provide appropriate tamping equipment, and water to obtain proper moisture content, to achieve specified compaction of backfill.
 6. Conduct operation of heavy equipment above pipe installation in such a manner as to prevent damage to pipe.
 7. Install warning / identification tape over utilities. Bury tape one foot below finished grade above the utility.
 8. Install tracer wire for non-metallic pressure pipe. Bury tracer wire one foot below finished grade over the pipe. Wire shall be looped into valve boxes and indication posts to allow access for direct contact location.

- C. Backfill in pipe embedment zone (bedding, haunching, and initial backfill).
1. General:
 - a. Backfill with material as specified below. Material shall be free from objects larger than 2 inches.
 - b. Where rock and hard material has been excavated below pipe bottom, backfill and compact bedding with Class I material. Class II or III material may be used for bedding with Engineer's approval unless specified otherwise below.
 - c. Place backfill material to assure placement of material under pipe haunches.
 - d. Take care during placement and compacting of material to avoid movement of pipe.
 2. Place backfill in bedding and haunching zones in 6 inch maximum lifts in traffic areas and 12 inch maximum lifts in non-traffic areas and compact to 90 percent density. Provide backfill material in pipe embedment zone as specified below.
 - a. Pressure Lines (Flexible and Rigid Pipe)
 - 1) Excavation in Class I, Class II, Class III, and stable Class IV soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.
 - 2) Excavation in Class V, unstable Class IV soils, running water, and other unstable soil conditions, excavate a minimum of 6 inches below pipe bottom and provide Class I material for bedding and haunch zone. Backfill with Class I, II, or III material in initial backfill.
 - b. Gravity Sewer Lines, Rigid pipe (ductile iron)
 - 1) Excavation in Class I, Class II, Class III, and stable Class IV soils suitable for bedding, the bedding surface shall provide a firm foundation of uniform density. Backfill with select excavated material.
 - 2) Excavation in Class V, unstable Class IV soils, running water, and other unstable soil conditions, excavate a minimum of 4 inches below pipe bottom and provide Class I material for bedding and haunch zone. Backfill with Class I, II, or III material in initial backfill.
 - c. Gravity Sewer Lines, Flexible (CCFRPM)
 - 1) Depth of cover 0 to 40 ft:
 - i) Provide Class I material for bedding and through embedment zone to 12" above the top of pipe.
 - d. Gravity Sewer Lines, Flexible (PVC SDR 35)
 - 1) Depth 0 to 12 ft: Provide Class I material for bedding and haunching. Backfill with Class I, II, or III material in initial backfill.
 - e. Gravity Sewer Lines, C900/C905
 - 1) Refer to Drawings.
- D. Final Backfill
1. Backfill with materials free of stones and debris larger than 6 inches in dimension. Place backfill in lifts not exceeding the thickness and compacted to the minimum density specified below.
 2. Lifts and density:
 - a. Undeveloped areas (i.e., forests, fields, and, croplands): Trench may be filled with bulldozer blade provided material fall will not damage pipe. Mound soil over the trench area sufficiently to settle level over time. Degree of compaction shall be 85 percent.
 - b. Lawns: Backfill in 12-inch lifts and compact to 90 percent. Top 12 inches shall be free of material with a dimension over 2 inches.

- c. Roads (including Rights-of-way), drives, parking areas (including areas within 20 feet), and adjacent to existing utilities: Backfill in 6 inch lifts compact to 95 percent. Compact the final 8 inches below finished subgrades beneath pavements/sidewalks to at least 100% of the soil's Standard Proctor maximum dry density within 2% of optimum moisture.
 - d. Within 20 feet of foundations: Backfill in 6-inch lifts compacted to 95 percent.
- E. Utility Structures: Bring backfill to grade in even lifts on all sides. Lift depths and compaction densities shall be as specified according to area of installation for pipe above. Backfill against cast-in-place concrete structure only after concrete has attained the specified 28-day compressive strength.

3.10 ANTI-SEEP COLLARS

- A. Anti-seep Collars: Provide anti-seep collars to prevent groundwater flow along pipe in wetlands as indicated on the Drawings. Collars shall extend past trench walls and bear against undisturbed soils. Dimension of collars shall be as indicated on the Drawings. Do not place stone in area of anti-seep collars.
- B. Concrete Collar: Provide Class B concrete with minimum cement content of 5 sacks per cubic yard (5.5 sacks for angular course aggregate); 6.8 gallons of water per sack water-cement ratio; 2-4 inch slump range; and 28-day strength of 2,500 psi.
- C. Clay Collar: Provide clay of medium to high plasticity with a soil classification of CL or CH and a permeability of 10-5 cm / second. Place clay in 6-inch lifts and compact by use of a mechanical hydraulic tamper to 95 percent.

3.11 SOIL TESTING

- A. Provide services of a soil-testing firm as specified in Section 01450, Quality Control.
- B. Testing laboratory soil specialist shall be at the project site, upon request of the Owner, to perform inspection and in-place density testing as specified in Section 02300 Earthwork.
- C. Density tests shall be made in accordance with ASTM D-698, Standard Proctor Method.
- D. Submit test reports and soil specialist daily logs in accordance with Section 01450, Quality Control.
- E. Allowance established in Section 01270, Unit Prices, shall be utilized to pay for costs of the initial tests.
- F. For each test that fails the compaction requirements, the testing firm, at the direction of the Engineer, shall make two additional tests. Contractor shall pay for cost of additional tests due to failure of compaction/density test.
- G. Based on test results, make corrections, adjustments, and modifications of methods, materials, and moisture content for proper trench compaction.

3.12 PAVEMENT REMOVAL AND PATCHING

- A. Repair damaged pavement structure.
- B. Cut existing pavement for utility installation in straight lines generally parallel to the utility. Properly dispose of removed pavement structure.
- C. Extend pavement patch 1 foot beyond each side of trench on firm subgrade. Slope new surface to drain.

- D. Asphalt Pavements: Replace asphalt pavement with a pavement structure equal to existing but no less than as detailed on the Drawings or as indicated in the Encroachment Agreement, whichever is more stringent.
- E. Concrete Pavements: Replace concrete pavement with pavement structure equal to existing but no less than as detailed as Drawings. Concrete shall be minimum 3,000 psi. When existing concrete joint is within 5 feet of trench remove existing concrete to joint. Provide expansion joint at edge of existing concrete. Surface treatment shall match existing. For overlays, as indicated on Drawings, set new driveway elevation at overlay depth and transition to existing driveway elevation.
- F. Curbs, Gutters, and Sidewalks: Replace curbs and gutters, and sidewalks removed or damaged with similar sections to match the existing. Remove to nearest existing joint.
- G. Approval of Other Authorities: Pavements under the jurisdiction of the NC Division of Highways shall be subject to the approval of a representative of that Division.
- H. For overlays, coordinate final limits with Owner, Engineer, and NC Division of Highways. Perform in accordance with NCDOT Encroachment Agreement.
- I. For overlays, as indicated on Drawings, raise existing and new manholes and valve boxes to finished pavement grade. Excavate around top of existing manhole and valve box as necessary. Remove existing top ring, and install new grade ring(s) as necessary. Install existing cover. Raise existing valve box. Provide concrete collar around manhole ring and valve box per details on the Plans.
- J. See Section 02700, Pavement and Appurtenances for additional requirements.

3.13 GRADING AND CLEAN-UP:

- A. Provide for testing and clean up as soon as practicable, so these operations do not lag far behind the pipe installation. Perform preliminary clean up and grading as soon as backfill is complete.
- B. Provide positive drainage of finished grade and drain away from structures. Finished grade shall be reasonably smooth, compacted, free from irregular surface changes and comparable to the adjacent existing ground surface.
- C. Seed disturbed areas in accordance with Section 02920, Lawns and Grasses.
- D. Upon completion of backfilling, remove and properly dispose of excess material and waste. Surplus materials shall be disposed in an Owner-approved facility. A list of approved facilities is available from City of Raleigh - Raleigh Water. The Contractor may submit an alternate facility for Owner approval, prior to utilization, in accordance with the Contract Documents.

END OF SECTION

U.S. BUREAU OF MINES VIBRATION GUIDELINES

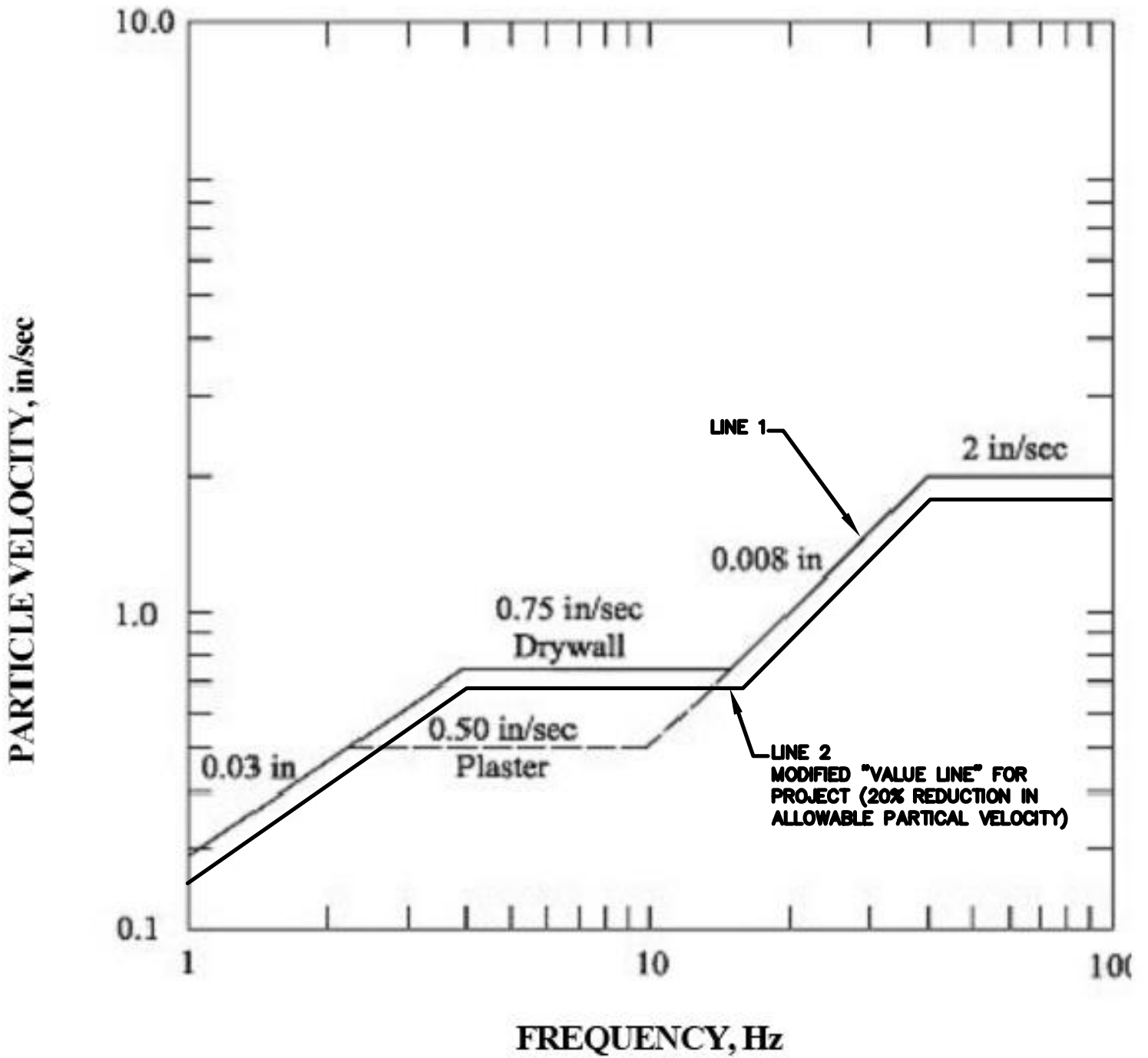


EXHIBIT 1

SECTION 02370

EROSION CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Provide erosion control work. Work shall include, but not be limited to, the following:
 - 1. Erosion control at project site.
 - 2. Erosion control at borrows and disposal areas as required by Contractor. Cost shall include erosion control permits as necessary for borrow and disposal areas.
 - 3. Removal of surface debris.
 - 4. Maintain and remove erosion control devices.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 02230 Clearing and Grubbing
 - 2. Section 02300 Earthwork
 - 3. Section 02315 Trenching For Utilities
 - 4. Section 02410 Microtunneling
 - 5. Section 02920 Lawns and Grasses

1.03 REFERENCED STANDARDS

- A. "Erosion and Sediment Control Planning and Design Manual," issued by the N. C. Sedimentation Control Commission.

1.04 QUALITY ASSURANCE

- A. Conform to rules and regulations of the Erosion Control Laws of the State of North Carolina, specifically the Sedimentation Pollution Control Act of 1973 (G.S. 113A) as amended, and the local jurisdiction where the project is located.
- B. Post a copy of the approved erosion control permit, furnished by Owner, at the site prior to starting work. Maintain a copy of the approved erosion control plan at the site.
- C. Provide permanent ground cover as soon as possible, and no later than the number of days after completion of work in accordance with Section 02920, Lawns and Grasses.

1.05 WARRANTY

- A. Contractor is liable for damages to public and private property and fines as may be placed on the Project by the governing agencies due to failure to provide erosion control devices in accordance with approved erosion control plan.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Matting / Erosion Control Fabric (ECF): Matting and ECF shall be an excelsior, jute, and or 100% straw mulch fabric encased in a medium weight no plastic matting (both sides) with a minimum permissible shear stress of 1.75 lbs/ft². Matting shall be 100% bio-degradable but suitable until vegetation has been established. Installation of ECF shall be done with staples per temporary liner detail in the Drawings. Commercially available ECFs may be used upon approval of the engineer. Approval of fabrics will require manufacturer's design data regarding velocity, shear strength, ditch slopes, method of installation, decay cycle, repair techniques, and grass growth enhancement characteristics.
- B. Wire Staples: 16 gauge steel wire, with minimum of 3" top and 4" long legs.
- C. Gravel for Stone Filters: #57 crushed stone.
- D. Filter Fabric: 7-1/2 oz. burlap fabric or other silt filtering fabric.
- E. Riprap:
 - 1. Class A: Stone shall conform to NCDOT standards and shall range in size from 2 to 6-inches with the stone gradation being equally distributed within the required size range.
 - 2. Class B: Stone shall conform to NCDOT standards and shall range in size from 5 to 12-inches with the stone gradation being equally distributed within the required size range.
 - 3. Type 1: Stone shall conform to NCDOT standards and shall range in size from 5 to 17-inches with the stone gradation being equally distributed within the required size range.
 - 4. Type 2: Stone shall conform to NCDOT standards and shall range in size from 9 to 23-inches with the stone gradation being equally distributed within the required size range.
- F. Silt Fence
 - 1. Line Wires shall be minimum 10 gauge, and intermediate wires to be minimum 12-1/2 gauge.
 - 2. Silt fence to be geotextile fabric at a height of 26-inches above grade.
 - 3. Posts to be constructed of 5' steel, buried 2' deep with 3' above grade.

PART 3 EXECUTION

3.01 INSTALL EROSION CONTROL DEVICES

- A. Install erosion control devices, which shall be in place and operational prior to other land disturbing activity.
- B. After installing erosion control devices as indicated on the Drawings, verify that reasonable measures have been taken to prevent the sedimentation of nearby watercourses, existing and new facilities, and adjacent property.
- C. Should Contractor believe that additional measures are necessary to adequately prevent erosion, immediately notify Engineer. If rain is predicted before the Engineer can be notified, take measures as necessary to prevent siltation of nearby water courses and work will be paid for as provided in the General Conditions.

- D. After installing erosion control devices, request an inspection by the local agency having jurisdiction and the Engineer.
- E. Incorporate permanent erosion control work into the project at the earliest practicable time. Coordinate temporary erosion control measures with permanent erosion control measures and other work on the project to assure effective and continuous erosion control throughout the construction and post construction period.
- F. Maintain erosion control devices during construction until the disturbed areas are stabilized and the agency having jurisdiction and the Engineer have approved the removal of the erosion control devices.

3.02 BORROW AND DISPOSAL AREAS:

- A. Obtain and pay for erosion control permit for borrow and disposal areas as required by Contractor.
- B. Install and maintain erosion control devices in accordance with Contractor's approved plan.

3.03 MAINTENANCE

- A. Make required repairs immediately. Remove sediment deposits when deposits reach approximately one-half of the capacity of the erosion control device.
- B. Respread accumulated sediments on the project site in a manner that will not adversely affect erosion control facilities and permanent ground cover.
- C. Silt Fence/Inlet Protection: Should the filter fabric decompose or become ineffective before approval of its removal by the Engineer, replace fabric immediately at no additional cost to the Owner.
- D. Temporary Construction Entrance: Maintain entrance in a condition that will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with 2 inches of stone, as conditions require, at no additional cost to the Owner.

3.04 INSPECTIONS AND REPORTING

- A. Inspect erosion control devices within 24 hours after each rainfall and as required by the Erosion Control permit.
- B. Inspect all stormwater discharge outfalls within 24 hours after each rainfall and as required by the Erosion Control permit.
- C. Generate and submit inspection reports as required by the Erosion Control permit.
- D. Inspection reports shall be submitted to the City and review agency for approval, as applicable.

3.05 SEEDING

- A. Disturbed areas not covered by new construction shall be seeded.
- B. Provide temporary and permanent seeding in accordance with Section 02920, Lawns and Grasses.

3.06 STABILIZATION AND CLEAN-UP

- A. Remove erosion control devices upon the approval of the permanent stabilization of this site by the agency having jurisdiction of the area and the Engineer. Dress

sediment deposits remaining in place after the erosion control devices are removed to conform to the existing grade. Seed disturbed area in accordance with Section 02920, Lawns and Grasses. Include cost of removal and cleanup in the unit cost of the installation of the device.

3.07 MODIFICATIONS

- A. If the Contractor needs additional area outside the allowable construction limits as indicated in the contract documents, he or she shall notify the Owner and Engineer as soon as possible. Any additional area requested must be approved by the Owner prior to use and an amended Erosion and Sedimentation Control Plan will be required to be submitted to NCDENR Land Quality for approval. The Contractor shall be responsible for all engineering costs associated with submittal, review and approval of the amended plan including review fees. The Contractor shall not proceed with any work in the additional area prior to receiving a written copy of the modified Erosion and Sedimentation Control Plan approval.**
- B. The Contractor shall be responsible for any fees or fines issued by regulatory agencies due to non-compliant erosion and sedimentation control work.**

END OF SECTION

SECTION 02422

TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 - GENERAL

1.01 SCOPE

- A. The work described by this Section consists of furnishing all labor, equipment, materials and supplies required to install temporary excavation support systems associated with construction of launch and exit shafts.
- B. The work shall be done in accordance with the Contract Documents, and all Federal, State and local laws, regulations, and requirements.
- C. Contractor is fully responsible for safety. Comply with all OSHA regulations including, but not limited to, 29 CFR Part 1926. Obtain all required permits for confined space entry.
- D. Geotechnical reports, logs, borings, and laboratory testing performed within proximity of the project corridor are made available as "Technical Data" and are not part of the Contract. This technical data is provided as information only and solely for the convenience of Bidders. The Owner and/or the Engineer do not warrant or guarantee the accuracy or correctness of this technical data with respect to actual subsurface conditions. Subsurface conditions are considered unclassified and no expectation of quantity, specific location of ground conditions, or geotechnical baselines are provided or assumed herein.
- E. Contractor shall review all available geotechnical reports and data and perform any additional subsurface investigations he deems necessary at his own expense for the planning and the selection of temporary excavation support systems in order to enable proper construction.
- F. Dewatering shall be controlled such that the launch and exit shafts are free of water, but the surrounding groundwater table is not substantially lowered such that settlement of nearby existing structures and foundations does not occur and surrounding wells are not affected.
- G. Where warranted in the experience of the Contractor or where identified on the Drawings, ground modification shall be performed as part of the preparation for shaft construction to maintain a stable excavation, reduce the risk of surface settlement and heaving, and protect nearby structures and utilities. Contractor shall design and include in his Bid the cost of furnishing all labor, equipment, materials, and supplies necessary for ground modification.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02315 — Trenching for Utilities
- B. Section 02445 — Utility Hand Tunneling

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
1. Applicable codes, ordinances, statutes and governing rules and regulations of governing municipalities and counties, the State of North Carolina, and the Federal Government.
 2. American Association of State Highway and Transportation Officials (AASHTO).
 3. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
 4. Occupational Safety and Health Administration (OSHA) Regulations 29 CFR Part 1926.
 5. Applicable ASTM and AWWA Standards for materials and methods.
 6. North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures.

1.04 DEFINITIONS

- A. Authority having Jurisdiction: Any third-party agency from whom a permit, license agreement or other agreement has been obtained to allow for construction.
- B. Entrance and Exit Seals: Seals placed at the breakout into and out of the shafts. The seals are intended to prevent groundwater inflow and loss of ground into the shafts.
- C. Exit Shaft or Retrieval Shaft: Shaft at end of drive used for retrieval of tunneling equipment. The term "pit" is used synonymously with the term "shaft."
- D. Ground Modification: Ground stabilization by jet grouting, compaction grouting, permeation grouting or other ground stabilization techniques.
- E. Jacking Pipe: A casing pipe used as the initial support in a two-pass tunneling operation or as both the casing pipe and carrier pipe in a one-pass tunneling operation.
- F. Launch Shaft: Shaft at beginning of drive from which tunneling equipment is launched. The term "pit" is used synonymously with the term "shaft."
- G. Spoil: Excavated soil and rock material generated during shaft excavation.
- H. Thrust Block: Concrete or steel wall at the back of the launch shaft that provides a reaction for jacks pushing the pipe.
- I. Working Shaft: Shaft at beginning of drive from which tunneling activities commence. The term "pit" is used synonymously with the term "shaft".

1.05 DESIGN CRITERIA

- A. Temporary excavation support systems selected by the Contractor shall be compatible with the geologic conditions described in the available geotechnical data provided as Technical Data, and any additional geologic testing performed by the Contractor that he deems necessary to select appropriate equipment.
- B. Launch/working and exit shafts shall be designed by Contractor's Engineer.
- C. Design backstops, thrust blocks and concrete seals for all ground loads, and to prevent significant water intrusion. Thrust blocks shall be perpendicular to the proposed pipe alignment and shall be designed to withstand the maximum jacking pressure to be used, with a factor of safety of at least 2.0, without excessive deflection or displacement.
- D. All design calculations provided by the Contractor as part of the required submittals shall be sealed by a licensed Professional Engineer registered in the State of North Carolina.

1.06 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Qualifications
 - 1. Submit experience qualifications for the Contractor/Subcontractor constructing the temporary excavation support systems for shafts.
 - 2. The Contractor or Subcontractor shall have a minimum of five (5) years of experience constructing temporary excavation support systems of similar size and scope.
 - 3. Provide resumes and written documentation of the qualifications of the project manager, project superintendent, shift foremen, and operators in accordance with paragraph 1.07.
- C. Detailed Methodology
 - 1. Shop drawings for temporary excavation support systems showing layouts, dimensions, excavation methods, initial support installation sequence, and survey control plan.
 - 2. Drawings and design details for launch shafts and exit shafts. Design and calculations for temporary excavation support systems used in shaft construction, along with thrust reaction blocks that impact the temporary excavation support systems, shall be signed and sealed by a licensed Professional Engineer registered in the State of North Carolina.
 - 3. Number and duration of shifts planned to be worked each day in accordance with restrictions on work hours.
 - 4. Sequence of work/operations.
 - 5. Procedures for handling, control and disposal of surface water, water input to the excavation by Contractor, and groundwater inflow.

6. Method of spoil transportation, surface storage, and disposal location. A description indicating the locations of spoil disposal sites and releases from property owners.
 7. Survey methods.
- D. Ground Modification Plan: Contractor shall design and submit proposed ground modification plans for ground stabilization, surface settlement prevention, and cutoff of groundwater inflow due to temporary excavation support system activities.
 - E. Ventilation Plan: Ventilation plan shall include a written description, calculations, drawings, fan curves and manufacturer's catalogue cut sheets. Ventilation plan shall be designed by a competent person with at least five (5) years of recent on-the-job experience on similar projects, involving shafts of similar size constructed by similar methods. Provide qualifications of Designer.
 - F. Settlement Monitoring Plan: Submit a settlement monitoring plan for review prior to construction. The plan shall be in accordance with paragraph 3.03.
 - G. Daily Reports: A shift log shall be maintained on a daily basis by Contractor. Submit reports no later than 24 hours after the end of the shift to the Engineer. Daily reports shall include at a minimum the following:
 1. Extend of temporary excavation support system installation accomplished during shift.
 2. Hours worked per shift, equipment and materials used, and duration of different activities performed.
 3. Groundwater control operations, groundwater inflow location and rates.
 4. Observation of any ground loss or other ground movement.
 5. Any unusual conditions or events.
 6. Reasons for operational shutdown.
 7. Air quality reports for dust, toxic and hazardous gases, and other atmospheric impurities in the working environment.
 - H. Record Drawings: Maintain at the construction site a complete set of field drawings for recording of as-built conditions. All marks and notes shall be dated, and thorough.
 - I. Permits: The Contractor shall be responsible for executing the requirements of permits obtained from the NCDOT, United States Army Corps of Engineers, and any State and local authority where the project is located. The Contractor shall be responsible for any phase submittals required by the permits. All submittal information required by the project permits shall be channeled through the Engineer.

1.07 QUALITY ASSURANCE

- A. Work shall be supervised by at least one (1) person with five (5) years of recent previous experience in construction of temporary excavation support systems for shafts.

- B. All shaft construction operations shall be performed under the supervision of experienced shift foremen with at least five (5) years of recent on-the-job supervision experience on similar projects involving temporary excavation support systems of similar size constructed using similar methods.

1.08 PRE-INSTALLATION MEETING

- A. At least three weeks prior to commencing the work of this section, convene a Pre-Installation Meeting at the job site to be attended by:
 - 1. Contractor and any subcontractor performing any related work.
 - 2. Project Owner.
 - 3. Engineer.
 - 4. Any other pertinent stakeholder.
- B. Meeting shall cover settlement monitoring, work hours, safety, staging and storage of materials, schedule, any changes to on-site staff from original Work Plan submittal, permitting, and the development of record drawings, etc. to ensure successful implementation of all requirements of this Section.

1.09 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall accept material on site and inspect for damage.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.
- B. Conduct operations to not interfere with roadway traffic, except with prior approval by the NCDOT and other applicable governing authorities.
- C. Provide temporary facilities to prevent erosion of disturbed construction area in accordance with the approved Erosion & Sedimentation Control Plan and Contract Documents.
- D. Maintain existing stormwater flow patterns or submit measures to temporarily bypass in accordance with the Erosion & Sedimentation Control Plan and Contract Documents.

1.11 COORDINATION

- A. Coordinate work with local, State and Federal authorities and utility owners to avoid interference with or damage to existing facilities in or adjacent to construction areas.

PART 2 — PRODUCTS

2.01 MATERIALS

- A. Materials for temporary excavation support systems may be new or used, provided they are sound and free from any strength-impairing defects. The Contractor's Engineer must approve the use of used materials.
- B. Soldier piles, wales, struts, and accessory steel shapes shall conform to ASTM A36, ASTM A572 and ASTM A992 as applicable.
- C. Steel sheet piles shall conform to ASTM A572 or ASTM A3328.
- D. Bolts and fasteners shall conform to ASTM A307 or A325.
- E. Timber lagging and blocking shall be hardwood.

PART 3 — EXECUTION

3.01 PROJECT SITE CONDITIONS

- A. Shaft excavations and installation of temporary excavation support systems shall not begin until the following have been completed:
 - 1. Required submittals have been made and the Engineer has reviewed and accepted all submittals.
 - 2. Notify the Owner and Engineer at least 30 days before beginning any excavation.
 - 3. Ground modification has been performed, if required.
 - 4. A Safety Officer has been designated and prepared a Health and Safety Plan in accordance with OSHA requirements for shaft construction. The Safety Officer shall have held safety meetings and provided safety instruction for new employees as required by OSHA.
 - 5. Pre-installation meeting has been held and all comments have been addressed from the meeting.
 - 6. Settlement monitoring system is in place and pre-construction readings have been provided to the Engineer.
 - 7. Pre-construction survey documents have been submitted to the Engineer.
- B. Install temporary excavation support systems in a manner that does not interfere with, interrupt, or endanger surface activity, and minimizes subsidence of surfaces, structures, and utilities. Surfaces, structures and utilities damaged by installation of temporary excavation support systems shall be repaired or replaced in a timely manner to their original condition at no additional cost to Owner.
- C. Furnish all necessary equipment, power, water, and utilities for installation of temporary excavation support systems and other associated work required for the Contractor's

methods of construction.

- D. Conduct all operations such that trucks and other vehicles do not create a dust or noise nuisance in the streets and adjacent properties. Promptly clean up, remove, and dispose of any spillage.
- E. Furnish all maintenance of traffic and establish and maintain all safety procedures on any highways whose thoroughfare is interrupted due to construction.
- F. Inspect the locations where temporary excavation support systems will be installed, verify conditions under which the work will be performed, and provide all necessary details, whether or not shown on the Drawings or specified, for the orderly prosecution of the work.

3.02 PREPARATION

- A. Existing utilities shown on Drawings are shown for general information only. Contractor shall verify locations, sizes and configurations of existing systems within potential conflict of installation operations.
- B. Complete any required testing, inspection, surveying, etc., of any existing utilities required by the Contract Documents.
- C. Call Local Utility Line Locate Service (811) not less than five working days before performing Work.
- D. Request underground utilities to be located and marked within and surrounding the construction areas.
- E. Locate, identify, and protect utilities indicated to remain from damage.

F. Protection

1. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
2. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic. Repair or replace items damaged during construction.
3. Repair or replace structures raised more than 0.50 inch due to pressure from installation of temporary excavation support systems, including pavement and sidewalk.

G. Ventilation

1. Furnish and operate a temporary ventilation system and air monitoring system conforming to the requirements of OSHA. Operate and maintain a ventilation system that provides a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gases.
2. All ventilation fans shall be placed within an enclosure to limit ambient noise.

H. Barricades

1. Protect shafts and other open excavations with barricades, security fencing and with additional measures approved by the Engineer as required to prevent unauthorized personnel from accessing.
2. During non-work hours, isolate with additional measures approved by the Engineer as required to prevent unauthorized personnel from accessing.
3. Remove equipment daily from vehicular and pedestrian roads, sidewalk and pathways not contained within the direct work area to permit access and use by public.

3.03 SETTLEMENT MONITORING

- A. Survey the site showing locations and elevations of existing ground, pavement, and other permanent features to establish a baseline for existing conditions adjacent to the shaft. All surveying for settlement monitoring shall be performed by a licensed Surveyor registered in the State of North Carolina.

3.04 GROUND SURFACE MOVEMENT

- A. Shaft excavation and installation of temporary support systems shall be performed in a manner that prevents ground loss and settlement adjacent to the shaft.
- B. If settlement occurs which causes or may cause damage to an existing structure adjacent to the work, immediately cease operations except that which assists in making the work secure and in preventing further movement or damage. Resume shaft excavation only after all necessary precautions have been taken to prevent further movement or damage.
- C. Lateral Displacements: Unless more stringent requirements are set forth by an authority having jurisdiction, lateral movement or deflection of temporary excavation support system shall be limited to 0.5 inch.
- D. Report any settlement or movement immediately to the Engineer and applicable agency and take immediate remedial action.

3.05 GROUNDWATER CONTROL

- A. Intercept and divert surface drainage, precipitation and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means within the conditions permitted by the approved Erosion & Sedimentation Control Plan and the Contract Documents.
- B. Develop substantially dry subgrade for prosecution of subsequent operations.
- C. Launch and exit shaft subgrade shall be kept continuously free from ground and surface waters. Dewatering shall be controlled such that the launch and exit shafts are free of water, but the surrounding groundwater table is not substantially lowered.
- D. Keep removal of soil particles to a minimum.

- E. Monitor surface facilities to verify there is no settlement or displacement occurring due to dewatering.
- F. Water discharge from dewatering operations shall be directed into approved receiving basins or silt bags in accordance with all applicable regulatory requirements and the approved Erosion & Sedimentation Control Plan.
- G. Should settlement or displacement be detected, notify the Engineer and applicable agency immediately and act to maintain safe conditions and prevent damage.

3.06 GROUND MODIFICATION PRIOR TO SHAFT CONSTRUCTION

- A. The use of jet grouting, compaction grouting, permeation grouting or other ground stabilization techniques shall be carefully considered by the Contractor to safely allow installation of temporary excavation support systems in loose and flowable soils or in rock that is fractured with joints, bedding planes, shears, or fault zones below the groundwater table. Contractor shall determine if ground modification is needed to maintain a stable excavation, reduce the risk of surface settlement, and protect nearby structures and utilities. Contractor is fully responsible for the determination of the necessity, selection, design, and implementation of ground modification plans.
- B. Ground modification plans shall be designed to work in concert with Contractor's selected excavation methods and implemented as needed to increase the stability of the ground, provide settlement control, reduce permeability, and increase stand-up time in areas of excavation required to construct launch and exit shafts. The cost of ground modification shall be included in the Bid.
- C. Contractor shall furnish all labor, equipment, materials, and supplies necessary to perform ground modifications.

3.07 EQUIPMENT

- A. Contractor shall employ shaft excavation equipment that is capable of handling the various anticipated ground conditions and which minimizes loss of ground and allows for satisfactory support of excavation.
- B. Air Quality: Contractor shall provide equipment to maintain proper air quality during construction in accordance with the requirements of 29 CFR Part 1926.
- C. Lighting Fixtures: Contractor shall enclose lighting fixtures in watertight enclosures with suitable guards and provide separate circuits for lighting and other equipment.
- D. Electrical Systems: Electrical systems shall conform to requirements of National Electrical Code — NFPA 70.
- E. Fire Suppression: Contractor shall furnish, install, and maintain a fire suppression system in accordance with local, State, and Federal requirements.

3.08 SPOIL TRANSPORT AND DISPOSAL

- A. Transport and dispose of all excavated materials properly away from the construction site. Spoil, slurry, and muck shall be disposed of at legal disposal facilities.

3.09 SITE PREPARATION

- A. Site restoration shall be in accordance with the Drawings and applicable Sections of these Specifications.

- END OF SECTION -

SECTION 02425

INITIAL TUNNEL SUPPORT

PART 1 -- GENERAL

1.01 SCOPE OF WORK

- A. The work described by this Section consists of furnishing all materials required for the initial tunnel support systems proposed by the Contractor to be provided as a part of the tunneling operations.
- B. The work shall be done in accordance with the Contract Documents, and all Federal, State, and local laws, regulations and requirements.
- C. Contractor is fully responsible for safety. Comply with all OSHA regulations including, but not limited to, 29 CFR Part 1926. Obtain all required permits for confined space entry.
- D. Geotechnical reports, logs, borings, and laboratory testing performed within proximity of the project corridor are made available as "Technical Data" and are not part of the Contract. This technical data is provided as information only and solely for the convenience of Bidders. The Owner and/or the Engineer do not warrant or guarantee the accuracy or correctness of this technical data with respect to actual subsurface conditions. Subsurface conditions are considered unclassified and no expectation of quantity, specific location of ground conditions, or geotechnical baselines are provided or assumed herein.
- E. Contractor shall review all available geotechnical reports and data and perform any additional subsurface investigations he deems necessary at his own expense for the planning and the selection of tunneling techniques and methods in order to enable proper construction.
- F. Contractor shall be responsible for designing, furnishing and installing the initial tunnel support systems that complement the means and methods selected in excavating the tunnels and shafts proposed for the Project.
- G. Contractor shall retain the service of a licensed Professional Engineer registered in the State of North Carolina to design the initial support systems and prepare submittals as described herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02426 – Installation of Carrier Pipe in Tunnels
- B. Section 02431 – Tunnel Grout
- C. Section 02432 – Low Density Cellular Concrete
- D. Section 02445 – Utility Hand Tunneling

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Applicable codes, ordinances, statutes and governing rules and regulations of governing municipalities and counties, the State of North Carolina, and the Federal Government.
 - 2. American Association of State Highway and Transportation Officials (AASHTO).
 - 3. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
 - 4. Occupational Safety and Health Administration (OSHA) Regulations 29 CFR Part 1926.
 - 5. Applicable ASTM and AWWA Standards for materials and methods.
 - 6. North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures.

1.04 DEFINITIONS

- A. Face: Vertical wall at the end of the tunnel excavation.
- B. Ground Class: A designation of ground type based on physical characteristics and engineering analysis.
- C. Initial Tunnel Support: Any combination of ground support elements installed in underground excavation prior to placement of final lining or carrier pipe. Initial tunnel support includes steel casing pipe, steel liner plates, and steel ribs and lagging.
- D. Lagging: Wood planking or other structural material that spans the area between ribs.
- E. Overbreak or Overexcavation: Any void or lost ground extending beyond the limit of the initial tunnel support or jacking pipe.
- F. Steel Casing Pipe: A jacked pipe that is used as initial ground support.
- G. Steel Liner Plate: Steel plates that are fastened together to provide initial ground support.
- H. Steel Rib: A rolled steel section, such as an H-beam, used to support the ground.

1.05 DESIGN CRITERIA

- A. Contractor is responsible for design, installation, maintenance, and safety of all initial tunnel support systems. All design calculations provided by the Contractor as part of the required submittals shall be sealed by a licensed Professional Engineer registered in the State of North Carolina.

1.06 SUBMITTALS

- A. Conform to Section 01300 – Submittals.
- B. Submit manufacturer's product data for all materials required to be incorporated into the work.
- C. Shop Drawings for Fabricated Materials
 - 1. General – design calculations for initial support systems, pre-support and face support measures, including estimates of support deformations for each ground class.
 - 2. Steel casing pipe – list of materials including dimensions, wall thickness, and grade of steel. Provide design calculations including estimates of jacking loads, allowable axial compressive load on the jacking pipe, and joint tolerances for each ground class.
 - 3. Steel liner plate – list of materials including dimensions, gauge thickness, grade of steel, and assembly hardware.
 - 4. Ribs and lagging support – geometry, grade of material, and dimensions of steel rib and lagging elements, including their assemblages, foot plates, welds, nuts and bolts, tie rods, braces, and lagging.
- D. Working Drawings and Method Statements
 - 1. Provide sequence of installation of initial support systems and pre-support measures integrated into the excavation process, including requirements for assuring the transfer of ground loads to initial tunnel support systems.
 - 2. Provide dimensions, spacing, and general pattern sequence of installation of the support systems with respect to excavation and final lining tolerances.
 - 3. Methods and details for repairing damage to initial tunnel support.
- E. Quality Control
 - 1. Identify procedures for ensuring quality of materials and installation including:
 - a. A written statement of site-specific quality control measures required by the Contractor's Engineer.
 - b. Methods for and frequency of monitoring initial support elements for loosening, deformation, or distress; and means for tightening, or supplementing with additional initial support, if needed.
 - c. Contingency plan in the event that ground loads exceed the capacity of the initial support.

F. Recordkeeping

1. As-built records of all erected support, including locations, spacing, lengths, types, thicknesses, weights, and number. Integrate this information into daily reports required for tunnel excavation.
2. Records of all testing performed as required by the Contractor's Engineer.

1.07 DELIEVERY, STORAGE, AND HANDLING

- A. The Contractor shall accept material on site and inspect for damage.
- B. The Contractor shall handle, support and store material to prevent injury or damage to the material.

1.08 TUNNEL SYSTEM SCHEDULE

- A. Tunnel requirements for this Section are outlines on the Drawings, in Division 2, and in the Tunnel System Schedule illustrated below.

Tunnel #	Allowable Initial Tunnel Lining	Min Casing Outside Diameter (inches)	Min Steel Casing Wall Thickness (inches)	Carrier Pipe Nominal Diameter (inches)	Elevation Tolerance (inches)	Horizontal Tolerance (inches)
Tunnel #1	Steel Liner Plate Only	See Detail	N/A	96	±3	±12
Tunnel #2	Steel Liner Plate Only	See Detail	N/A	96	±3	±12

B. Notes for Tunnel System Schedule above are as follows:

- 1) Minimum outside diameter of casing or initial tunnel support lining is provided herein. Contractor may elect to upsize casing/lining diameter size as needed:
 - i. to accommodate the requirements of the carrier pipe installation, and/or
 - ii. to accommodate the Contractor's selected tunneling methods.
- 2) In cases where Contractor elected to increase diameter of initial tunnel lining the following minimum standards shall apply:
 - i. steel casing wall thickness shall at minimum meet the following formula:
 $t \geq D/Ra$
 Where, casing thickness (t) must be greater than or equal to Diameter (D) divided by the minimum axial compressive limit state (Ra) provided in the following table.

Casing Diameter Range (in)	Axial Compressive State Limit (Ra)
18 - 24	58
30 - 42	64
48 and larger	72

- ii. steel liner plate thickness shall at minimum meet the applicable provisions of Chapter 1, Part 4 of the “Manual of Railway Engineering” of the American Railway Engineering Association.
 - iii. Upsizing of tunnel lining diameter as elected by the Contractor shall be provided at no additional cost to the Owner.
- 3) All steel casing shall meet requirements of Chapter 1, Part 5 of the “Manual of Railway Engineering” of the American Railway Engineering Association and North Carolina Department of Transportation (NCDOT) Specification Section 232.02, part (c), paragraph 5 – Smooth Wall Steel Pipe (Jacked or Casing for General Use).
- 4) Maximum tolerance for vertical deviation from elevations and horizontal deviation from alignments shown on the Contract Drawings for the sewer carrier pipe shall be as provided in the Tunnel System Schedule provided herein. See Section 02426 Installation of Carrier Pipe in Tunnels for all other carrier pipe tunnel installation acceptance criteria.
- 5) For initial tunnel support systems other than steel casing, the minimum outside diameter (O.D.) shall be the contractor’s selected carrier pipe’s greatest outside diameter (Bell O.D. or Coupling O.D.) PLUS a minimum installation clearance of 2-inches PLUS the tunnel’s elevation tolerance listed in the Tunnel System Schedule in Section 15390 PLUS two (2) times the liner plate or rib thickness. Provided in equation form:

Minimum O.D. = Carrier Pipe Bell/Coupling O.D. + 2-inches + Elevation Tolerance + (2 * Liner Plate/Rib Thickness)

PART 2 – MATERIALS

2.01 STEEL CASING PIPE

- A. The casing pipe shall be smooth-wall or spiral-welded carbon steel pipe. The minimum exterior diameter of the casing pipe shall be as indicated on the Drawings. Casing pipe shall be leak-proof construction and be capable of withstanding highway or railroad loadings where applicable. Casing pipe shall be steel pipe in sizes 12-inches and larger manufactured from steel having a minimum yield stress strength of 35,000 psi and shall have a minimum wall thickness as indicated in Section 1.08.
- B. All joints shall be butt welded with a full depth, single "V" groove weld. Machined, interlocking, press-fit joints such as Permalok made by Northwest Pipe Company of Vancouver, WA or equal may be substituted if written acceptance has been acquired by all property owners and permitting authorities associated with crossing.
- C. The casing pipe shall conform to ASTM A139, Grade B (without hydro-test) or ASTM A53, Grade B (without hydro-test), and AWWA C200-75.

2.02 STEEL LINER PLATE

- A. Steel liner plate selected and installed by the Contractor shall be designed by the Contractor’s Engineer and shall meet the latest AREMA specifications Chapter 1, Part 4 with the following factors of safety:
 - 1. Joint Strength = 3.0,

2. Minimum Stiffness = 3.0 for 2-flange and 1.5 for 4-flange,
 3. Critical Buckling = 2.0, and
 4. Meet all appropriate corrosion protection through the selection of coatings and cathodic protection as needed.
- B. All 2-flange liner plate shall be minimum 10 gage or thicker as required by the Contract Documents.
 - C. All 4-flange liner plate shall be minimum 8 gage or thicker as required by the Contract Documents.
 - D. The maximum width of liner plate shall be 18 inches.
 - E. Steel liner plate shall be fabricated from structural-quality, hot-rolled, new carbon-steel sheets or plates conforming to ASTM A569.
 - F. All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be so fabricated as to permit complete erection from the inside of the tunnel.
 - G. Holes shall be provided in every third ring of liner plate (a minimum of three grout holes per ring required unless otherwise directed by the Engineer) to permit grouting as the erection of liner plate progresses.
 - H. Bolts and nuts shall be a minimum of 5/8-inch diameter and length as recommended by the manufacturer of the liner plate and be manufactured domestically. For plate thicknesses equal to or greater than 0.209 inches, bolts shall conform to ASTM A449. For plate thicknesses less than 0.209 inches, bolts shall conform to ASTM A307.

2.03 STEEL RIBS AND LAGGING

- A. Structural steel for use in initial support shall be manufactured in accordance with ASTM A36.
- B. Bolts, nuts, and fasteners conforming to ASTM A307.
- C. End plates and foot plates shall be fabricated from steel conforming to ASTM A36.
- D. Timber used for blocking, cribbing or any other structural use shall be Douglas Fir No. 1 grade or equal and of rectangular cross section.

PART 3 – EXECUTION

3.01 INSTALLATION – GENERAL

- A. Work shall not begin until all required submittals have been reviewed and accepted by the Engineer.

3.02 INSTALLATION OF STEEL CASING PIPE

- A. Steel casing shall be installed in accordance with the approved submittal.
- B. Grouting of the annular space between the steel casing and the ground shall be performed following completion of casing installation. Grout shall be in accordance with Section 02431 – Tunnel Grout. Grout pressure shall not exceed one-half of the existing overburden pressure.

- C. Grouting shall be performed from within the casing pipe through grout holes. Grouting shall start with the lowest connections and proceed until grout begins to flow from upper connections. The void between the casing pipe and the ground shall be completely filled. Lubricant shall be displaced by the grout. Displaced lubricant shall be disposed of off-site in accordance with applicable regulations and codes of all Federal, State, and local agencies.
- D. After grouting is complete, pressure shall be maintained by means of stopcocks or other suitable devices until the grout has set sufficiently in the judgment of the Engineer, or for a minimum of 24 hours, whichever is longer. After the grout is set, grout holes shall be completely filled with dense concrete and finished neatly without evidence of voids or projections.

3.03 INSTALLATION OF STEEL LINER PLATES

- A. Steel liner plates shall be assembled in accordance with the manufacturer's instructions.
- B. Grouting of the annular space between the liner plate and the ground shall be kept as close to the heading as possible, using grout stops behind the liner plates as necessary. Grouting shall proceed as needed to cut off inflow of groundwater and material and stabilize the excavation, but the distance from the face of tunnel to grouted section shall not exceed 10 feet. Grout shall be in accordance with Section 02431 – Tunnel Grout. Grout pressure shall not exceed one-half of the existing overburden pressure.

3.04 INSTALLATION OF STEEL RIBS AND LAGGING

- A. Scale excavated surfaces and remove loose material prior to placing and blocking steel ribs. Brace each steel rib with blocking, collar braces, shims, and wedges as necessary to transfer ground loads to the steel sets.
- B. Secure steel ribs against horizontal movement and distortion using tie rods and collar braces.
- C. Immediately install lagging.
- D. Immediately crib areas of overbreak or overexcavation with timber to provide contact between steel ribs and the ground.
- E. Perform all surveys necessary in a timely manner such that steel ribs and lagging do not encroach on the necessary clearance for the final lining.
- F. Monitor installed support to ensure that any increase of loading with time, i.e. squeezing loads, is detected. Monitor for excessive deformations and instability locally. Install additional support in a timely manner to mitigate overstressing of the initial support system.
- G. Grouting of the annular space between the lagging and the ground shall be performed immediately following installation of the ribs and lagging. The distance from the face of tunnel to grouted section shall not exceed 10 feet. Grout shall be in accordance with Section 02431 – Tunnel Grout. Grout pressure shall not exceed one-half of the existing overburden pressure.

- END OF SECTION -

SECTION 02426

INSTALLATION OF CARRIER PIPE IN TUNNELS

PART 1 - GENERAL

1.01 SCOPE

- A. The work described in this Section covers handling, transporting, and installing carrier pipe in two-pass tunnels.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02431 – Tunnel Grout
- B. Section 02432 – Low Density Cellular Concrete
- C. Section 02530 – Sanitary Sewer Systems

1.03 SUBMITTALS

- A. Conform to Section 01300 - Submittals
- B. Carrier Pipe Installation Plan
 1. Description of method of lowering pipe into shaft; method of transporting carrier pipe into tunnel; method of positioning, aligning, and jointing pipe; and blocking plan. Include sketches showing method of carrier pipe transporting, hoisting, and positioning; and sketch of carrier pipe blocking plan.
 2. If casing spacers are the Contractor's proposed means of supporting the carrier pipe within the tunnel, provide complete information on casing spacers.
 3. Buoyant force calculations, provisions to prevent flotation of carrier pipe, bulkhead design, and blocking details. Calculations shall include an analysis of the stresses and deformation induced on the carrier pipe by the annular space backfilling operation. Submittal shall be sealed by a licensed Professional Engineer registered in the State of North Carolina.

1.04 CARRIER PIPE SCHEDULE

PIPE IDENTIFICATION	MIN. INSIDE PIPE DIAMETER	MATERIAL	TYPE OF JOINT	CLASS/ DESIGN	TEST PRESSURE
GRAVITY SEWER	96 INCHES	CCFRPM	PUSH ON	SN-46	REFER TO SECTION 02530

PART 2 - PRODUCTS

2.01 PIPE MATERIAL

- A. The carrier pipe shall be as listed in Section 1.04.
- B. Contractor shall be responsible for selecting appropriate pipes and pipe joints to safely carry the loads imposed during all phases of construction.

2.02 ANNULAR BACKFILL

- A. Backfilling of the annular space between the carrier pipe and the initial tunnel support system pipe shall be as specified in Section 02431 - Tunnel Grout, or Section 02432 – Low Density Cellular Concrete.

2.03 CASING SPACERS

- A. Casing spacers, if selected for use by Contractor, shall be Model SSI with EPDM skids by Advance Products and Systems, Inc., Style CCS by Cascade Waterworks Mfg. Co., Black Widow SS by Spider Mfg., or approved equal.

PART 3 - EXECUTION

3.01 ACCEPTANCE CRITERIA FOR LINE AND GRADE TOLERANCES

- A. Prior to installing the carrier pipe, Contractor shall verify that the initial tunnel support system has been installed such that the carrier pipe can be placed in conformance with specified tolerances.
- B. Gravity Mains: Tolerances from lines and grades shown on the Drawings for gravity sewer pipes installed within the initial tunnel support system shall be in accordance with the tolerances listed in Section 1.04. Reverse grades, low points or sags in the carrier pipe shall not be permitted or accepted. Should misalignment of the jacking pipe or initial tunnel support preclude installation of the sewer pipe to the tolerances specified, notify Engineer.
- C. Pressure Service Mains: Line and grade for trenchless installation of water mains and force mains may not vary by more than 2% of the total length from the required horizontal alignment, one foot from the vertical alignment and shall maintain the minimum cover required.
- D. If the carrier pipe cannot be installed to the invert elevations shown on the Drawings, but it still is within the tolerances shown, notify the Engineer and establish a plan for adjusting the grade of the pipeline upstream and/or downstream to meet minimum slope requirements, avoid reverse grade, and return to the design grade at the nearest possible point.
- E. Pipe installed outside tolerances and subsequently abandoned shall be filled completely with grout.

3.02 PIPE HANDLING

- A. Handle and transport pipe into the tunnel in a manner that prevents damage to the pipe, joints and gaskets. Do not install pipe damaged during placement operations. If any damage occurs, the Contractor may either replace the pipe or propose repair procedures for review and approval by the Engineer.

3.03 TUNNEL CLEANUP

- A. Prior to placement of carrier pipe in tunnel, Contractor shall remove temporary tunnel utilities, loose material, dirt, standing water, and debris.
- B. Temporary steel construction tracks may be left in place if they do not interfere with alignment and blocking of the carrier pipe, or interfere with final placement of the annular backfill, as approved by the Engineer.

3.04 PIPE MANUFACTURER REPRESENTATIVE

- A. During carrier pipe installation and annular backfill placement, each pipe manufacturer shall provide his own supervisor to instruct the Contractor's pipe laying personnel in the correct procedure to be followed, at no additional expense to the Owner.

3.05 CARRIER PIPE BLOCKING AND SUPPORT

- A. Provide support and anti-flotation blocking adequate to:
 - 1. Establish final pipe grade.
 - 2. Support weight of carrier pipe without deformation or collapse during installation.
 - 3. Provide restraint to hold carrier pipe stable to prevent flotation or movement during backfilling operations.
- B. Support and anti-flotation blocking may include steel beams, wooden blocking, casing spacers, concrete bedding, liquid ballasting, or other methods as designed by Contractor's Engineer.
- C. If casing spacers are selected by the Contractor, then provide the number of spacers per joint as listed in Section 1.04. Additional casing spacers shall be provided if recommended by the casing pipe manufacturer.
- D. Secure the pipe support to the pipe and initial tunnel support in accordance with approved design.

3.06 JOINING PIPE IN TUNNELS

- A. Join pipe segments to properly compress the gaskets and allow for the correct final positioning of the pipe for line and grade. Closely align pipes by bringing them loosely together by means of hydraulic jacks, locomotives, pipe mobiles, or winches. Once pipes have been loosely joined, pull them home by means of a hydraulic tugger or other similar method while suitably protecting pipe and joints against damage. Impact jointing such as ramming with locomotives or other mechanical equipment is not permitted. All joining of pipe shall at minimum be in accordance with manufacturer's recommendations.

- B. If carrier pipe is 36" or larger, provide stationing on the inside of the pipe at the spring line of the pipe written in bright fluorescent orange paint every 50 feet in numbers at least 2 inches in height.

3.07 TRACER WIRE INSTALLATION

- A. Install tracer wire in accordance with Section 02530 – Sanitary Sewer Systems.

3.08 TESTING PRIOR TO GROUTING ANNULAR SPACE

- A. Carrier pipe invert shall be surveyed and hydraulic grade line verified prior to grouting of annular space.
- B. After carrier pipe is installed within the initial tunnel support system, the carrier pipe shall be tested in accordance with Section 02530 – Sanitary Sewer Systems.

3.09 LIMIT ON CARRIER PIPE INSTALLATION

- A. Carrier pipe installation shall be constructed in reaches (lift segments) of manageable length that can be surveyed, inspected, and tested for acceptance, then backfilled in-place prior to installing the next carrier pipe reach. Carrier pipe installation segments shall be limited in length as indicated in the Carrier Pipe Installation Schedule below. Maximum lengths are based on the results of Contractor's tested in-place wet density for his annular backfill mix design. See Section 02431 – Tunnel Grout and Section 02432 – Low Density Cellular Concrete for definitions and mix design requirements. Under no circumstances shall the backfill pressures, lift segments lengths, lift depths, or heat of hydration during curing exceed carrier pipe manufacturer's recommendations.

CARRIER PIPE INSTALLATION SCHEDULE

ANNULAR BACKFILL PLACEMENT, MAXIMUM LIFT SEGMENT LENGTH

TESTED IN-PLACE WET DENSITY	MAXIMUM LIFT SEGMENT LENGTH
≥ 130 pcf	≤ 50 feet
120 pcf – 129 pcf	≤ 100 feet
110 pcf – 119 pcf	≤ 125 feet
100 pcf – 109 pcf	≤ 200 feet
90 pcf – 99 pcf	≤ 250 feet
80 pcf – 89 pcf	≤ 300 feet

- B. Maximum length of annular backfill placement shall not exceed maximum lift segment length indicated in the schedule

3.10 BULKHEADS AND CRADDLE SUPPORTS

- A. Construct bulkheads to withstand imposed backfill pressure without excessive leakage at the terminal ends of the tunnel in accordance with the Drawings and at intermediate points as required.
- B. Terminal bulkheads shall be constructed using concrete brick and mortar and have air and water vent holes. Walls shall be constructed flush with the terminal ends of the tunnel. Brick shall have a nominal size 2-1/4 inches by 3-3/4 inches by 8 inches. Mortar shall be one part Portland cement blended with three parts sand (100% passing #4 sieve and minimum 95% passing No. 8 sieve) and have a minimum 7-day compressive strength of 500 psi. Prepared bag mixes are acceptable if approved by the Engineer.
- C. Intermediate bulkheads shall be installed as designed by the Contractor's Engineer. Intermediate bulkheads shall be removed as pipe installation and backfilling progresses.
- D. If placement is being performed through bulkheads a section of bulkhead shall be left out to allow for visual inspection of the installation until the time at which the final lift is to be placed.
- E. Provide concrete cradles using Class B concrete in accordance with NCDOT requirements at terminal ends of tunnel. Cradles shall be provided from the end of the jacking pipe/tunnel bulkhead to the first pipe joint outside the tunnel/jacking pipe.

3.11 DEFLECTION TESTING

- A. Deflection testing shall be in accordance with Section 02530 – Sanitary Sewer Systems.

- END OF SECTION -

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SECTION 02431

TUNNEL GROUT

PART 1 - GENERAL

1.01 SCOPE

- A. The work described in this Section covers mix design requirements, testing, furnishing and production of grout for:
 - 1. Filling exterior space between the initial tunnel support system and the ground.
 - 2. Backfilling annular space between the carrier pipe and the initial tunnel support system.
 - 3. Filling voids in ground resulting from overbreak, overexcavation, or loss of ground.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02426 – Installation of Carrier Pipe in Tunnels
- B. Section 02432 – Low Density Cellular Concrete
- C. Section 02445 – Utility Hand Tunneling

1.03 DEFINITIONS

- A. Annular Backfill Grout: Grout used to backfill the annular space between the carrier pipe and the initial tunnel support system.
- B. Final Exterior Grout: Grout used to fill voids that extend beyond the limit of the initial tunnel support system following completion of tunnel excavation.
- C. Void Repair Grout: Grout injected outside of the initial tunnel support system for immediate filling of voids as tunnel excavation is advancing.

1.04 REFERENCE STANDARDS

- A. ASTM C39: Standard Test Method for compressive Strength of Cylindrical Concrete Specimens.
- B. ASTM C138: Standard Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete.
- C. ASTM C144: Standard Specification for Masonry Mortar.
- D. ASTM C150: Standard Specification for Portland Cement.
- E. ASTM C494: Standard Specification for Chemical Admixtures for Concrete.

- F. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - G. ASTM C937: Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete.
 - H. ASTM C939: Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
 - I. ASTM C940: Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - J. ASTM C942: Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - K. ASTM C953: Standard Test Method for Time of Setting of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
 - L. ASTM C1017: Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.
 - M. U.S. Army Corps of Engineers CRD-C 621, Specification for Non-Shrink Grout.
- 1.05 SUBMITTALS
- A. Conform to Section 01300 – Submittals.
 - B. Grout Work Plan
 - 1. For each type of grouting operation, provide working drawings of proposed grouting systems detailing type and location of equipment, operational procedures, location of injection points, means of measuring grout pressures and volumes, method of venting, location of flowlines, grouting sequence, and schedule.
 - C. Laboratory Test Reports
 - 1. Provide laboratory test data confirming that the selected products and mix designs will produce grouts that have the characteristics and qualities required for completion of the work.
 - D. Grout Mix Design Report
 - 1. Application.
 - 2. Mix constituents and proportions, including materials by weight and volume.
 - 3. Mix properties including wet density, initial set time, flow, bleed and compressive strength.
 - E. Recordkeeping
 - 1. Provide logs of grouting operations indicating location, wet density, pressure, and volume pumped for each grout placement, as part of the required Daily Reports.

PART 2 - - PRODUCTS

2.01 APPLICATIONS AND REQUIRED MIXES

- A. Annular Backfill Grouting: Use standard sand-cement mix, structural sand-cement mix, or bentonite-cement mix.
- B. Final Exterior Grouting: Use structural sand-cement mix.
- C. Void Repair Grouting: Use standard sand-cement mix, structural sand-cement mix, or bentonite-cement mix.

2.02 MATERIALS

- A. Standard sand-cement grout mixes and structural sand-cement grout mixes shall be formulated from materials meeting the following requirements:
 - 1. Cement: ASTM C150, Type II.
 - 2. Fly Ash: ASTM C618, Type F.
 - 3. Water: Use potable water free from deleterious amounts of alkali, acid, and organic material which would adversely affect setting time or strength.
- B. Bentonite-cement grout mixes shall be formulated from materials meeting the following requirements:
 - 1. Cement: ASTM C150, Type II.
 - 2. Fly Ash: ASTM C618, Type F.
 - 3. Water: Use potable water free from deleterious amounts of alkali, acid, and organic material which would adversely affect setting time or strength.
 - 4. Bentonite: Finely ground (200-mesh), premium-grade, high-yielding Wyoming sodium bentonite.
- C. Admixtures used in grout mixes shall conform to the following:
 - 1. ASTM C494 and/or ASTM C1017, as required to improve pumpability, to control set time, to hold sand in suspension and to reduce segregation and bleeding.
 - 2. No calcium chloride or admixture containing chloride or other impurities from admixture ingredients will be acceptable.
 - 3. Do not use admixtures that promote steel corrosion.
 - 4. Ensure that admixtures used in any mix are compatible. Provide written confirmation from the admixture manufacturers of their compatibility.
- D. Water: Clean, fresh potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the grout.

2.03 MIX DESIGNS

- A. General: Develop grout mixes based on the following criteria as applicable:
 - 1. Size of annular space between the carrier pipe and initial tunnel support or jacking pipe, or size of void between initial tunnel support or jacking pipe and the surrounding ground.
 - 2. Pumping distances and characteristics, including pumpability, pot life and retardation.
 - 3. Presence of groundwater.
- B. Compressive Strength
 - 1. Standard sand-cement grout and bentonite-cement grout shall have a minimum compressive strength of 100 psi attained within 3 days, and 200 psi attained within 28 days.
 - 2. Structural sand-cement grout shall have a minimum 28-day compressive strength of 1,000 psi.
- C. Testing: Employ a commercial testing laboratory, acceptable to the Engineer, to prepare and test each grout mix design. These results will be compared with field test results to confirm consistent properties are obtained in the field. Testing for each mix shall be as follows:
 - 1. Two sets of compression test cylinders (3 inches by 6 inches), three cylinders per set.
 - 2. One set of three cylinders shall be tested at an age of 7 days and the other set shall be tested at an age of 28 days.

2.04 EQUIPMENT

- A. For each type of grout, use equipment for mixing and injecting which is designed for the particular grout. Provide batching, mixing and pumping equipment that is compatible and of sufficient size and capacity to place the grout to the distances and volumes proposed by the Contractor.
- B. Grouting equipment shall be capable of mixing grout to a homogeneous consistency and delivering grout to injection points at steady pressures. Equipment shall be configured to provide means of accurately measuring grout component quantities and accurately measuring pumping pressures.
- C. Maintain equipment in good operating condition, capable of satisfactorily mixing, agitating, and forcing grout into injection ports at a uniform flow rate under the required constant pressure.
- D. Grouting equipment shall be configured so flushing can be accomplished without contents flushed being discharged in to the tunnel.

- E. An adequate inventory of spare parts or backup equipment shall be provided to ensure that operable backfill grouting equipment is available at all times during the work. Maintain sufficient quantities of spare pressure gauges, stop valves, and other wear parts on site.
- F. Batch system shall provide graphical or digital printout records of batch scale readings, accurate to one (1) point, of the dry mix ingredients before delivery to mixer.
- G. At the point of injection, suitable valves and calibrated pressure gauges shall be provided so that the pressure and grout flow at the grout hole may be regulated and monitored. At or very near the point of injection, provide a system of valves in the line transporting the grout that will allow easy access for collection of test specimens. Provide an automatic bypass valve set to the maximum pressure specified. Provide suitable stop valves at the injection point for use in maintaining pressure, as required, until grout has set. Use hoses or pipes of proper type and diameter to withstand maximum injection pressures used.

PART 3 - - EXECUTION

3.01 PREPARATION

- A. Notify Engineer at least 24 hours in advance of beginning any grouting operation.
- B. Select and operate grouting equipment to avoid damage to new or existing underground utilities and structures.
- C. In developing plan for grout placement, consider pipe flotation, length of pipe, length of tunnel, depth from surface, type of final lining, type of pipe blocking and bulkheading, pumping capabilities, grout volume, and length of pipe to be grouted between bulkheads.
- D. Operate dewatering systems until the grouting operations are complete.

3.02 ANNULAR BACKFILL GROUTING

- A. General Requirements: Fill the annular space between the carrier pipe and the initial tunnel support system with grout as defined herein. Force grout into all irregularities around the carrier pipe to completely fill the tunnel arch and annulus.
- B. Backfilling of the carrier pipe with grout shall be performed in three or more equal-volume lifts.
- C. The limits of each grout placement stage shall be predetermined by the size and capacity of the batching equipment and the initial set time of the proposed grout. Under no circumstances shall placement continue at an injection point longer than that period of time for the mix to take initial set. Grout hole spacing and locations shall be based on the number of stages necessary to complete the grouting process. A lift cannot be installed on top of the prior lift until a proper set has been attained.
- D. Contractor shall ensure that the carrier pipe temperature does not exceed the manufacturer's recommendation as a result of the heat of hydration of the grout.
- E. The length of carrier pipe installed at any time shall not exceed the annular backfill placement maximum lift segment length as stated in Section 02426 – Installation of Carrier

Pipe in Tunnel.

- F. Pressure gauges of appropriate range for monitoring grout injection pressures shall be located in the line transporting the grout as close to the point of injection as possible.
- G. Volume of grout injected shall be calculated on an indirect basis and compared with the anticipated volume per foot of pipe backfilled.
- H. Provide a means of direct communication between the injection point and the pump operator.
- I. Protection and Cleanup
 - 1. Take all necessary precautions to protect and preserve the interior of the carrier pipe from damage. Spills shall be minimized and cleaned up immediately. Any damage to the pipe caused by or occurring during the backfilling operation shall be repaired by a method approved by the Engineer, at no additional cost to the Owner.
 - 2. During backfilling, provide for removal and disposal of all waste and wastewater resulting from backfill grouting operation.

3.03 FINAL EXTERIOR GROUTING

- A. Pump structural sand-cement grout to fill the exterior space between initial tunnel support system and the ground.

3.04 VOID REPAIR GROUTING

- A. Fill voids outside the limits of excavation caused by overexcavation, overbreak, or loss of ground. Such voids can be the result of boulder or obstruction removal, an existing void, or collapse of ground. Pump standard sand-cement grout, structural sand-cement grout, or bentonite-cement grout to temporarily fill all voids until installation of initial tunnel support or jacking pipe is complete. Upon completion of excavation, fill all voids in accordance with the requirements for final exterior grouting.

3.05 FIELD QUALITY CONTROL

- A. General: Field quality control tests, including unit weight (wet density), and compressive strength shall be performed by the Contractor and the results submitted to the Engineer.
 - 1. The frequency specified herein for each field control test is approximate. A greater or lesser number of tests may be made, as required by the Engineer.
 - 2. Test specimens shall be collected within the tunnel at or near the connection where the grout is being injected.
 - 3. Supply all materials necessary for fabricating the test cylinders.
 - 4. Monitor carrier pipe temperature for one week after grout placement.

- B. Unit Weight: Unit weight (wet density) tests shall be made from the first batch mixed each day, after a change in mix design, every 30 minutes during pumping, and from each batch of grout from which compression test cylinders are made. Unit weight at the point of placement shall be within plus or minus 5 percent of the unit weight established for the mix design being placed. Adjust mix as required to obtain the specified wet density.
- C. Compressive strength test cylinders shall be made in the field, cured and stored in the laboratory, and tested.
- D. Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location (station) in the work where the grout represented by the cylinder was placed, batch number, and unit weight (wet density).
- E. Two cylinders from each set will be tested at an age of 3 days and two cylinders from each set will be tested at an age of 28 days.
- F. Compressive strength of grout shall be considered satisfactory if both of the following requirements are met:
 - 1. Average of three consecutive compressive strength tests equal or exceed the specified unconfined compressive strength. (A strength test shall be the average of two compressive strengths of two cylinders made from the same concrete sample and tested at the age specified.)
 - 2. No individual compressive strength test (average of the two cylinders) is below the specified unconfined compressive strength by more than 20 percent.
- G. Contractor to test grout as follows:
 - 1. Annular Backfill Grouting: One set of six (6) compressive test specimens for every 100 cubic yards of grout placed.

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SECTION 02432

LOW DENSITY CELLULAR CONCRETE

PART 1 - GENERAL

1.01 SCOPE

- A. The work described in this Section covers filling the annular space between the carrier pipe and the initial tunnel support or jacking pipe with low density cellular concrete (LDCC). In the event of conflicts with Section 02431 – Tunnel Grout, this Section takes precedence.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02426 – Installation Of Carrier Pipe In Tunnels
- B. Section 02431 – Tunnel Grout

1.03 DEFINITIONS

- A. Low Density Cellular Concrete (LDCC): A lightweight cementitious material that contains stable air or gas cells uniformly distributed throughout the mixture of a volume percentage greater than 20 percent.
- B. Annular Backfill Grouting: Grout used to fill the annular space between the carrier pipe and the initial tunnel support system or jacking pipe.
- C. Wet Density: The wet density, as used in this Section, refers to the final foamed wet slurry density (unit weight) of the in-place LDCC.

1.04 REFERENCE SPECIFICATIONS, CODES AND STANDARDS.

- A. American Concrete Institute (ACI):
 - 1. ACI 523.1R: Guide for Cast-in-Place Low Density Cellular Concrete.
 - 2. ACI 523.3R: Guide for Cellular Concretes above 50 pcf.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C94: Standard Specification for Ready-Mixed Concrete.
 - 2. ASTM C138: Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
 - 3. ASTM C150: Standard Specification for Portland Cement.
 - 4. ASTM C311: Standard test Methods for Sampling and Testing Fly Ash or Natural

Pozzolans for Use in Portland-Cement Concrete.

5. ASTM C495: Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
6. ASTM C567: Standard Test Method for Determining Density of Structural Lightweight Concrete.
7. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
8. ASTM C796: Standard Test Method of Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.
9. ASTM C869: Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete.

1.05 SUBMITTALS

- A. Conform to Section 01300 - Submittals.
- B. Quality Control: Submit qualifications of Contractor/Subcontractor, personnel, and manufacturer.
- C. Qualifications: The Contractor or Subcontractor supplying and placing LDCC shall be capable of developing a mix design, and batching, mixing, handling and placing LDCC under tunnel conditions; shall have furnished and placed LDCC on at least four tunnels of the general type and the size specified herein which have been in successful operation; and shall have a record of experience and quality of work using LDCC that is satisfactory to the Engineer.
- D. Personnel Qualifications: Workers, including the LDCC Contractor's superintendent and foreman, shall be fully qualified to perform the work. The LDCC Contractor's superintendent shall have previous experience under similar ground and tunnel conditions, or the supplying and placing of LDCC shall be performed under the supervision of the foaming agent supplier's representative.
- E. Product Data: Mix designs for each cellular concrete mix proposed for use. Each mix design shall show the ingredients of the mix and shall include:
 1. Type, brand, source, and amounts of cement, pozzolans, admixtures, and other additives.
 2. Source and amount of water.
 3. Representative samples of materials for materials testing and mix proportion testing.
 4. Combined grading of each mix design.

5. Specific gravity of all materials.
 6. Results of all required tests.
 7. A certificate of compliance signed by the supplier identifying the type of fly ash and stating that the fly ash is in accordance with ASTM C618 and these specifications. Supporting test data shall be furnished when requested by the Engineer. All testing and sampling procedures shall be in accordance with ASTM C311.
 8. Water: Use potable water. Verify with foaming agent supplier that water supplied contains no substance deleterious to the foaming agent.
 9. Concrete Admixtures: Material specifications and instructions for use.
 10. Air content, unit weight, and compressive strength test results for proposed mix design.
- F. Equipment: Manufacturer's specifications and operation instructions for equipment.
1. Pumps.
 2. Foam generators and ancillary equipment.
- G. Work Plan: The work plan for placing LDCC, including sequence of work, types of equipment, location of equipment, placing procedures, (i.e., batching, mixing, and pumping procedures), pumpline arrangement (including moving and breaking), intermediate and end bulkhead details, communications provisions, methods for monitoring mix, testing procedures, and cleanup procedures. The work plan shall include pumping pressures, pumping rates, volumes to be placed per day, injection locations, valving at injection locations to facilitate testing, method for monitoring carrier pipe temperature, and sequence of placement and pumping.
- H. Test Reports and Certifications
1. Mill test reports for cement.
 2. Certificates of compliance for each load of cement and pozzolan.
 3. Certificates of compliance for all admixtures.
 4. When delivered by truck from a batch facility, a delivery ticket with the information stated in section 14 of ASTM C94, except for actual scale weights of materials, shall be furnished to the Engineer with each batch of concrete before unloading at the site.
 5. A printout of the actual scale weights for all loads batched shall be submitted to the Engineer at the end of each working day.
 6. Daily reports and records of concrete placement, including but not limited to, volumes placed, stationing of placement, injection locations, pressures, unit weight

and air content testing results, time of placement, and designation of cylinder samples prepared that day.

7. Test reports indicating the results of compressive strength tests from a certified testing laboratory.
 - I. Provide grouting pressure calculations showing grout pressure during annular space grouting will not exceed the carrier pipe manufacturer's recommendations for allowable grouting pressure and safety factor for each lift segment. Annular volume, grade, length of lift segment, carrier pipe material, groundwater pressure, and subsurface conditions outside the initial tunnel lining shall be accounted for in submitted calculations.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Cement: Portland Cement, ASTM C150, Type I or II.
- B. Water: Clean, fresh potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the LDCC.
- C. Admixtures: Admixtures may only be used when specifically approved by foaming agent supplier in writing.
- D. Foaming Agent: Foaming agent shall comply with ASTM C869 when tested in accordance with ASTM C796.
- E. Type and Manufacturer: Mearl Geofoam Liquid Concentrate manufactured by Aerix Industries, Golden, CO; Foam Liquid Concentrate manufactured by Cellufoam Concrete Systems; Rheocell 30 manufactured by BASF Construction Chemicals, LLC of Cleveland, OH; Elastizell EF by Elastizell Corporation of America of Ann Arbor, MI; or approved equal.
- F. Fly ash: Type F.

2.02 MIX DESIGN

- A. General: The LDCC mix shall be designed in accordance with the requirements of ACI 523.1R, ACI 523.3R and the additional requirements specified herein. Mixes shall be adjusted in the field as necessary to meet the requirements of these specifications. The foaming agent material manufacturer's field services representative shall approve all changes to the mix designs.
- B. Minimum 28-day compressive strength (ASTM C495): 200 psi. Minimum 56-day compressive strength (ASTM C495): 250 psi.
- C. Limiting Requirements: Each LDCC mix shall be designed and controlled for the purposes of filling all annular voids, displacing water, and within the following limits unless otherwise specified:

1. Wet Density: Wet density (unit weight) of the LDCC shall be not less than 75 pcf, plus or minus 5 pcf, at the point of placement, unless a higher density is required to achieve strength requirements.
 2. Only Type F fly ash will be permitted. Fly ash/cement ratios shall not exceed 1.0 by weight.
- D. Preformed Foam: Preformed foam shall be generated by combining controlled quantities of air, water, and foaming agent under pressure. Foam shall retain its stability until the cement sets to form a self-supporting matrix. The resulting LDCC shall have essentially closed cell and low water absorptive characteristics. The concentration of foam agent shall be in accordance with the foaming agent material manufacturer's recommendations.
- E. Admixtures: The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations for minimum shrinkage and for compliance with these specifications. Admixtures may be used when specifically approved by foaming agent material manufacturer and shall be in accordance with their recommendations. No calcium chloride or admixture containing chloride, other than impurities from admixture ingredients, will be acceptable.
- F. Testing: A test mix shall be designed and tested in accordance with ASTM C796 for each consistency intended for use. These results will be compared with field test results to confirm consistent properties are obtained in the field. Testing for each mix shall be as follows:
1. Two sets of compression test cylinders (3 inches by 6 inches), three cylinders per set, shall be made from each proposed LDCC mix.
 2. One set of three cylinders shall be tested at an age of 7 days and the other set shall be tested at an age of 28 days. LDCC test specimens shall be made, cured, stored, and tested in accordance with ASTM C495.
 3. Determine total air content of each proposed LDCC mix in accordance with ASTM C796.
 4. Determine unit weight of each proposed LDCC mix in accordance with ASTM C567.

2.03 EQUIPMENT

- A. Use equipment for mixing and injecting LDCC which is designed for underground backfill grouting service. Provide batching, mixing and pumping equipment that is compatible and of sufficient size and capacity to place LDCC to distances and volumes proposed by the Contractor.
- B. LDCC shall be made using preformed foam process equipment approved by the foaming agent material manufacturer.
- C. Maintain equipment in good operating condition, capable of satisfactorily mixing, agitating,

and forcing LDCC backfill into injection ports at a uniform flow rate under the required constant pressure.

- D. Backfill grouting equipment shall be configured so flushing can be accomplished without contents flushed being discharged in to the tunnel.
- E. An adequate inventory of spare parts or backup equipment shall be provided to ensure that operable backfill grouting equipment is available at all times during the work. Maintain sufficient quantities of spare pressure gauges, stop valves, and other wear parts on site.
- F. Batch system shall provide graphical or digital printout records of batch scale readings, accurate to one (1) pound, of the dry mix ingredients before delivery to mixer.
- G. At the point of injection, suitable valves and calibrated pressure gauges shall be provided so that the pressure and grout flow at the grout hole may be regulated and monitored. At or very near the point of injection, provide a system of valves in the line transporting the grout that will allow easy access for collection of test specimens. Provide an automatic bypass valve set to the maximum pressure specified. Provide suitable stop valves at the injection point for use in maintaining pressure, as required, until grout has set. Use hoses or pipes of proper type and diameter to withstand maximum injection pressures used.

2.04 QUALITY ASSURANCE

- A. Field Services: The foaming agent material manufacturer shall provide engineering field services to review the project and the material application prior to any preparation; to approve the applicator, the material used, the equipment, and the procedure to be used; to approve setup before production of LDCC; and to observe during initial application. The field representative of the material manufacturer shall submit, in writing, approvals of proposed material, equipment, application procedures, applicator, and setup before production.
- B. Pipe Manufacturer Representative: Refer to Section 02426 – Installation of Carrier Pipe in Tunnel for pipe manufacturer field services employee requirements during annular backfill grouting.

PART 3 - EXECUTION

3.01 GENERAL

- A. LDCC shall be placed in accordance with the approved work plan.
- B. Bulkheads shall be constructed at the end of each reach of pipe (lift segment) to be backfilled.
 - 1. Bulkheads shall be constructed so the annular space will be completely backfill grouted.

2. Bulkheads shall incorporate a minimum 1-inch diameter drain pipe in the invert of the tunnel to facilitate drainage of water during backfill grouting. This pipe shall be securely capped and plugged once LDCC backfill begins to flow from the drain line.
 3. An opening shall be provided in the tunnel crown to allow entrapped air to escape. Vent outlets shall be provided where required.
 4. If LDCC placement is being performed through bulkheads a section of bulkhead shall be left out to allow for visual inspection of the LDCC installation until the time at which the final lift is to be placed.
- C. Inform the Engineer at least 24 hours in advance of the times and locations where placement of cellular concrete is anticipated.

3.02 BATCHING AND MIXING

- A. General: Conform to the requirements of accepted submittals and the foaming agent manufacturer's recommendations.
- B. Mixing: All LDCC shall be mechanically mixed to produce a uniform distribution of the materials with a suitable consistency and the specified limiting requirements. Excessive mixing shall be avoided in order to reduce the possibility of changes in unit weight and consistency.
1. In batch mixing operations, follow the manufacturer's recommendations concerning the order of charging the mixer with the various ingredients. The as-cast unit weight shall be monitored at the point of placement. Allowance should be made for any additional mixing that may result from the method of placement, such as mechanical or pneumatic pumping, and for any unit weight changes that may result from these methods.
 2. For continuous mixing operations, provision shall be made for reasonably uniform and continuous rate of addition of all mix components at appropriate positions in the mixing machine, and in the correct ratio, to assure uniformity and the specified limiting requirements at the point of placement.

3.03 PLACING LDCC

- A. General Requirements: Fill the annular space between the carrier pipe and the initial tunnel support or jacking pipe completely with LDCC. Force LDCC into all irregularities around the tunnel to completely fill the tunnel arch and annulus.
- B. Backfilling of carrier pipe with LDCC shall be performed in three or more equal-volume lifts.
- C. The limits of each LDCC placement stage shall be predetermined by the size and capacity of the batching equipment and the initial set time of the LDCC mix. Under no circumstances shall placement continue at an injection point longer than that period of time for the LDCC mix to take initial set. Injection hole spacings and locations shall be

based on the number of stages necessary to complete the backfilling process. A lift cannot be installed on top of the prior lift until a proper set has been attained.

- D. Contractor shall ensure that the carrier pipe temperature does not exceed the manufacturer's recommendation as a result of the heat of hydration of the LDCC.
- E. The length of carrier pipe installed at any time shall not exceed the annular backfill placement maximum lift segment length as stated in Section 02426 – Installation of Carrier Pipe in Tunnel.
- F. Pressure gauges of appropriate range for monitoring the LDCC injection pressures shall be located in the line transporting the LDCC as close to the point of injection as possible.
- G. Volume of LDCC injected shall be calculated on an indirect basis and compared with the anticipated volume per foot of pipe backfilled.
- H. Provide a means of direct communication between the injection point and the pump operator.

3.04 FIELD QUALITY CONTROL

- A. General: Field quality control tests, including unit weight (wet density), air content, and compressive strength shall be performed by the Contractor and the results submitted to the Engineer.
 - 1. The frequency specified herein for each field control test is approximate. A greater or lesser number of tests may be made, as required by the Engineer.
 - 2. Test specimens shall be collected within the tunnel at or near the connection where the LDCC is being injected.
 - 3. Supply all materials necessary for fabricating the test cylinders.
 - 4. Monitor carrier pipe temperature for one week after grout placement.
- B. Unit Weight: Unit weight (wet density) tests shall be made from the first batch mixed each day, after a change in mix design, every 30 minutes during pumping, and from each batch of LDCC from which compression test cylinders are made. Unit weight shall be determined in accordance with ASTM C567. Unit weight at the point of placement shall be within plus or minus 5 percent of the unit weight established for the mix design being placed. Adjust mix as required to obtain the specified wet density.
- C. Air Content: An air content test shall be made from the first batch mixed each day, and from each batch of LDCC from which concrete compression test cylinders are made. Air content at the point of placement will be the difference between the wet density at the point of placement less the wet density at the point immediately before the addition of preformed foam. Air content shall be determined in accordance with ASTM C138 except there will be no vibration or rodding of the sample.

- D. Compressive strength test cylinders shall be made in the field, cured and stored in the laboratory, and tested in accordance with ASTM C495. One set of six (6) test cylinders (3 inches by 6 inches) shall be made for each shift when LDCC is placed. Each set of compressive strength test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the LDCC represented by the cylinder was placed, batch number, unit weight (wet density), and air content. One additional set of test cylinders shall be made from each additional 200 cubic yards, or major fraction thereof, placed in any one shift. Two cylinders from each set shall be tested at an age of 28 days and two cylinders from each set shall be tested at an age of 56 days.
- E. Compressive strength of LDCC shall be considered satisfactory if both of the following requirements are met:
 - 1. Average of three consecutive compressive strength tests equal or exceed the specified unconfined compressive strength. (A strength test shall be the average of two compressive strengths of two cylinders made from the same concrete sample and tested at 28 days.)
 - 2. No individual compressive strength test (average of the two cylinders) is below the specified unconfined compressive strength by more than 20 percent.

3.05 PROTECTION AND CLEAN UP

- A. Take all necessary precautions to protect and preserve the interior of the pipe from damage. Spills shall be minimized and shall be cleaned up immediately. Any damage to the pipe caused by or occurring during the backfilling operations shall be repaired by a method approved by the Engineer, at no additional cost to the Owner.
- B. During backfilling work, provide for adequate disposal of all waste and wastewater. Remove and properly dispose of all waste resulting from backfilling operations.

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SECTION 02445

UTILITY HAND TUNNELING

PART 1 - GENERAL

1.01 SCOPE

- A. The work described by this Section consists of furnishing all labor, equipment, materials, and supplies required for tunnel construction. Hand tunneling methods include open-face excavation using pneumatic hand tools, roadheader excavation, or drill and blast methods.
- B. Work shall be done in accordance with the Contract Documents, and all Federal, State and local laws, regulations, and requirements.
- C. Contractor is fully responsible for safety. Comply with all OSHA regulations including, but not limited to, 29 CFR Part 1926. Obtain all required permits for confined space entry.
- D. Geotechnical reports, logs, borings, and laboratory testing performed within proximity of the project corridor are made available as "Technical Data" and are not part of the Contract. This technical data is provided as information only and solely for the convenience of Bidders. The Owner and/or the Engineer do not warrant or guarantee the accuracy or correctness of this technical data with respect to actual subsurface conditions. Subsurface conditions are considered unclassified and no expectation of quantity, specific location of ground conditions, or geotechnical baselines are provided or assumed herein.
- E. Contractor shall review all available geotechnical reports and data and perform any additional subsurface investigations he deems necessary at his own expense for the planning and the selection of tunneling techniques and methods in order to enable proper construction.
- F. Dewatering shall be controlled such that the launch and exit shafts are free of water. Surrounding groundwater table shall not be substantially lowered. Settlement of nearby existing structures and foundations due to dewatering shall not occur. Surrounding wells shall not be affected.
- G. Contractor-selected tunneling techniques shall include all equipment, associated support systems, guidance systems required to meet line and grade tolerances, ground modification where needed, tunnel excavation tooling, face of excavation support, and initial tunnel support materials as required to maintain face stability, advance heading within line and grade tolerances, transport spoils, and accomplish productivity assumed in Contractor's bid.
- H. The Contractor shall furnish all labor, equipment, and material required to complete the work including but not limited to the following:
 - 1. Tunnel construction across State, Federal, railroad, and private transportation corridors or other structures, utilities, waterways, or environmentally sensitive areas as indicated on the Drawings,
 - 2. Pneumatic hand tools, roadheaders, or drill and blast equipment, and all related supplies appropriate for the prevailing ground conditions,

3. Compressed air systems, if applicable,
 4. Removal of tunnel spoil,
 5. Supplying and installing of initial tunnel support,
 6. Installation of carrier pipe and associated blocking and support,
 7. Bulkheads and concrete cradles,
 8. Filling of voids between initial tunnel support and the ground,
 9. Grouting of annular space outside of initial tunnel support,
 10. Grouting annular space between initial tunnel support and carrier pipe,
 11. Design and construction of launch and receiving shafts,
 12. Dewatering at the shafts,
 13. Dewatering of the tunnel alignment (if allowed),
 14. Appropriate disposal of groundwater effluent, and
 15. Location markers, tracer wire and miscellaneous appurtenances as required to complete the installation.
- I. The minimum dimensions of the cross-section of the tunnel excavation shall be determined by the Contractor based on the following:
1. The construction requirements for final installation of the carrier pipe,
 2. Minimum size limitations of the annular space as required for installation and to meet line and grade tolerances,
 3. The minimum outside diameter of the tunnel indicated on the Contract Drawings and in Section 02425 – Initial Tunnel Support, and
 4. Any right-of-way, encroachment, or occupancy requirements and specifications of governing permitting agencies such as the North Carolina Department of Transportation (NCDOT).
- J. Contractor may increase the tunnel diameter if allowed by the governing agency, at no additional cost to the Owner, as needed to account for the Contractor's selected means and methods, operational procedures, and to provide adequate internal tolerance to account for the prevailing project site and subsurface conditions. If Contractor elects to modify tunnel diameter from size shown in the Contract Documents, the Contractor accepts all responsibility for acquiring approval for any modification or addenda to all right-of-way encroachment agreements, occupancy permits, or other established requirements and specifications of the entity being crossed.
- K. Where warranted in the experience of the Contractor or where identified on the Drawings, ground modification shall be performed as part of the preparation for tunneling to maintain a stable excavation, reduce the risk of surface settlement and heaving, and protect nearby structures and utilities. Contractor shall design and include in his Bid the cost of furnishing all labor, equipment, materials, and supplies necessary for ground modification.
- L. If required by the authority having jurisdiction, boring/tunneling operations under roads and railroads shall be on a continuous basis, 24 hours per day, 7 days a week as required until initial tunnel support installation is complete.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02315 – Trenching for Utilities
- B. Section 02422 – Temporary Excavation Support Systems
- C. Section 02425 – Initial Tunnel Support
- D. Section 02426 – Installation of Carrier Pipe in Tunnels
- E. Section 02431 – Tunnel Grout
- F. Section 02432 – Low Density Cellular Concrete
- G. Section 02530 – Sanitary Sewer Systems

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Applicable codes, ordinances, statutes and governing rules and regulations of governing municipalities and counties, the State of North Carolina, and the Federal Government.
 - 2. American Association of State Highway and Transportation Officials (AASHTO).
 - 3. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
 - 4. Occupational Safety and Health Administration (OSHA) Regulations 29 CFR Part 1926.
 - 5. Applicable ASTM and AWWA Standards for materials and methods.
 - 6. North Carolina Department of Transportation (NCDOT) Standard Specifications for Roads and Structures.

1.04 DEFINITIONS

- A. Authority having Jurisdiction: Any third-party agency from whom a permit, license agreement or other agreement has been obtained to allow for construction.
- B. Carrier Pipe: A pipe used for conveyance of water or sewer.
- C. Drive: Section of initial support system installed by tunneling from entrance shaft to exit shaft.

- D. Exit Shaft or Retrieval Shaft: Shaft at end of drive used for retrieval of tunneling equipment. The term “pit” is used synonymously with the term “shaft.”
- E. Exterior Annular Space: The void between the outside of the initial tunnel support system and the ground.
- F. Ground Modification: Soil stabilization by jet grouting, compaction grouting, void filling, soil mixing, slurry walls or other ground stabilization technologies.
- G. Initial Support: The first tunnel support installed in a two-pass tunneling method.
- H. Internal Annular Space: The void between the initial tunnel support system and the carrier pipe.
- I. Launch Shaft: Shaft at beginning of drive from which tunneling equipment is launched. The term “pit” is used synonymously with the term “shaft”.
- J. Spoil: Excavated soil and bedrock material generated by the tunneling process.
- K. Tunneling Methodology: A written description, together with supporting documentation, which defines Contractor's plans and procedures for the tunneling operations.
- L. Two-Pass Tunneling: Tunneling where initial support is installed concurrent with the excavation process to stabilize the tunnel excavation and a carrier pipe is installed in a subsequent phase or the second pass.
- M. Working Shaft: Shaft a beginning of drive from which tunneling activities commence. The term “pit” is used synonymously with the term “shaft”.

1.05 DESIGN CRITERIA

- A. Tunneling equipment selected for the project shall be compatible with the geologic conditions described in the available geotechnical data provided as Technical Data, and any additional geologic testing performed by the Contractor that he deems necessary to select appropriate equipment.
- B. Initial tunnel support shall be designed by Contractor's Engineer in accordance with Section 02425 – Initial Tunnel Support
- C. Launch shaft and exit shaft shall be designed by Contractor's Engineer in accordance with Section 02422 – Temporary Excavation Support Systems.
- D. All design calculations provided by the Contractor as part of the required submittals shall be sealed by a licensed Professional Engineer registered in the State of North Carolina.

1.06 SUBMITTALS

- A. Conform to Section 01300 – Submittals.
- B. Qualifications
 - 1. Submit experience qualifications for the Contractor/Subcontractor performing the hand tunneling.

2. The Contractor or Subcontractor shall have the following minimum experience related to hand tunneling:
 - a. A minimum of five (5) years of experience performing projects of similar size and scope.
 - b. Installed a minimum of 2,000 linear feet of 48-inch or larger hand-excavated tunnels.
 - c. Two (2) tunnel projects completed in the last 10 years performed using hand tunneling in rock with either partial or full-face rock excavation.
 - d. Installed a minimum of 2,000 linear feet of carrier pipe and grouted the annular space.
3. Provide resumes and written documentation of the qualifications of the project manager, project superintendent, shift foremen, and operators in accordance with paragraph 1.07.

C. Detailed Methodology

1. Method of tunnel excavation, face support and initial ground support.
2. Manufacturer and type of tunneling equipment including specifications.
3. Details of lighting and ventilation systems, including type and output.
4. Shop drawings for tunneling equipment showing layout, dimensions, method of operation, face control capability, excavation system, and alignment control.
5. Drawings and design details for launch shafts and exit shafts. Design and calculations for temporary excavation support systems used in shaft construction shall be signed and sealed by a licensed Professional Engineer registered in the State of North Carolina.
6. Methods, schedule and procedures for grouting voids outside the initial tunnel support.
7. Number and duration of shifts planned to be worked each day in accordance with restrictions on work hours.
8. Sequence of work/operations.
9. Procedures for handling, control and disposal of surface water, water input to the tunnel by Contractor, and groundwater inflow.
10. Method of spoil transportation from the tunnel face and up the shafts, surface storage, and disposal location. A description indicating the locations of spoil disposal sites and releases from property owners.
11. Survey methods and proposed procedures for alignment and grade control.
12. Identification of critical utility crossings and special precautions proposed.
13. Manufacturer and type of any chemical grouts proposed.

- D. Contingency Plan: Contractor shall submit a proposed contingency plan describing the methods and procedures to be implemented in the event of:
 - 1. Unusual or adverse ground conditions (i.e.: running sand, swelling ground, water, etc.) are encountered, and
 - 2. Surface settlement or heaving occurs.
- E. Ground Modification Plan: Contractor shall design and submit proposed ground modification plans for ground stabilization, surface settlement prevention and cutoff of groundwater inflow due to tunneling activities.
- F. Ventilation Plan: Ventilation plan to include a written description, calculations, drawings, fan curves and manufacturer's catalogue cut sheets. Ventilation plan shall be designed by a competent person with at least five (5) years of recent on-the-job experience on similar projects, involving tunnels of similar size constructed by similar methods. Provide qualifications of Designer.
- G. Settlement Monitoring Plan: Submit a settlement monitoring plan for review prior to construction. The plan shall be in accordance with paragraph 3.03.
- H. Daily Reports: A shift log shall be maintained on a daily basis by Contractor. Submit reports no later than 24 hours after the end of the shift to the Engineer. Daily reports shall include at a minimum the following:
 - 1. Location of face by station and progress of tunnel drive during shift.
 - 2. Hours worked per shift on tunneling operations, equipment and materials used, and duration of different activities performed.
 - 3. Completed field forms for checking line and grade of the tunneling operation, showing achieved tolerance relative to design alignment.
 - 4. Groundwater control operations, groundwater inflow location and rates.
 - 5. Observation of any ground loss or other ground movement.
 - 6. Any unusual conditions or events.
 - 7. Reasons for operational shutdown whenever a drive is halted.
 - 8. Air quality reports for dust, toxic and hazardous gases, and other atmospheric impurities in the working environment.
- I. Record Drawings: Maintain at the construction site a complete set of field drawings for recording of as-built conditions. All marks and notes shall be dated, and thorough. Submit the following:
 - 1. Record of actual locations of tunnel face excavation with elevations. Elevations shall be taken at every 10 feet and recorded to the nearest eighth of an inch (0.01 feet). Horizontal coordinates of all surveyed points shall be on the coordinate system utilized by the Owner.
 - 2. Written report to verify there are no voids or defects outside of the initial tunnel support.
 - 3. Written log of each tunnel drive to the Engineer and Owner for review within three (3) business days of completing each drive.
- J. Permits: The Contractor shall be responsible for executing the requirements of permits obtained from the NCDOT, United States Army Corps of Engineers, and any State and local authority where the project is located. The Contractor shall be responsible for any phase

submittals required by the permits. All submittal information required by the project permits shall be channeled through the Engineer.

1.07 QUALITY ASSURANCE

- A. Work shall be supervised by at least one (1) person with five (5) years of recent previous experience in tunneling using the proposed equipment on projects of similar size, drive lengths and ground conditions. Tunneling operations shall be performed under the direction of tunneling supervisor who shall be in responsible charge throughout the tunneling operation.
- B. All tunneling operations shall be performed under the supervision of experienced shift foremen with at least five (5) years of recent on-the-job supervision experience on similar projects involving tunnels of similar size constructed using similar methods.
- C. Operators shall be experienced in tunneling with prior knowledge and ability to properly operate the systems being employed. All operators shall have minimum of five (5) years of experience performing tunneling of similar size, drive lengths and ground conditions.
- D. Operate systems following manufacturer's instructions and recommendations. Make available at all times copies of operations manuals to the Engineer and operational personnel on site.
- E. Before commencement of any drive, demonstrate to the Engineer that required set up procedures and system checks are complete and required materials are at hand to commence drive.

1.08 PRE-INSTALLATION MEETING

- A. At least three weeks prior to commencing the work of this section, convene a Pre-Installation Meeting at the job site to be attended by:
 - 1. Contractor and any subcontractor performing any related work.
 - 2. Project Owner.
 - 3. Engineer.
 - 4. Any other pertinent stakeholder.
- B. Meeting shall cover settlement monitoring, work hours, safety, staging and storage of materials, schedule, any changes to on-site staff from original Work Plan submittal, permitting, and the development of record drawings, etc. to ensure successful implementation of all requirements of this Section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall accept material on site and inspect for damage.
- B. The Contractor shall handle, support and store materials to prevent injury or damage.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.
- B. Conduct operations to not interfere with roadway traffic, except with prior approval by the NCDOT and other applicable governing authorities.
- C. Provide temporary facilities to prevent erosion of disturbed construction area in accordance with the approved Erosion & Sedimentation Control Plan and Contract Documents.
- D. Maintain existing stormwater flow patterns or submit measures to temporarily bypass in accordance with the Erosion & Sedimentation Control Plan and Contract Documents.

1.11 COORDINATION

- A. Coordinate work with local, State and Federal authorities and utility owners to avoid interference with or damage to existing facilities in or adjacent to construction areas.

PART 2 – PRODUCTS

2.01 INITIAL SUPPORT SYSTEM

- A. Initial tunnel support shall be in accordance with Section 02425 – Initial Tunnel Support.

PART 3 – EXECUTION

3.01 PROJECT SITE CONDITIONS

- A. Tunneling shall not begin until the following have been completed:
 - 1. All submittals including, but not limited to, shafts, initial tunnel support, tunnel equipment, installation of carrier pipe and annular backfill grouting/LDCC have been reviewed and accepted by the Engineer.
 - 2. Notify the Owner and Engineer at least 30 days before beginning any excavation.
 - 3. Ground modification has been performed, if required.
 - 4. Groundwater control for breaking out and breaking into the shafts has been established.
 - 5. A Safety Officer has been designated and prepared a Health and Safety Plan in accordance with OSHA requirements for tunnel construction. The Safety Officer shall have held safety meetings and provided safety instruction for new employees as required by OSHA.
 - 6. Pre-installation meeting has been held and all comments have been addressed from the meeting.
 - 7. Settlement monitoring system is in place and pre-construction readings have been provided to the Engineer.
 - 8. Pre-construction survey documents have been submitted to the Engineer.

- B. Perform tunneling operations in a manner that does not interfere with, interrupt, or endanger surface activity, and minimizes subsidence of surfaces, structures, and utilities above and adjacent to the tunnel. Surfaces, structures and utilities damaged by tunneling operations shall be repaired or replaced in a timely manner to their original condition at no additional cost to Owner.
- C. Furnish all necessary equipment, power, water, and utilities for tunneling, removal and disposal of spoil, grouting, and other associated work required for the Contractor's methods of construction.
- D. Conduct all operations such that trucks and other vehicles do not create a dust or noise nuisance in the streets and adjacent properties. Promptly clean up, remove, and dispose of any spoil or slurry spillage.
- E. Furnish all maintenance of traffic and establish and maintain all safety procedures on any highways whose thoroughfare is interrupted due to the tunneling operation.
- F. Inspect the locations where tunneling will be conducted, verify conditions under which the work will be performed, and provide all necessary details, whether or not shown on the Drawings or specified, for the orderly prosecution of the work.

3.02 PREPARATION

- A. Existing utilities shown on Drawings are shown for general information only. Contractor shall verify locations, sizes and configurations of existing systems within potential conflict of installation operations.
- B. Complete any required testing, inspection, surveying, etc., of any existing utilities required by the Contract Documents.
- C. Call Local Utility Line Locate Service (811) not less than five working days before performing Work.
- D. Request underground utilities to be located and marked within and surrounding the construction areas.
- E. Locate, identify, and protect utilities indicated to remain from damage.
- F. Protection
 - 1. Protect plant life, lawns, rock outcroppings and other features remaining as portion of final landscaping.
 - 2. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic. Repair or replace items damaged during construction.
 - 3. Repair or replace structures raised more than 0.50 inch due to pressure from tunneling operations including pavement, and sidewalk.
- G. Ventilation
 - 1. Furnish and operate a temporary ventilation system and air monitoring system conforming to the requirements of OSHA at all times that personnel are underground. Operate and maintain a ventilation system that provides a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gases in all underground work areas.
 - 2. All ventilation fans not within the tunnel shall be placed within an enclosure to limit

ambient noise.

H. Barricades

1. Protect shafts and other open excavations with barricades, security fencing and with additional measures approved by the Engineer as required to prevent unauthorized personnel from accessing.
2. During non-work hours, isolate with additional measures as required to prevent unauthorized personnel from accessing.
3. Remove equipment daily from vehicular and pedestrian roads, sidewalk and pathways not contained within the direct work area to permit access and use by public.

3.03 SETTLEMENT MONITORING

- A. Survey the site showing locations and elevations of existing ground, pavement, and other permanent features to establish a baseline for existing conditions along the centerline of the tunnel, and along two parallel lines located 10 feet on either side of centerline. All surveying for settlement monitoring shall be performed by a licensed Surveyor registered in the State of North Carolina.
- B. Surface settlement markers shall be established at 10-foot centers along tunnel centerline and at 10 feet each side of centerline.
- C. Subsurface settlement monitors may be considered in lieu of surface settlement markers and shall be in accordance with the detail provided in the Contract Drawings. Location of subsurface monitors shall be submitted for review by the Engineer and approved prior to installation.
- D. Settlement markers shall be surveyed by the licensed surveyor as follows:
 1. Prior to beginning any work.
 2. Every 24 hours during tunnel excavation.
 3. At completion of tunnel excavation.
 4. At 90 days after work is complete and shafts have been backfilled.

3.04 GROUND SURFACE MOVEMENT

- A. Tunneling shall be performed in a manner that prevents ground loss, settlement and surface heave.
- B. Unless more stringent requirements are set forth by an authority having jurisdiction, settlement or heave of the ground surface along the alignment shall not exceed 0.02 feet.
- C. If settlement or heave exceeds 0.02 feet, the tunneling operations shall cease and remedial measures approved by the Engineer shall be implemented. Modify tunneling operations as needed to prevent further settlement or heave.
- D. If settlement or heave occurs which causes or may cause damage to an existing structure above or adjacent to the work, immediately cease operations except that which assists in making the work secure and in preventing further movement or damage. Resume tunneling

only after all necessary precautions have been taken to prevent further movement or damage.

- F. Lateral Displacements: Unless more stringent requirements are set forth by an authority having jurisdiction, lateral movement or deflection of shaft excavation support system shall be limited to 0.5 inch.
- G. Report any settlement or movement immediately to the Engineer and applicable agency and take immediate remedial action.

3.05 GROUNDWATER CONTROL

- A. Intercept and divert surface drainage, precipitation and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means within the conditions permitted by the approved Erosion & Sedimentation Control Plan and the Contract Documents.
- B. Develop substantially dry subgrade for prosecution of subsequent operations.
- C. Launch and exit shaft subgrade shall be kept continuously free from ground and surface waters during tunneling operations. Dewatering shall be controlled such that the launch and exit shafts are free of water, but the surrounding groundwater table is not substantially lowered such that settlement along the tunnel drive occurs.
- D. Keep removal of soil particles to a minimum.
- E. Monitor surface facilities to verify there is no settlement or displacement occurring due to dewatering.
- F. Water discharge from dewatering operations shall be directed into approved receiving basins or silt bags in accordance with all applicable regulatory requirements and the approved Erosion & Sedimentation Control Plan.
- G. Should settlement or displacement be detected, notify the Engineer and applicable agency immediately and act to maintain safe conditions and prevent damage.

3.06 GROUND MODIFICATION PRIOR TO TUNNELING

- A. The use of jet grouting, compaction grouting, permeation grouting or other ground stabilization techniques shall be carefully considered by the Contractor to safely allow tunneling in loose and flowable soils or in rock that is fractured with joints, bedding planes, shears, or fault zones below the groundwater table. Contractor shall determine if ground modification is needed to maintain a stable excavation, reduce the risk of surface settlement and heaving, and protect nearby structures and utilities. Contractor is fully responsible for determination of the necessity, selection, design, and implementation of ground modification plans.
- B. Ground modification plans shall be designed to work in concert with Contractor's selected excavation methods and implemented as needed to increase the stability of the ground, provide settlement control, reduce permeability, and increase stand-up time at the face of tunnel excavation and in excavations for launch and exit shafts. The cost of ground modification shall be included in the Bid.
- C. Contractor shall furnish all labor, equipment, materials, and supplies necessary for ground modifications.

3.07 EQUIPMENT

- A. Contractor shall employ tunneling equipment that will be capable of handling the various anticipated ground conditions and which minimizes loss of ground ahead of the face and allows for satisfactory support of the excavated face.
- B. Air Quality: Contractor shall provide equipment to maintain proper air quality of tunnel operations during construction in accordance with the requirements of 29 CFR Part 1926, Subpart S, Underground Construction. In addition, Contractor shall provide portable multi-gas detectors to measure oxygen (O₂), carbon monoxide (CO), hydrogen sulfide (H₂S), and lower explosive level of combustible gas (LEL) concentrations continuously at the heading when the tunnel is occupied by personnel.
- C. Lighting Fixtures: Contractor shall enclose lighting fixtures in watertight enclosures with suitable guards and provide separate circuits for lighting and other equipment.
- D. Electrical Systems: Electrical systems shall conform to requirements of National Electrical Code – NFPA 70.
- E. Fire Suppression: Contractor shall furnish, install, and maintain a fire suppression system in accordance with all local, State, and Federal requirements.

3.08 INSTALLATION – WORKING AND EXIT SHAFTS

- A. Excavate working and exit shafts in accordance with Section 02422 – Temporary Excavation Support Systems.
- B. Provide excavation supports as designed by the Contractor’s Engineer.
- C. Support soil, pavement, utilities and structures existing outside excavation.
- D. Construct shafts to limit intrusion of groundwater. Dewatering discharge shall be in accordance with State and local erosion, sediment control, and stormwater requirements and the provisions of the Contract Documents.
- E. Furnish and install, to the extent required, thrust blocks or such other provisions as may be required for the tunneling process.
- F. Do not apply loads to concrete until it has achieved required design strength.
- G. Upon completion of tunneling operations remove shafts. Backfill, compact and restore area in accordance with the Contract Documents.

3.09 TUNNEL EXCAVATION AND INITIAL SUPPORT INSTALLATION

- A. Tunnel excavation shall remain within the easements and rights-of-way indicated on the Drawings, and to the lines and grades shown on the Drawings.
- B. Excavate each drive in a safe manner that maintains the stability of the ground and provides full bearing of the initial support system against the ground without significant settlement or movement of the surrounding ground.
- C. Keep the face breasted or otherwise supported where required to prevent ground loss, excessive raveling, or erosion. Maintain standby face supports for immediate use when needed.

- D. Control volume of spoil removed. Monitor the advance rate and the muck removal rate to prevent overexcavation or loss of ground.
- E. Monitor conditions that might threaten the stability of the heading, take appropriate action to prevent or limit influx of ground and groundwater which would threaten the stability of the heading.
- F. Install initial tunnel support in accordance with methodology provided by Contractor's Engineer. Any damaged, displaced, or improperly installed initial tunnel support shall be removed and replaced or repaired immediately in a manner acceptable to the Engineer. All elements of the initial tunnel support shall be maintained in good condition until pipeline construction is complete. Any defect which threatens the satisfactory performance of the initial tunnel support system shall be repaired immediately.
- G. If tunnel conditions require changes to the installation method or material, the Contractor shall submit complete information on proposed changes to Engineer for review prior to making any changes.
- H. Upon completion of the initial tunnel support installation, the Contractor shall allow two (2) business days for the Engineer or other representative of the Owner to inspect the completed installation.

3.10 SPOIL TRANSPORT AND DISPOSAL

- A. Transport and dispose of all excavated materials properly away from the construction site. Tunnel spoil, slurry, and muck shall be disposed of at legal disposal facilities.

3.11 CONTROL OF TUNNEL LINE AND GRADE

- A. Establish benchmarks and survey control points. Benchmarks and control points shall be established by a licensed Surveyor registered in the State of North Carolina.
- B. Verify benchmarks prior to start of construction and report any errors or discrepancies to the Engineer.
- C. When satisfied that all benchmarks are correct, use these benchmarks to furnish and maintain all reference lines and grades for tunneling. Use these lines and grades to establish the location of the tunneling guidance system. Submit to the Engineer copies of field notes used to establish all lines and grades and allow the Engineer to check set up prior to beginning tunneling. The Contractor remains fully responsible for the accuracy of the work and the correction of it, as required.
- D. Benchmark Movement: Contractor shall ensure that if settlement of the ground surface occurs during construction which affects the accuracy of the temporary benchmarks, Contractor shall detect and report such movement and reestablish temporary bench marks.
- E. Maintain a means sufficient to control alignment and grade continuously.
- F. Contractor shall survey the crown, invert, and springline of the tunnel at 50-foot intervals or more frequently if line and grade tolerances have been exceeded, to ensure the alignment is within the tolerances specified. The survey shall be conducted immediately behind the tunnel excavation to allow immediate correction of misalignment.
- G. If excavation is off line or grade notify Engineer immediately and make necessary alignment corrections. The maximum rate of return to established line and grade shall be 1 inch per 25 feet.

- H. Check the survey control for tunneling against an aboveground undisturbed reference at least once each week and once for each 250 feet of tunnel constructed.
- I. Tunnel shall be clearly marked with paint every 10 feet along its length with stationing as indicated on the Drawings.

3.13 GROUTING OUTSIDE OF INITIAL TUNNEL SUPPORT

- A. Promptly following completion of the initial tunnel support installation, pressure grout to fill all voids existing outside of the initial tunnel support.
- B. Grouting shall be performed in accordance with the requirements for final exterior grouting in Section 02431 – Tunnel Grout.

3.14 ACCEPTANCE CRITERIA FOR LINE AND GRADE TOLERANCES

- A. Prior to installing the carrier pipe, Contractor shall verify that the initial tunnel support has been installed such that the carrier pipe can be placed in conformance with specified tolerances.
- B. Gravity Mains: Tolerances from lines and grades shown on the Drawings for gravity sewer pipes installed within the initial tunnel support system shall be in accordance with the tolerances listed in Section 02426 – Installation of Carrier Pipe. Reverse grades, low points or sags in the carrier pipe shall not be permitted or accepted. Should misalignment of the initial tunnel support preclude installation of the sewer pipe to the tolerances specified, notify Engineer.
- C. Pressure Service Mains: Line and grade for trenchless installation of water mains and force mains may not vary by more than 2% of the total length from the required horizontal alignment, one foot from the vertical alignment and shall maintain the minimum cover required.
- D. If the carrier pipe cannot be installed to the invert elevations shown on the Drawings, but it still is within the tolerances shown, notify the Engineer and establish a plan for adjusting the grade of the pipeline upstream and/or downstream to meet minimum slope requirements, avoid reverse grade, and return to the design grade at the nearest possible point.
- E. Pipe installed outside tolerances and subsequently abandoned shall be filled completely with grout.

3.15 INSTALLATION OF CARRIER PIPE IN TUNNEL

- A. Install carrier pipe in accordance with Section 02426 – Installation of Carrier Pipe in Tunnels.

3.16 SITE RESTORATION:

- A. Site restoration shall be in accordance with the Drawings and applicable Sections of these Specifications.

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SECTION 02530

SANITARY SEWER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work under this section includes, but is not limited to, piping, manholes, diversion structures, valves, and appurtenances for a complete sanitary sewer collection system.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 02315 Trenching for Utilities
 - 2. Section 02445 Bore & Jack of Conduits
 - 3. Section 02415 Microtunneling
 - 4. Section 02560 Sewer Line Cleaning and TV Inspection

1.03 REFERENCES

- A. Publications are referred to in the text by basic designation only.
 - 1. American Society for Testing and Materials (ASTM)
 - a. A126 Gray Iron Castings and Valves, Flanges and Pipe Fittings.
 - b. B117 Operating Salt Spray (Fog) Apparatus
 - c. C33 Concrete Aggregates
 - d. C76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - e. C150 Portland Cement
 - f. C361 Reinforced Concrete Low-Head Pressure Pipe.
 - g. C443 Flexible Watertight Joints for Precast Manhole Sections
 - h. C478 Precast Reinforced Concrete Manhole Sections
 - i. C497 Standard Methods Testing Concrete Pipe, Manhole Sections or Tile
 - j. C618 Coal Fly Ash and Raw or Calcined natural Possolan for Use as a Mineral Admixture in Portland Cement Concrete
 - k. C655 Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
 - l. C822 Definition of Terms Related to Concrete Pipe and Related Products
 - m. C890 Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
 - n. C923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
 - o. C1103 Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
 - p. C1131 Least Cost (Life Cycle) Analysis of Concrete Culvert, Storm Sewer, and Sanitary Sewer Systems
 - q. C1619 Elastomeric Seals for Joining Concrete Structures
 - r. C2794 Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
 - s. D638 Tensile Properties of Plastics

- t. D714 Evaluating Degree of Blistering of Paints
- u. D1244 Test Method for Concrete Sewer Manholes by the Negative Air Pressure
- v. D1248 Polyethylene Plastics Molding and Extrusion Materials
- w. D1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
- x. D2241 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
- y. D2310 Machine Made Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
- z. D 2321 Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe
- aa. D2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- bb. D2924 Standard Test Method for External Pressure Resistance of Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
- cc. D2996 Filament Wound Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
- dd. D2997 Centrifugally Cast Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe
- ee. D3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- ff. D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
- gg. D3262 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
- hh. D3350 Polyethylene Plastics Pipe and Fittings Materials
- ii. D3567 Determining Dimensions of Fiberglass (Glass Reinforced Thermosetting Resin) Pipe and Fittings
- jj. D3681 Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition
- kk. D3839 Underground Installation of "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Pipe
- ll. D4060 Abrasion Resistance of Organic Coatings by the Taber Abraser
- mm. D4161 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
- nn. D4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers
- oo. D4258 Surface Cleaning Concrete for Coating
- pp. D4259 Abrading Concrete
- qq. E96 Water Vapor Transmission of Materials
- rr. F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- ss. F1417 Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
- tt. G95 Cathodic Disbondment Test of Pipeline Coatings
- 2. American Water Works Association (AWWA)
 - a. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - b. C110 Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids
 - c. C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
 - d. C153 Ductile-Iron Compact Fittings, 3 inch through 16 inch, for Water and Other Liquids
 - e. C504 Rubber-Seated Butterfly Valves

- f. C508 Swing-Check Valves for Waterworks Service, 2 inch Through 24 inch NPS
- g. C512 Air-Release, Air / Vacuum, and Combination Air Valves for Waterworks Service
- h. C550 Protective Epoxy Interior Coatings for Valves and Hydrants
- i. C600 Standard for Installation of Ductile Iron Water Mains and Their Appurtenances
- j. C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch through 12 inch, for Water Distribution
- k. C905 Polyvinyl Chloride (PVC) Water Transmission Pipe, 14 inch through 36 inch, for Water Distribution
- l. C950 Standard for Fiberglass Pipe
- m. M23 PVC Pipe - Design Installation
- n. M41 Ductile Iron Pipe and Fittings
- o. M45 Fiberglass Pipe Design
- 3. National Sanitation Foundation (NSF) Standards
 - a. 14 Plastic Piping Components and Related Materials
- 4. UNI-BELL Plastic Pipe Association (UNI)
 - a. B-5 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Sewer Pipe
 - b. B-6 Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
- 5. Ductile Iron Pipe Research Association (DIPRA)
 - a. 8-08/5M Design of Ductile Iron Pipe
- 6. Reinforced Concrete Pipe
 - a. American Concrete Pipe Association (ACPA) Design Data 9 Standard Installations and Bedding Factors for the Indirect Design Method.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section, Submittal Procedures:
 - 1. Affidavit of Compliance: Affidavit shall attest that supplied products conform to the referenced standard and this specification and that tests set forth in each applicable referenced publication have been performed and that test requirements have been met. Submit for each of the following materials:
 - a. Pipe
 - 1) Ductile iron
 - 2) PVC Pressure Pipe
 - i) C900
 - ii) C905
 - 3) Polyvinyl Chloride (PVC) gravity sewer pipe
 - i) SDR 35
 - ii) Schedule 40, drain, waste, and vent (DWV) pipe
 - 4) Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Pipe
 - 5) Filament Wound Fiberglass Reinforced Polymer Mortar Pipe
 - 6) Reinforced Concrete HDPE Lined Pipe
 - b. Pre-cast concrete manholes
 - 1) For T-base manholes the precast manufacturer shall provide detailed design calculations for each configuration, which shall include calculations for wall stresses, flotation, depth, reinforcement, and all other criteria necessary for a complete design.

- c. Valves
 - 1) Plug
 - 2) Check
 - 3) Air Release
 - 4) Resilient-seated gate
- d. Protecto 401 Ductile Iron Pipe Liner
- 2. Catalog Data and Calculations: Submit manufacturer's standard drawings or catalog cuts and calculations for pipe pressure/thickness class, concrete reinforcement and stiffness class for the appropriate type pipe based on the Drawings and Specifications for the following. Clearly indicate material to be furnished for the Project including options to be provided and indicate if a greater pipe pressure/thickness class, concrete reinforcement or pipe stiffness class will be necessary based on the manufacturer's calculations.
 - a. Pipe
 - 1) Ductile iron
 - 2) Ductile Iron with restrained joints
 - 3) PVC Pressure Pipe
 - i) C900
 - ii) C905
 - 4) Polyvinyl Chloride (PVC) gravity sewer pipe
 - i) SDR 35
 - ii) Schedule 40, drain, waste, and vent (DWV) pipe
 - iii) Composite (Truss)
 - iv) Ribbed
 - 5) Centrifugally Cast Fiberglass Reinforced Polymer Mortar (CCFRPM) Pipe
 - 6) Filament Wound Fiberglass Reinforced Polymer Mortar Pipe
 - 7) Reinforced Concrete HDPE Lined Pipe
 - b. Pre-cast Concrete Manholes and the following appurtenances:
 - 1) Manhole steps
 - 2) Pipe connectors
 - 3) Joint material
 - 4) Castings
 - 5) Interior Coating System
 - c. Service saddles
 - d. Valves
 - 1) Resilient-seated gate
 - 2) Plug
 - 3) Check
 - 4) Air Release
 - e. Protecto 401 Ductile Iron Pipe Liner
- 3. Reports:
 - a. Field test report for each section of pipe for the following:
 - 1) Pressure test for force mains.
 - 2) Low-pressure air test for gravity mains.
 - 3) Vacuum test for manholes.
 - 4) Deflection test for gravity mains.
- 4. Operation and Maintenance Instructions: Submit complete operation and maintenance manual for the following:
 - a. Valves.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Provide a rope sling when handling the pipe. Lifting of the pipe shall be done in a vertical plane. Under no conditions shall the sling be allowed to pass through the pipe unless adequate measures are taken to prevent damage to both tongue and groove ends.
- B. Deliver pipe in the field as near as practicable to the place where it is to be installed. Distribute pipe along the side of the trench opposite to the spoil bank. Where necessary to move the pipe longitudinally along the trench, it shall be done in such a manner as not to injure the pipe or coating.
- C. Shield PVC pipe and fittings stored on site from the sun's ultraviolet rays by suitable cover, or indoor storage.

PART 2 PRODUCTS

2.01 DUCTILE-IRON PIPE

- A. Pipe and fittings shall conform to the following requirements:
 - 1. Size shall be as indicated on the Drawings.
 - 2. Minimum pipe pressure class shall be 350 for pipes 6-inch to 12-inch diameter, and a minimum pressure class 250 for pipes 16-inch and larger.
 - 3. Suitable for a system working pressure of 250 psi minimum for gravity sewer, 150 psi for force mains.
 - 4. Pipe shall be supplied in nominal lengths of 18 or 20 feet.
 - 5. Cement-mortar lined with seal coat in accordance with AWWA C104 for pipes smaller than 12-inches.
 - 6. Interior of pipes and fittings for pipes 12-inches and larger shall be lined with PROTECTO 401 ceramic epoxy as described in paragraph in this section.
 - 7. Pipe pressure/thickness class shall be suitable for the type laying condition as provided in Section 02315, Trenching for Utilities, and at the depth indicated on the Drawings. The proper pressure/thickness class shall be at a minimum as shown on the Contract Drawings. Pipe manufacturer to verify pipe selection, and document to Engineer, prior to ordering and manufacture of pipe.

Note: The pipe pressure classes shown on the Contract Drawings were determined with the use of the pipe liner as specified above. If this specified pipe liner is modified or changed for any reason, then the Engineer and Pipe Manufacturer, prior to the Contractor ordering the pipe, shall reevaluate the pressure class.

- 8. Provide mechanical joint fittings, unless noted otherwise on the Drawings.
 - 9. Pipe class shall not transition between manholes and shall be the highest pressure/thickness class required for that reach with exception to sections between manholes including jacking pipe as indicated on the Drawings.
 - 10. Ductile Iron may be used for gravity sewers and force mains.
- B. Ductile-iron pipe for below ground service shall have push-on or mechanical joints, unless noted otherwise on the Drawings, conforming to AWWA C150 and C151, and to the following requirements:
 - 1. Provide mechanical joint fittings for push-on or mechanical joint pipe, unless noted otherwise on the Drawings.

- C. Ductile-iron pipe for above ground service shall have flanged joints, unless noted otherwise on the Drawings, and conform to AWWA C115.
 - 1. Pipes to be painted shall have only a shop primer on the outside by the manufacturer. Verify that proposed manufacturer's primer is compatible with the proposed paint system.
- D. Fittings for ductile-iron pipe shall conform to AWWA C110, or C153 and to the following requirements:
 - 1. Joint type shall be as specified above for the supplied ductile-iron pipe.
 - 2. Fittings shall be made of ductile-iron.
- E. Ductile iron pipe on piers shall have Mech-Lok™ rigid restrained joint by Griffin Pipe Products Co. or approved equal.
- F. Special Pipe Joints
 - 1. River Crossing (Ball Joint)
 - a. Boltless
 - b. Bolted
 - 2. Restrained
 - a. Provide restrained joint pipe at fittings and valves where indicated on the Drawings. Length of restrained pipe shall be as shown. Restrained joints shall be Snap-Lok (Griffin Pipe), Flex Ring and Lok-Ring (American), TR Flex (U.S. Pipe) or approved equal.
 - b. Restrained joint pipe and fittings shall meet all AWWA standards and other requirements as specified above for standard ductile iron pipe and fittings unless addressed herein.
 - c. Field made joints are allowable but should be avoided where possible. Careful planning to locate field cuts in standard pipe sections is preferred. For field made joints in restrained piping, use field weldments or an insert equal to TR Flex Gripper Rings or approved equal. Gasket type field made joints will not be allowed.
 - d. Restrained joint fittings shall be provided by the restrained joint pipe manufacturer where located within restrained joint pipe sections. Fittings shall be of the same model and type as the pipe supplied from the pipe manufacturer.
 - e. Restrained joint fittings may be push-on joint type.
 - f. Megalugs, Series 1100, as manufactured by EBAA Iron Sales or approved equal shall be allowable for restraint where fittings or valves are not available with restrained joints.
 - g. Where additional fittings/valves are required and not shown on Drawings, consult with Engineer for length of restrained joint pipe necessary each side of fittings/valve prior to installation of pipe/fitting.
 - h. Tees for hydrants do not have to be restrained along the main line except where they are within required restrained length of nearby fittings or valves.
 - i. Contractor shall develop a field layout schedule and drawing(s) for restrained joint pipe installations that are to be submitted for approval as outlined in Section 01330, Submittal Procedures.

2.02 PROTECTO 401 DUCTILE IRON PIPE LINER

- A. General
 - 1. The interior wall of ductile iron sewer pipe 12" and larger in diameter shall be protected by the Protecto 401 Ceramic Epoxy liner.

2. The lining shall meet the manufacturer's recommendations and the following requirements as a minimum.
 3. The liner manufacturer shall have a minimum of ten (10) years of successful experience and be able to demonstrate successful performance on comparable projects.
- B. Lining Material
1. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment.
 2. Permeability rating of 0.00 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 days.
 3. The following tests must be run on coupons from factory lined ductile iron pipe:
 - a. ASTM B-117 Salt Spray (scribed panel) – Results to equal 0.0 undercutting after two years.
 - b. ASTM G-95 Cathodic Disbondment 1.5 volts @ 77°F. Results to equal no more than 0.5mm undercutting after 30 days.
 - c. Immersion testing rated on using ASTM D-714-87.
 - 1) 20% Sulfuric Acid – No effect after two years.
 - 2) 140°F 25% Sodium Hydroxide – No affect after two years.
 - 3) 160°F Distilled Water – No effect after two years.
 - 4) 120°F Tap Water (scribed panel) – 0.0 undercutting after two years with no effect.
 - d. An abrasion resistance of no more than 3 mils (0.075mm) loss after one million cycles using European Standard EN 598: 1994 section 7.8 Abrasion resistance.

2.03 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE

- A. General
1. Pipe and fitting size shall be as indicated on the Drawings.
 2. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
 3. Pipe used for potable water systems shall comply with NSF 61.
 4. PVC pipe is allowable only for gravity sewers.
- B. AWWA C900: C900 PVC pipe 4-inch to 12-inch shall conform to AWWA C900 and the following requirements:
1. Outside diameter shall conform to ductile-iron pipe.
 2. Pipe shall be pressure class **160** with a standard dimension ratio of DR **18**.
 3. Pipe shall have plain end and elastomeric-gasket bell ends.
 4. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.
- C. AWWA C905: C905 PVC pipe 14-inch to 48-inch shall conform to AWWA C905 and the following requirements:
1. Outside diameter shall conform to ductile-iron pipe.
 2. Pipe shall have a pressure rating of **160** with a standard dimension ratio of DR **18**.
 3. Pipe shall have plain end and elastomeric-gasket bell ends.

4. Fittings shall conform to AWWA C110 or C153 and have mechanical joints. Fittings shall be made of gray-iron or ductile-iron. Interior of fittings shall be cement-mortar lined with seal coat in accordance with AWWA C104.
- D. Schedule 40 & 80: Schedule 40 & 80 PVC pipe ½-inch to 12-inch shall conform to ASTM D1785 and the following requirements:
1. Outside diameter shall conform to iron pipe.
 2. Pipe shall be schedule 40 or 80.
 3. Pipe shall have an integral elastomeric-gasket bell end or solvent weld joints.
 4. Fittings for the pipe shall conform to ASTM D2466 or D2467 as appropriate for the pipe schedule.

2.04 CENTRIFUGALLY CAST FIBERGLASS REINFORCED POLYMER MORTAR (CCFRPM) PIPE

- A. Pipe and fittings shall conform to the following requirements:
1. Size stiffness class (SN) shall be as indicated on the Drawings.
 2. Pipe shall be supplied in 20-foot nominal lengths.
 3. Each length of pipe, fittings, couplings, specials to be used shall be plainly and permanently marked with the following: pipe class or strength designation, manufacturer's name or trademark, date of manufacture, and the nominal pipe size.
 4. CCFRPM Pipe is allowable only for gravity sewers.
- B. Centrifugally Cast Fiberglass Reinforced Polymer Mortar Pipe shall conform to ASTM D3262, for CCFRPM pipe manufactured of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) materials, and to the following requirements:
1. CCFRPM pipe shall be as manufactured by HOBAS Pipe.
 2. The pipe shall be manufactured in accordance with ASTM D3262 with a minimum nominal pipe stiffness of (SN) as shown on the Drawings. The pipe shall meet the following cell limits: Type 1, Liner 2, Grade 3, as described by Section 4.2 and Table 1 of ASTM D3262. The stiffness is to be measured in accordance with ASTM D2412. The corrosion liner shall not be considered as contributing to the structural strength of the pipe.
 3. The pipe shall be manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion-resistant, consistent, composite structure to meet the operating conditions as shown on the Drawings.
 4. Pipe shall conform to ASTM D2412 for minimum stiffness and external loading characteristics.
 5. Couplings, fittings and push-on joints shall be manufactured with flexible, elastomeric seals conforming to the requirements of ASTM D4161 and ASTM F477 and shall meet or exceed the pipe class at the location of its installation.
 6. Pipe joint shall be push-on type couplings unless specified otherwise.
 7. Pipe shall meet the minimum requirements of ASTM D3681 and ASTM D3262. Manufacturer shall provide complete 10,000-hour test results on pipe produced at the proposed location of manufacture. Results shall reflect that the pipe has a minimum allowable strain of no less than 0.9% at fifty years when tested in accordance with ASTM D3681 and D3262.
 8. Normal production pipe for this project shall not incorporate raw materials that are not in compliance with ASTM D3681 and ASTM 3262.

9. Interior of pipe shall be manufactured using a nonstructural resin with a minimum allowable elongation of 50% when measured in accordance with ASTM D638. The liner nominal thickness shall be 40-mils.
10. Exterior pipe surfaces shall be comprised of a layer of sand and resin to provide UV protection to the exterior.

2.05 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

A. General

1. Shall only be used for 15-inch diameter and smaller gravity sewers.
2. Pipe and fitting size shall be as indicated on the Drawings.
3. PVC materials shall comply with ASTM D1784 with a cell classification of 12454-B.
4. Pipe shall have an integral elastomeric-gasket bell end. Gaskets shall be in conformance with ASTM F477.
5. See Section, Trenching for Utilities, for trench bedding and haunching requirements.

B. SDR 35: PVC SDR 35 gravity sewer pipe 4-inch to 15-inch and related fittings shall conform to ASTM D-3034 and the following requirements:

1. Pipe shall have standard dimension ratio of SDR 35.
2. Nominal pipe length shall be a minimum of 13 feet.

2.07 FILAMENT-WOUND FIBERGLASS REINFORCED POLYMER MORTAR PIPE

A. Pipe and fittings shall conform to the following requirements:

1. Size and stiffness class (SN) shall be as indicated on the Drawings.
2. Pipe shall be supplied in 20-foot or 40-foot nominal lengths.
3. Each length of pipe, fittings, couplings, specials to be used shall be plainly and permanently marked with the following: pipe class or strength designation, manufacturer's name or trademark, date of manufacture, and the nominal pipe size.
4. Filament-Wound Fiberglass reinforced Polymer Mortar Pipe is allowable only for gravity sewers.
5. Wall Thickness: The average wall thickness of the pipe shall not be less than the nominal wall thickness published in the manufacturer's literature, and the minimum wall thickness at any point shall not be less than 87.5% of the nominal wall thickness.
6. End Squareness: All points around each end of a pipe unit shall fall within +/- 1/4 inch or +/-0.5% of the nominal diameter of the pipe, whichever is greater, to a plane perpendicular to the longitudinal axis of the pipe.
7. Stiffness: Each pipe shall have sufficient strength to exhibit the minimum pipe stiffness at 5% deflection as required by the Engineer. Stiffness shall be tested in accordance with the test method of ASTM D2412. A minimum of one pipe shall be tested every 100 lengths of each type, grade, and size pipe produced.

B. Filament-Wound Fiberglass Reinforced Polymer Mortar Pipe shall conform to ASTM D3262, for fiberglass reinforced polymer mortar pipe manufactured of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) materials, and to the following requirements:

1. The pipe shall be as manufactured by Flowtite Pipe and supplied by U.S. Composite Pipe South (USCPS), Inc.

2. The pipe shall be manufactured in accordance with ASTM D3262 with a minimum nominal pipe stiffness of (SN) as shown on the Drawings. The pipe shall meet the following cell limits: Type 1, Liner 2, Grade 3, as described by Section 4.2 and Table 1 of ASTM D3262. The stiffness is to be measured in accordance with ASTM D2412. The corrosion liner shall not be considered as contributing to the structural strength of the pipe.
 3. The pipe shall be manufactured by the continuous advancing mandrel (filament wound) process resulting in a dense, nonporous, corrosion-resistant, consistent, composite structure to meet the operating conditions as shown on the Drawings.
 4. Pipe shall conform to ASTM D2412 for minimum stiffness and external loading characteristics.
 5. Couplings, fittings and push-on joints shall be manufactured with flexible, elastomeric seals conforming to the requirements of ASTM D4161 and ASTM F477 and shall meet or exceed the pipe class at the location of its installation.
 6. Pipe joint shall be push-on type couplings unless specified otherwise.
 7. Pipe shall meet the minimum requirements of ASTM D3681 and ASTM D3262. Manufacturer shall provide complete 10,000-hour test results on pipe produced at the proposed location of manufacture. Results shall reflect that the pipe has a minimum allowable strain of no less than 0.65% at fifty years when tested in accordance with ASTM D3681 and D3262.
 8. Normal production pipe for this project shall not incorporate raw materials that are not in compliance with ASTM D3681 and ASTM 3262.
 9. Interior of pipe shall be manufactured using a nonstructural resin with a minimum allowable elongation of 50% when measured in accordance with ASTM D638. The liner nominal thickness shall be 40-mils.
 10. Exterior pipe surfaces shall be comprised of a layer of sand and resin to provide UV protection to the exterior.
- C. Resin Systems: The manufacturer shall use only approved polyester resin systems with a proven history of performance of in this particular application.
- D. Glass Reinforcements: The reinforcing glass fibers to be used to manufacture the components shall be of the highest quality commercial grade of glass filaments suitably treated with binder and sizing compatible with impregnating resins.
- E. The internal liner shall be suitable for service in a sewer pipe, and shall be highly resistant to exposure to sulfuric acid as produced by biological activity from hydrogen sulfide gases. Pipe shall meet or exceed requirements off ASTM D3681.
- F. Silica Sand: Sand shall be minimum 98% silica with a maximum moisture content of 0.2%
- G. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, thixotropic agents, etc., when used, shall not detrimentally effect the performance of the product.
- H. Elastomeric Gaskets: Gaskets shall be supplied by qualified gasket manufacturers and be suitable for the service intended.

2.08 REINFORCED CONCRETE HDPE LINED GRAVITY SEWER PIPE

- A. All Pipe Reinforced Concrete HDPE Lined Sewer shall conform to the applicable ASTM Standard. The Class or D-Load strength of the pipe shall be as specified on the Drawings or Bid Form.

1. All pipe shall be manufactured using the Dri-cast or Wet Cast Method of manufacture. The manufacturing method shall be at the option of the pipe manufacturer but once a method is selected, it shall not be changed without the approval of the Engineer. Joint lengths shall be a minimum of 8' except where shorter lengths are needed for closures and connections.
2. All joints shall meet the requirements of ASTM C 361 Section 8. All gaskets shall meet the requirements of ASTM C361 Section 6.9 and ASTM C1619.
3. Non-air-entraining Portland cement conforming to ASTM C 150 Type II or Type V shall be used. Flyash conforming to ASTM C 618 Class F or Class C may be used. Total flyash content shall not exceed 25% by weight of total cementitious material.
4. The use of any admixture must be approved by the Engineer.
5. All coarse and fine aggregates shall meet the requirements of ASTM C 33 except for gradation.
6. The application of HDPE liner to forms and other surfaces is considered to be specialized work. Personnel performing such work shall be adequately trained in the methods of liner installation prior to commencing work.
7. To ensure adequate liner/pipe wall bond, all HDPE lined pipe shall pre-set for a minimum of two hours with the forming core left in the pipe. All pipe shall be cured in a fully enclosed curing chamber or have individual curing covers placed over each pipe.
8. Each pipe shall be clearly marked with the strength, date of manufacture, the name or trade mark of the manufacturer and the manufacturer's Quality Assurance stamp of approval.

B. HDPE Liner

1. Liner shall demonstrate minimum pull-out strength of 14,000 psf.
2. Embedded liner shall demonstrate its ability to withstand back pressure hydrostatic forces of 50 feet of hydrostatic head (20 psi). Test procedure shall be submitted to the engineer for approval.
3. Liner sheets shall be produced in rolls that are 8.0 ft (2.4 m) in width and a thickness of 80 mils (2.0 mm).
4. The locking studs shall be an integral part of the liner sheet. Stud spacing shall be on approximately 1.25 in (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).
5. The liner and welding cap strips shall be made from 97-98% virgin high density polyethylene and 1.5-3% carbon black or pigmentation for the purpose of an otherwise specified color.
6. Cap strips shall be approximately 4 inches wide but not greater than 6" and shall be equivalent to that of the liner.
7. Liner sheets shall have the physical properties as stated and when tested in accordance with Table 1.
8. Raw resin shall have the properties as tested and when tested in accordance with Table 2.
9. Liner sheets shall be supplied in pre-fabricated tubes and shall be manufactured by GSE Lining Technology, Inc. or approved equal.

Table 1: Liner Properties

TESTED PROPERTY	TEST METHOD	FREQUENCY	NOMINAL VALUE			
Thickness, m(mil) Density, g/cm ³	ASTM D 5199 ASTM D 1505	Every 5th roll 1/100,000 ft ²	2.00 (80) 0.94	3.00 (120) 0.94	4.00 (160) 0.94	5.00 (200) 0.94

Tensile Properties (each direction) Strength at Yield, lb/in ² (MPa) Elongation at Break, %	ASTM D 6693, Type IV Dumbbell G.L. = 2.0 in (50 mm)	1/100,000 ft ²	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500	2,200 (15.2) 500
Stud Pull-Out Strength ¹ , lb/ft ² (kN/m ²)		1/product	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)
Carbon Black Content/Pigment Content, % Black (carbon) Gray (pigment)	ASTM D 1603*/421 8 ASTM D 5630, Modified	1/100,000 ft ²	2-3 1.5-2.5	2-3 1.5-2.5	2-3 1.5-2.5	2-3 1.5-2.5
Carbon Black Dispersion ²	ASTM D 5596	1/100,000 ft ²	Note 2	Note 2	Note 2	Note 2
Notched Constant Tensile Load, hours	ASTM D 5397	1/formulation	1,000	1,000	1,000	1,000
Coefficient of Linear Thermal Expansion, per °C	ASTM D 696	1/product	1 .20E-04	1 .20E-04	1 .20E-04	1 .20E-04
Low Temperature Brittleness, °C	ASTM D 746	1/product	-77	-77	-77	-77
Dimensional Stability, % (each direction)	ASTM D 1204	1/product	±1.0	±1.0	±1.0	±1.0
Water Absorption, %	ASTM D 570	1/product	0.1	0.1	0.1	0.1
Water Vapor Transmission, (g/m ² /day)	ASTM E 96	1/product	<0.01	<0.01	<0.01	<0.01
Roll Width, ft (m)			8 (2.44)	8 (2.44)	8 (2.44)	8 (2.44)
Roll Length, ft (m)			246 (74.97)	213 (64.91)	196 (59.73)	196 (59.73)
Roll Area, ft ² (m ²)			1,968 (182.83)	1,704 (158.30)	1,568 (145.67)	1,568 (145.67)

Table 2: Raw Material Properties

Property	Test Method	Value	Testing Frequency
Density, g/cm ³	ASTM D 1505	0.932	1/ resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	≤ 1.0	1/ resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/ formulation

10. Welding procedure shall be submitted and approved as required in 5.01.B.2.
11. Joints shall be welded by the electrofusion process or a process approved by the Engineer.
12. Welding procedure shall include the following:
 - a. Prior to the start of each days joint welding or if welding is stopped for more than 3 hours, sample cap strips will be welded and coupons cut and pull tested to verify the strength of the weld.
 - b. Each weld shall be visibly inspected. In addition, all joint welds shall be probed with a trowel, putty knife, or similar tool approved by the Engineer.
 - c. Each joint weld shall be fully vacuum tested immediately following the completion of the welding process.
 - d. At the completion of each run of joint welds, a computer print-out of each weld shall be provided to the Engineer. Print-out shall include welder

identification, weld/joint identification, weld time, cool time & power supply conditions, as a minimum.

2.09 MANHOLES

A. Provide manholes made of precast concrete sections in conformance with ASTM C478, the Drawings, the City of Raleigh Public Utilities Handbook, NC Department of Transportation, and the following requirements:

1. General

- a. Provide manholes to the depth as indicated on the Drawings. Manhole style, type, and inside diameter shall be as noted on the Drawings.
- b. Manholes on lines 12" and larger in diameter, as well as manholes that directly receive a force main discharge, shall be internally coated with a polyurea coating. Coating shall be Duramer 1030 as manufactured by SewerKote or approved equal. Coatings may be applied by brush, spray, or roller. Coating shall be provide in three separate parts; primer, intermediate coat, and top coat
 - 1) Primer coat shall be a 20% solids, deeply penetrating, dual-component polyurea primer applied to 0.5 – 1.0 mils dry film thickness (150 ft²/gal).
 - 2) Intermediate coat shall be a dual component polyurea applied at 50 – 100 mils dry film thickness (50 ft²/gal).
 - 3) Top coat shall be a 65% solids, two-part polyurea applied at 7.5 – 10 mils dry film thickness (125 ft²/gal).
- c. Precast concrete manholes shall be as manufactured by Tindall Concrete Products, Inc., Adams Concrete, Hanson Pipe and Precast, D & M Concrete Specialties, Inc., N. C. Products Corp., Stay Right Tank, or approved substitute.
- d. T-series manholes as manufactured by Tindall Concrete Products or approved equal shall be an acceptable substitute to round manholes as specified herein. The T-series shall be the same size manhole as shown on the Drawings for round manholes (e.g., 6' ID manhole, etc.) and shall meet all applicable requirements of the specifications. No reduction in size of the riser sections and top slab shall be allowable.
- e. When applying coatings to new manholes, coatings will be applied above ground (before manhole components are installed). Areas to be coated shall meet coating manufacturer requirements for surface preparation.

2. Precast Concrete Sections

- a. Minimum wall thickness shall be 5-inches.
- b. Base: Cast monolithically without construction joints or with an approved PVC waterstop in the cold joint between the base slab and the walls. Minimum thickness of base shall be 6-inches.
- c. The width of the base extensions on Extended Base Manholes shall be no less than the base slab thickness. Extended bases shall comply with the details on Drawings.
- d. Riser: Minimum lay length of 16 inches.
- e. Cone: Eccentric or concentric cones may be used on 8 through 12-inch mains. Concentric cones shall be used on all 15-inch and larger mains.
- f. Transition Slab: Provide a flat transition from 60-inch and larger manholes to 48-inch diameter risers, cones, and flat slab top sections. The maximum

height of manhole over the transition top section shall be 12 feet. Transition sections shall not be used in areas subject to vehicle traffic.

- g. Flat Slab Top: Designed for HS-20 traffic loadings as defined in ASTM C890. Items to be cast into Special Flat Slab Tops (i.e. ring, cover, vent base) shall be sized to fit within the manhole ID and the top and bottom surfaces. Provide a float finish for exterior slab surface.
 - h. Precast or core holes for pipe connections. Diameter of hole shall not exceed outside diameter of pipe by more than 3-inches.
 - i. Lifting Devices: Devices for handling precast components shall be provided by the precast manufacturer and comply with OSHA Standard 1926.704.
3. Joints
- a. Manufacturer in accordance with tolerance requirements of ASTM C 990 for butyl type joints.
 - b. Minimize number of joints. Do not use riser section for manholes up to 6 feet tall and no more than one riser for each additional 4 feet in height.
 - c. Flexible Joint Sealants: Flexible Joint Sealants: Preformed butyl rubber based sealant material conforming to Federal Specification SS-S-210A, Type B and ASTM C990.
 - d. External Seal: Polyethylene backed flat butyl rubber sheet no less than 1/16-inch thick and 8-inches wide.
4. Inverts
- a. Brick and mortar or precast concrete invert constructed to the width of the effluent pipe.
 - b. Form and finish invert channel to provide a consistent slope from inlet(s) to outlet up to 6-inches.
 - c. Channel walls shall be formed to the springline of the outlet pipe diameter.
 - d. Finish benches at 60 degrees to manhole walls. Provide a 1/4-inch radius at the edge of bench and trough.
5. Flexible Pipe Connectors: Provide flexible connectors for pipe to manhole that conform to ASTM C923. Location of connectors shall vary from Drawings no more than 1/2-inch vertically and 5 degrees horizontally. Boot sleeves shall have stainless steel expansion bands and pipe clamps that meet or exceed ASTM C923 and A167.
6. Manhole Steps:
- a. Steps shall be made of 1/2-inch grade 60 steel encapsulated by co-polymer polypropylene and have serrated tread and tall end lugs.
 - b. Secure steps to the wall with compression fit in tapered holes or cast-in-place. Align steps along a vertical wall and shall not be located over a pipe opening. First step shall be a maximum of 26 inches from the bottom.
 - c. Steps shall be provided inside manholes and shall be provided on the outside when the top of manhole elevation is greater than three (3) feet above the existing ground elevation.
 - d. Steps shall be as shown on the Drawings.
 - e. Steps shall be by American Step Co., Inc., Bowco Industries, Inc., M. A. Industries, Inc. or approved substitute.

2.10 CASTINGS

A. General

- 1. Made of gray iron, ASTM A-48 - class 30.
- 2. Castings shall be free from imperfections not true to pattern. Casting tolerances shall be plus or minus 1/16-inch per foot of dimension. Top shall set neatly in

frame, with edges machined for even bearing and proper fit to prevent rattling and flush with the edge of frame.

3. Castings shall be as manufactured by Neenah Foundry Co., U.S. Foundry & Manufacturing Corp., or Vulcan Foundry

B. Manhole Frame and Cover:

1. Minimum clear opening shall be 22 inches.
2. Minimum weight for frame and cover shall be 300 pounds and suitable for Heavy Duty Highway Traffic Loads of H-20.
3. Frame shall have four 3/8-inch anchor bolt holes equally spaced.
4. Cast "DANGER PERMIT REQUIRED – CONFINED SPACE DO NOT ENTER" on the cover. Casting shall bear the name of the manufacturer and the part number.
5. Provide camlocks on all manholes located in sanitary sewer easement.
6. Provide cover with one 1-inch perforated holes unless noted as watertight on the Drawings.
7. Provide the following where indicated on the Drawings:
 - a. Ring and cover shall be watertight.
 - b. Bolt down cover. Bolt down covers shall be provided with four (4) 3/8-inch stainless steel hex head bolts at 90 degrees.

2.11 SEWER SERVICE

- A. Provide PVC wye sewer saddles for services on PVC mains. Saddles shall be solvent welded and fastened with double stainless steel bands.
- B. Provide a cast or ductile iron wye sewer saddle for services on ductile iron main. Saddles shall be "Geneco E40" sewer saddles or approved equal consisting of a virgin SBR gasket compounded for sewer service, a ductile iron saddle casting, a 304 stainless steel adjustable strap for fastening the gasket and the saddle casting to the sewer main, and a 304 stainless steel adjustable circle clamp for securing the service line into the SBR gasket.

2.12 VALVES

- A. General: Valves shall meet the following requirements:
 1. Size shall be as required for the pipe size and material as indicated on the Drawings and specified.
 2. Open by counterclockwise rotation.
 3. Standard system working pressure is pressure 175 psi.
 4. Equip valves with a suitable means of operation.
 5. For buried valves over 5 feet deep, provide extension stems of cold rolled steel to bring the operating nut to within 2 feet of the ground surface.
 6. Provide valve accessories as required for proper valve operation for valve locations as indicated on the Drawings and as recommended by valve manufacturer.
 7. Valve accessories shall be compatible to proper valve operation.
 8. Similar valve types shall be of one manufacturer.
- B. Gate Valves, Resilient-Seated: Gate valves 3-inch to 20-inch shall conform to AWWA C509 for and to the following requirements:
 1. O-ring stem seal on non-rising (NRS) stem valves.
 2. Ends shall be mechanical joint for underground locations and flanged joint for above ground locations.

3. Valves shall be non-rising stem (NRS) with wrench nut for underground locations and Outside Screw and Yoke (OS&Y) with handwheel for above ground locations unless noted otherwise on the Drawings.
 4. Be of one manufacturer.
 5. Valves 16-inch and larger shall be equipped with cast iron gearing to facilitated opening. Gear cases shall be extended or totally enclosed type. Geared valves shall be equipped with indicators to show the position of the gate in relation to the water.
 6. Valves 16-inch and larger shall be equipped with a bypass.
 7. Special material for bolts and nuts.
- C. Plug Valves: Plug valves shall conform to the following requirements:
1. Plug valves shall be of the non-lubricated, eccentric type designed for a working pressure of 175 psi for valves 12 inch and smaller, 150 psi for vales 14 inch and larger.
 2. Valves shall provide tight shut-off at rated pressure.
 3. The plug valve body shall be cast iron ASTM A126 Class B with a welded-in overlay of not less than 90% nickel alloy content on all the surfaces contacting the face of the plug.
 4. The valve plug shall be constructed of cast iron conforming to ASTM A126 Class B, with Buna N resilient seating surface to mate with the body seat.
 5. Valve flanges shall be in accordance with ANSI B16.1 Class 125.
 6. Shaft bearings shall be sleeve-type, sintered, oil impregnated, and permanently lubricated stainless steel.
 7. Plug valve shaft seals shall be of the multiple V-ring type and shall be adjustable. Sealing system shall conform to AWWA C504 and C507 standards. All packing shall be replaceable without removing the bonnet or actuator and while valve is in service.
 8. Valves 6" and larger shall be provided with gear actuators.
 9. Provide levers or hand wheels to operate the valve as recommended by the manufacturer.
- D. Swing Check Valves: Swing check valves from 2 to 24 inch shall conform to AWWA C508 and to the following requirements:
1. Provide lever and weight for swing check control.
 2. Resilient material to Metal seat construction.
 3. Ends shall be flanged.

2.13 AIR VALVES

- A. Provide air valves in conformance with AWWA C512 and the following:
1. Valve type shall be a combination valve.
 - a. Inlet size: 2 inch
 - b. Large orifice minimum: 1 inch
 - c. Small orifice minimum: 1/8 inch
 2. Valve shall be designed for the following automatic operation:
 - a. Release of large quantities of air during the filling of the main.
 - b. Permit air to enter the main when it is being emptied.
 - c. Release accumulated air while the main is in operation and under pressure.
 3. Valve shall be designed for a system pressure 150 psi. Valve shall also operate at a minimum system pressure of 20 psi.
 4. Provide threaded inlet.

5. Provide stainless steel ball float and internal trim.
6. Provide isolating bronze ball valve for connection to main line.
7. For sewage force mains provide tall body to minimize possibility of sewage plugging orifice or linkage.
8. Sewage force main valve shall include backwash accessories. They shall include bronze flushing ball valves and 5 feet of rubber hose with quick-connect coupling on each end.

2.14 VALVE BOX

- A. Valve Box, Below Ground: Boxes shall be high strength cast iron of the screw or telescopic type. Box shall consist of a base section, center extension as required, and a top section with cover marked "SEWER."

2.15 THRUST BLOCKING

- A. Provide concrete thrust blocking for pressure lines in accordance with the detail on the Drawings.
- B. Thrust blocking is not required where restrained joint fittings and equivalent length of restrained joint pipe are used unless shown otherwise on the Drawings.

PART 3 EXECUTION

3.01 GENERAL

- A. Pipe installation shall meet the following general guidelines:
 1. Lay pipe in the presence of Engineer, unless specifically approved otherwise.
 2. Handle pipe and accessories in accordance with manufacturer's recommendations. Take particular care not to damage pipe coatings.
 3. Carefully inspect pipe immediately prior to laying. Do not use defective pipe. Replace pipe damaged during construction.
 4. Lay pipe to grade and alignment indicated on the Drawings.
 5. Provide proper equipment for lowering pipe into trench.
 6. Provide tight closure pipe ends when work is not in progress.
 7. Keep pipe interior free of foreign materials.
 8. Do not lay pipe in water or when the trench or weather conditions are unsuitable for the work.
 9. Clean bell and spigots before joining. Make joints and lubricate gasket in accordance with pipe manufacturer recommendation.
 10. Block fittings with concrete, or restrained as indicated on the Drawings or as required to prevent movement.
- B. Gravity Pipe: Gravity pipe installation shall meet the following general guidelines:
 1. Lay pipe upgrade from the lower end and at the grades and alignment indicated on the Drawings.

3.02 RELATION OF WATER MAINS TO SEWERS

- A. Lateral Separation: Lay water mains at least 10 feet laterally from existing and proposed sewers. Where existing conditions prevent a 10-foot lateral separation, the following shall be followed with approval of the Engineer:
 1. Lay water main in a separate trench, with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.

2. Lay water main in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least 18 inches above the top of the sewer.
- B. Crossing Separation: Lay bottom of water main at least 18 inches above the top of the sewer. Where existing conditions prevent an 18-inch vertical separation, construct both the water main and sewer of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
 - C. Crossing a Water Main Under a Sewer: When it is necessary for a water main to cross under a sewer, construct both the water main and the sewer of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing.

3.03 SEWER PIPE

- A. Lay sewer pipe to true lines and grades by using laser beam equipment or other acceptable means.
- B. Minimum Separation Distances:
 1. In general, 100-foot horizontal separation from wells or other water supplies. If sewer pipe is installed within 50 foot of a public well or water supply or 25 foot of a private well or water supply, ferrous pipe must be used. Manholes shall not be located within 50-foot of a public well or water supply or 25 foot from a private well or water supply.
 2. 24-inch vertical separation from storm sewers or ferrous pipe shall be used.
 3. For separation from water mains see paragraph 3.02 above.

3.04 DUCTILE IRON PIPE

- A. Install pipe in conformance with AWWA C600 and the following:
 1. For laying pipe in a vertical or horizontal curve, each full length pipe may be deflected by the following offset distance unless the pipe manufacturer's recommended distances are less:
 - a. Push-on joint
 - 1) 3 to 12-inch pipe: 14-inch offset
 - 2) 14 to 36-inch pipe: 8-inch offset
 - b. Mechanical joint
 - 1) 3 to 6-inch pipe: 20-inch offset
 - 2) 8 to 12-inch pipe: 15-inch offset
 - 3) 14 to 20-inch pipe: 8-inch offset
 - 4) 24 to 36-inch pipe: 6-inch offset
 2. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:
 - a. 6 to 12-inch pipe: 11-inch offset
 - b. 16 to 20-inch pipe: 7-inch offset
 - c. 24 to 30-inch pipe: 5-inch offset
 - d. 36-inch pipe: 4-inch offset
 - e. 42 to 48-inch pipe: 1 ¼ -inch offset

3. For laying restrained joint pipe in a vertical or horizontal curve, except for horizontal directional drills (HDD), each full length pipe may be deflected by the following offset distance:
 - a. 6 to 12-inch pipe: 11-inch offset
 - b. 16 to 20-inch pipe: 7-inch offset
 - c. 24 to 30-inch pipe: 5-inch offset
 - d. 36-inch pipe: 4-inch offset
 - e. 42 to 48-inch pipe: 1 ¼ -inch offset
4. The Contractor shall verify the offset distances specified are acceptable with the pipe manufacturer prior to installation.
5. Carrier pipe of any joint type may not be deflected.

3.05 PROTECTO 401 DUCTILE IRON PIPE LINER

A. Application

1. The entire surface shall be inspected prior to receiving protective compound to ensure that no oil, grease, etc. exists on the surface. If any surface contains any of these items shall be solvent cleaned to remove said substances.
2. Once free of any oil, grease, etc., all surfaces shall be abrasive blasted using sand or grit abrasive media. No rust shall be present on surface at the time of application.
3. After surface preparation, the pipe interior shall receive 40 mils nominal dry film thickness of Protecto 401.
4. No lining shall take place when the substrate or ambient temperature is below 40°F.
5. The surface must be dry and dust free during application.
6. Bell Sockets and Spigot Ends shall be coated with 6 mils nominal, 10 mils maximum with Protecto Joint Compound 6 inches back from the end of the spigot end.
7. The joint compound shall be applied by brush to ensure full coverage.
8. No excessive buildup shall be present in the gasket seat or on the spigot ends.
9. Coating of the gasket seat and spigot ends shall be done after the application of the lining to the interior of the pipe.
10. The number of coats shall be as recommended by the lining manufacturer.
11. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.
12. Provide touch up, as necessary, using Protecto Joint Compound per manufacturer's recommendations.

B. Inspection and Certification

1. A magnetic film thickness gauge shall be used to confirm the thickness on all ductile iron pipe and fittings. Thickness testing shall be done in accordance with SSPC-PA-2 Film Thickness Rating.
2. The interior lining shall be tested using a non-destructive 2,500 volt test to check for pinholes. Repair defects prior to shipment.
3. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work. These records shall be made available to the Engineer upon request.
4. The pipe/fitting manufacturer shall provide a certificate attesting that the applicator meets the requirements of this specification, and that the material used was as specified and applied as specified.

3.06 PVC PRESSURE PIPE

- A. Install PVC C900/C905 pipe in conformance with AWWA C605.
- B. Solvent Weld: Where indicated in these specifications or on the plans, solvent weld type joints shall be used. Field cut ends shall be sanded to roughing the surface. Joints shall be cleaned of foreign material. Solvent shall be applied to the joint and joint made as recommended by the manufacturer. Excess solvent shall be wiped off. The joint should not be moved until sufficiently set up.
- C. Bell and Spigot Joints: Clean bell and spigot ends prior to jointing. Ends of field cut pipe shall be beveled with file. Gasket shall be clean and lightly lubricated. Joint shall be made as recommended by the manufacturer.

3.07 FIBERGLASS REINFORCED PIPE – CENTRIFUGALLY CAST AND FILAMENT WOUND

- A. Install pipe in accordance with manufacturer's recommendations and the following requirements:
 - 1. The bedding and burial of pipe and fittings shall be in accordance with the Drawings and Specifications and the Manufacturer's requirements.
 - 2. Do not exceed forces recommended by the manufacturer when joining pipe.
 - 3. Gasket shall be wiped clean prior to joining. Damaged, defective, or bulging gaskets shall be replaced with a new coupling.
 - 4. Wipe the plain end of pipe clean prior to insertion in the coupling. The coupling components shall also be wiped clean prior to connection.
 - 5. Apply joint lubricant, as approved by pipe manufacturer, to pipe end and elastomeric gaskets.
 - 6. For handling pipe, use textile slings or other suitable materials or a forklift. Use of cables or chains is not permitted. Damaged pipe will be rejected.
 - 7. Pipe shall be free of nicks, scratches and gouges at the time of installation. Visible gouges shall be cause for rejection of pipe.
 - 8. Join pipe in straight alignment then deflect slightly if required. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer.
 - 9. No blocking under the pipe will be permitted.
 - 10. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation and with approval of the Engineer.
 - 11. Under no circumstances shall pipe or fittings be dropped either into the trench or during unloading. The interior of the pipe shall be kept clean of oil, dirt, and foreign matter; and the machined ends and couplings shall be wiped clean immediately prior to jointing.
 - 12. Use a pipe cutter where necessary to cut and machine all pipe in the field. A "full insertion mark" shall be provided on each field-cut pipe end. Field-cut pipe shall be beveled with a beveling tool in accordance with the manufacturer's recommendations. Bevels shall be in accordance with the manufacturer's requirements.
 - 13. If not integral to the bell or coupling, rubber gaskets shall be marked with manufacturer's identification sizes and proper insertion direction.
 - 14. Before use, all pipe and specials shall be thoroughly examined for defects; and no piece shall be installed which is known to be defective. If any defective piece should be discovered after having been installed, it shall be removed and

replaced with a sound on in a satisfactory manner at no additional cost to the Owner.

15. For open-trench construction, the laying of the pipe in finished trenches shall begin at the lowest point with the coupling/bell ends pointing opposite to the direction of flow. The interior of the pipe and the jointing seal shall be free from sand, dirt, and trash before installing in the line. Extreme care must be taken to keep the couplings of the pipe free from dirt and rocks so joints may be properly assembled without overstressing the coupling. The jointing of the pipe shall be done in strict accordance with the pipe manufacturer's instructions and shall be done entirely in the trench.

3.08 REINFORCED CONCRETE HDPE LINED SEWER PIPE

- A. Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe. All pipe shall be examined and approved by the Engineer or his appointed representative before laying and no piece shall be installed which is found to be defective.
- B. Preparation of bedding and backfill shall be as specified on the Drawings and per the requirements of the American Concrete Pipe Association's Design Data 9. Pipe shall be laid with uniform bearing under the full barrel of the pipe.
- C. Pipe shall be protected from lateral displacement by pipe embedment material installed as provided in the Drawings. Under no circumstances shall concrete pipe be laid in water and no pipe shall be laid in unsuitable weather or trench conditions. Pipe shall be laid with bell ends facing the direction of laying except when making closures.
- D. Rubber gaskets shall be installed in strict conformance with the pipe manufacturer's recommendations.
- E. Pipe shall be laid to line and grade as shown on the plans. Curves may be formed using fittings, specials, or unsymmetrical joint closure of straight pipe as required.
- F. As the pipe line is being laid, and prior to welding of the HDPE liner, each joint shall be tested with a Go/No-Go joint air test to verify joint integrity. The test shall be conducted on the mated joint after two subsequent joints have been laid to confirm that the joint and gasket are assembled properly, i.e. no pinched or rolled gaskets or cracked bells. The test shall consist of using a Cherne Joint Tester (or approved equal) employing a modified test procedure. The modified test shall consist of pressurizing the sealing bladders to 80 psi and then pressurizing the joint to 5 psi. The pressure can not drop more than 1 psi in 5 seconds for the joint to be considered acceptable. Any problems with the joint (bell, spigot, or gasket) will be identified by the inability to pressurize the joint. If the joint fails this test, the joint shall be removed and replaced using new gaskets then re-tested. All joint tests shall be witnessed and approved by the Engineer or the designated representative.

3.09 VALVES AND FITTINGS

- A. Install buried valves on top of an 18-inch square, 3-inch thick, solid concrete pad (minimum dimensions). The concrete pad may be provided by a pre-cast manufacturer or cast-in-place in the field above grade. Concrete used for the pads shall be a minimum 3,000 psi mix. The pads may not be cast-in-place in the pipe trench. Connection to pipe shall be such that there shall be no stress at the joint caused by misalignment or inadequate support of pipe or valve.

- B. Install fittings as recommended by the manufacturer. Fittings shall be blocked or otherwise restrained from movement.
- C. Valve Boxes: Set valve boxes flush with finished grade. Box shall be supported so that no stress shall be transmitted to the valve. Operating nut shall be centered in box.
- D. Install valves, gates, and accessories indicated on the Drawings and in complete accordance with the manufacturer's recommendations.
- E. Valve boxes shall be set straight with the operating nut centered and supported on (2) 4" concrete blocks, to prevent load transfer onto valve body or pipe line. Set top of box at finished grade. Provide a 24-inch x 24-inch wide by 6-inch thick concrete pad at top of valve boxes outside paved areas.

3.10 AIR VALVES

- A. Main shall be drilled for a two inch connection.
- B. Valve shall be installed on the main line with a service saddle.
- C. Install air valve in a flat top manhole.

3.11 MANHOLES

- A. Set base plumb and level. If using precast inverts, then align manhole invert with pipe invert.
- B. Secure pipe connectors to pipe in accordance with manufacturer's recommendation.
- C. Clean bells and spigots of foreign material that may prevent sealing. Unroll the butyl sealant rope directly against base of spigot. Do not stretch. Follow manufacturer's instructions when using O-ring seals.
- D. Set precast components so that steps align.
- E. Plug lift holes using a non-shrink grout. Cover with a butyl sealant sheet on the outside and seal on the inside with an application of an epoxy gel 1/8-inch thick extending 2 inches beyond the opening.
- F. Set manhole frames to grade with grade rings in paved areas. Grade rings are not allowable for manholes located in easements. Seal joints between cone, adjusting rings, and manhole frame with butyl sealant rope and sheet. Concrete collar as shown in detail on the drawings shall be installed for manholes located in pavement.
- G. Apply external seal to the outside of joint.
- H. Finish the interior by filling fractures greater than 1/2-inch in length, width or depth with a sand cement mortar.
- I. Clean the interior of the manhole of foreign matter.

3.12 SEWER CLEANOUTS

- A. Sewer cleanouts connected to ductile iron pipe shall also be ductile iron sewer pipe conforming to these specifications.
- B. Sewer cleanouts connected to PVC pipe shall also be PVC sewer pipe schedule 40 conforming to ASTM-D-3034 latest revision. Use elastomeric gaskets for pipe joints.

- C. PVC wye sewer saddles shall be used on new PVC pipe. Saddles shall be used on existing PVC, solvent welded to the main and fastened with double stainless steel bands.
- D. Cleanouts shall be a minimum of 4-inch diameter unless noted otherwise on the Drawings. Provide sewer cleanouts with screw-in watertight cap. Installation shall be in accordance with the details as shown on the Drawings.

3.13 SERVICE CONNECTIONS

- A. Make service connections in accordance with the standard detail(s) on the Drawings.
- B. Service connections to the main lines shall be perpendicular to the main line to the edge of the right-of-way or easement line.
- C. Four-inch lines shall have a minimum slope of 1.0 % and have cleanouts every 75 feet at a minimum in addition to a cleanout at the right-of-way line or at the edge of the easement.
- D. Six-inch lines shall have a minimum slope of 0.60 % and have cleanouts every 100 feet at a minimum in addition to a cleanout at the right-of-way line or at the edge of the easement.
- E. 6-inch service lines shall tie directly into a manhole.
- F. Wye sewer saddles shall be made only when the sewer main is 8-, 10-, or 12-inch diameter concrete, ductile iron, or PVC sewer pipe. This type connection cannot be used on truss sewer pipe. The opening in the sewer main for the saddle shall be cut with a hydraulically driven or pneumatically driven circular tapping saw of the same nominal diameter as the sewer service line.

3.14 PAINTING

- A. Equipment shall receive the manufacturer's standard coating for the intended application. Coatings shall be suitable for the intended application.
- B. Repaint damaged paint services.
- C. Above ground piping and piping within vaults shall be painted in accordance with the specification section for each item.

3.15 TESTING

- A. General
 1. Clean and flush pipe system of foreign matter prior to testing.
 2. Notify Owner and Engineer a minimum of 48 hours prior to testing.
 3. Perform tests in the presence of Engineer.
 4. Length of line to be tested at one time shall be subject to approval of Engineer.
 5. Pipe sections shall not be accepted and placed into service until specified test have been performed and approved.
 6. Repair defects in the pipe system. Make repairs to the same standard as specified for the pipe system.
 7. Retest repaired sections until acceptance.
 8. Repair visible leaks regardless of the test results.
- B. Pressure Mains
 1. The Engineer shall approve the source, quality, and method of disposal of water to be used in test procedures.

2. Obtain Owner's permission 48 hours prior to filling or flushing of pipe system with water from Owner's water system. Owner shall operate valves connected to the existing water system. Keep pipe interior clean during construction to minimize the amount of water required for flushing. Where large quantities of water may be required for flushing, Engineer reserves the right to require that flushing be done at periods of low demand.
3. Pressure test in accordance with AWWA C600 for ductile iron pipe and AWWA C605 and M23 for PVC pipe and the following.
4. Make pressure tests between valves. Furnish suitable test plugs where line ends in "free flow."
5. Provide air vents at the high points in the line section to be tested for releasing of air during filling. Service corporation stops may be used for air vent when located at a high point. Include cost of air vents in price of testing. Leave corporation stops in place after testing and note locations on As-Built Drawings.
6. Allow concrete blocking to reach design strength prior to pressure testing.
7. Force main shall be completely filled with water, all air expelled from the pipe, and the discharge end of the pipeline shall be plugged and adequately blocked before hydrostatic test begins.
8. Upon completing a section of pipe between valves, test pipe by maintaining for a two hour period the following hydrostatic pressure for each main:
 - a. Force main: **150** psig
9. Test pressure shall not vary by more than +/- 5 psi for the duration of the test.
10. No length of line shall be accepted if the leakage is greater than that determined by the following formula based on the appropriate test pressure:
 - L = Allowable leakage per 1,000 feet of pipe in gallons per hour.
 - D = Nominal diameter of the pipe in inches.
 - 100 psi: $L = D \times 0.07$
 - 150 psi: $L = D \times 0.08$
 - 200 psi: $L = D \times 0.09$
 - 250 psi: $L = D \times 0.10$

C. Gravity Sewer Mains

1. Test gravity lines between manholes.
2. Light Testing: Engineer will check for displacement of pipe as follows:
 - a. A light will be flashed between the ends of the pipe section being tested.
 - b. If the illuminated interior shows misalignment, or other defects as designated by Engineer, defects shall be repaired.
3. General
 - a. Infiltration shall not exceed 100 gallons per inch of diameter, per mile of pipe, per 24 hours. Engineer may require flow measurement for verification of infiltration.
 - b. Verify that maximum infiltration rate shall not be surpassed by air testing as follows.
4. Low Pressure Air Test:
 - a. Air testing of sewer mains shall conform to UNI-B-6 and the following requirements:
 - b. Perform initial air test when each section of main is complete including services to right of way. Test as construction proceeds.
 - c. Wet interior surfaces of porous pipe material prior to testing.

- d. Safety
 - 1) Provide a superintendent who has experience in low pressure air testing of gravity sewer mains.
 - 2) Follow safety recommendations of air testing equipment manufacturer.
 - 3) Properly brace sewer plugs during testing. Test plugs prior to use in air testing.
 - 4) No one shall be allowed in manhole or trench when pipe is under pressure.
 - 5) Pressurizing equipment shall include a regulator and a pressure relief valve, which are set no higher than 9 psig. Monitor gauges continuously to assure that the pressure does not exceed 9 psig.
- e. Equipment
 - 1) Sewer plugs shall be specifically designed for low pressure air testing.
 - 2) Use two separate air hoses.
 - i) One to connect the control panel to the sealed line for introducing the air.
 - ii) One from the sealed line to the control panel to provide constant monitoring of the air pressure in the line.
 - iii) If Pneumatic plugs are used a separate line shall be used to inflate the plugs.
 - 3) As a minimum the above ground air testing equipment shall include a shutoff valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psig.
 - 4) Continuous monitoring pressure gauge shall be at least 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of +/- 0.04 psi.
 - 5) Monitoring gauges shall be subject to calibration as deemed necessary.
 - 6) Air used for testing shall pass through a single above ground control panel.
- f. Testing
 - 1) Groundwater Determination: Immediately prior to each air test, determine groundwater level by a method acceptable to the Engineer. Adjust pressure used in air test in accordance with groundwater level.
 - 2) Apply air slowly to the test section until the pressure reached is 4.0 psi plus an adjustment of 0.433 psi for each foot of ground water above the crown of the pipe. Internal air pressure, including adjustment for ground water, should never exceed 9.0 psi for ductile iron and concrete pipe and 5.0 psi for Fiberglass pipes. The Contractor may have to dewater trench to maintain ground water at or below crown of fiberglass pipe when testing. Cost for this shall be included in unit price for pipe installation.
 - 3) When the above required pressure is reached, throttle air supply to maintain internal pressure for at least two minutes to permit stabilization.
 - 4) When pressure has stabilized at required pressure, shut off air supply.
 - 5) While observing the continuous monitoring pressure gauge, decrease pressure approximately 0.5 psi from required pressure.
 - 6) At this reading timing shall commence with a stop watch and allowed to run until pressure has dropped 1.0 psi or allowable time has lapsed.

Line shall be "Acceptable" if the pressure drop does not exceed 1 psig in the time prescribed for the test in Table 1, Low Pressure Air Testing for Gravity Sewer Mains, at the end of this section.

5. Deflection Test for SDR 35 and Ribbed (ASTM F 949) PVC pipe.
 - a. Measure for deflection of pipe no sooner than thirty days after installation and backfill.
 - b. Deflection shall not exceed 5 percent of pipe diameter. Maximum allowable long term deflection shall be 5 percent.
 - c. Measure deflection with an approved "GO-NO-GO GAUGE" method or by an approved recording deflectometer. Verify gauge on site prior to testing.
6. Deflection Test for Fiberglass Pipe.
 - a. Measure for deflection of pipe within 48 hours (initial test) after installation and backfill and again (final test) within thirty days.
 - b. Deflection shall not exceed 3 percent of pipe diameter for the initial test and 4 percent of pipe diameter for the final test. Maximum allowable long term deflection shall be 5 percent.
 - c. Measure deflection with an approved "GO-NO-GO GAUGE" method or by an approved recording deflectometer. Verify gauge on site prior to testing.

7.

- D. Vacuum test each manhole in accordance with ASTM C1244 and the following:
1. No personnel shall be allowed in manhole during testing.
 2. Test manhole after assembly and prior to backfilling.
 3. Plug pipes with suitably sized and rated pneumatic or mechanical pipeline plugs. Brace plugs to prevent displacement.
 4. Position vacuum test head assembly to seal against interior surface of the top of cone section in accordance with manufacturer's recommendation.
 5. Draw vacuum of 10 inches of mercury on manhole. Shut off the vacuum pump and close valve on vacuum line.
 6. Measure time for vacuum to drop to 9 inches of mercury. Manhole shall pass if time meets or exceeds the following:

Manhole I.D. (inches)	48	60	72	84	96	120	T-series
Seconds	60	75	90	105	120	150	105
 7. If manhole fails test, remove head assembly, coat interior with a soap and water solution, and repeat vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. Make necessary repairs to the satisfaction of Engineer and repeat test until manhole passes.

3.16 CLEANING AND TV INSPECTION

- A. Upon completion of other testing, clean all newly installed sewer mains. This shall include all sewer main and lateral connections. This cleaning shall meet the following requirements:
 1. The Engineer and Owner shall be present throughout the cleaning operations.
 2. The sewer mains shall be cleaned with a high-velocity water jet. No debris of any kind shall be released into the sewer system.
- B. Upon completion of cleaning operations, within 2 hours, Owner shall televise all newly installed sewer mains.
 1. Contractor shall coordinate cleaning and televising operations with Owner to ensure time schedules can be achieved.
 2. If televising is not properly coordinated, Owner may request Contractor to clean sewer mains again at no additional cost to the Owner.

- C. Cured in Place Pipe (CIPP) post-installation cleaning and TV inspection shall be the responsibility of the contractor. Refer to Section 02570, Cured in Place Liner Installation and Section 02560, Sewer Line Cleaning and TV Inspection.

END OF SECTION

TABLE I

LOW PRESSURE AIR TESTING
FOR
GRAVITY SEWER MAINS

MINIMUM TIME REQUIRED FOR A MAXIMUM 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length for Minimum Time (ft)	4 Time for Longer Length (sec)	5 Specification Time for Length (L) Shown (min:sec)							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:36	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.324 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

This Table is from UNI-B-6-90. The table is based on a Q (allowable air loss rate in test section) = 0.0015 cubic feet / minute / square feet. To shorten required test time a maximum pressure drop of 0.5 psig may be used and time requirements reduced by half.

SECTION 02560

SEWER LINE CLEANING AND TV INSPECTION

PART 1 GENERAL

1.01 GENERAL REQUIREMENTS

- A. Provide labor, materials, and equipment required to clean the sewer lines designated on the drawings, including manhole walls, of dirt, grease, sand, sludge, roots and other solid or semi-solid materials prior to trenchless rehabilitation. Equipment shall be subject to approval of the Engineer.

1.02 SCOPE OF WORK

- A. Clean the lines and perform a TV inspection. Based on the TV inspection recommend to the Owner and Engineer, in report form, the location and extent of the dig up rehabilitation for each manhole reach as well as the service lateral locations. For the lines shown to be sliplined, the report will give location and description of obstructions that may hinder liner installation and will also include service lateral locations. The report will be completed and submitted to the Owner and Engineer along with an IT Pipes database. After an appropriate period of time for review, the Engineer will call for a meeting to discuss the report and make determinations on the final scope of work.

1.03 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 01500 Temporary Facilities

1.04 REFERENCES

- A. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP)

PART 2 PRODUCTS

2.01 HYDRAULIC CLEANING METHOD

- A. Method shall employ the use of a moveable type dam constructed in such a way that the dam may be collapsed at any time during the cleaning. Equipment which cannot be collapsed instantly will not be allowed. Other equipment, equally effective, that will permit passage of sewage when in use may be approved. Moveable dam shall be of equal diameter to the pipe being cleaned and shall provide a flexible scraper around the periphery to insure removal of grease.

2.02 HIGH VELOCITY JET CLEANING METHOD

- A. Method shall employ high pressure water streams containing cleaning and sanitizing chemicals ejected through hose nozzles and pressure gun. Truck mounted mobile equipment shall carry a 1000-gallon water tank capable of holding corrosive or caustic cleaning or sanitizing chemicals, auxiliary engines, pumps and hydraulically driven hose reel. Refiller pipe to the tank shall have a minimum 4-inch air gap to prevent backflow and contamination of the Owner water system.

- B. There shall be included a minimum of 500 feet of high pressure hose with a selection of two or more high velocity nozzles. The nozzles shall have a minimum capacity of 60 gpm at the nozzle head and a working pressure of 950 to 1250 psi. The nozzle shall be capable of producing a scouring action from 15 degrees to 45 degrees in all size lines designated to be cleaned.
- C. There shall be included a high velocity gun for washing and scouring manhole walls and floor. The gun capacity shall equal 25 gpm at 500 to 800 psi. The gun shall be capable of producing flows from a fine spray to a long distance solid stream and shall be operated from the high pressure hose.

2.03 MECHANICAL CLEANING METHOD

- A. Bucket machines shall be in pairs with each machine powered with a minimum of a 25 HP engine to insure sufficient pulling power. Each machine shall be equipped with a two-speed transmission and shall be capable of pulling at rates of 150 feet per minute in high speed and 100 feet per minute in low speed.
- B. Power rodding shall be capable of holding a minimum of 800 feet of rod. The rod shall be of specially treated steel. The machine shall have a positive rod drive and produce a 1000-pound rod pull. To insure safe operation, the machine shall have a fully enclosed body and an automatic safety throw out clutch.

PART 3 EXECUTION

3.01 CLEANING OPERATIONS - GENERAL

- A. Take precautions to protect the sewer lines from damage by the improper use of cleaning equipment.
- B. Properly dispose of material removed from the sewer.
- C. When hydraulically propelled cleaning tools, which depend upon water pressure to provide cleaning force, or any in the sewer line are used, take precautions to insure that tools which retard the flow of water or that use water pressure for cleaning will not cause damage or flooding to public or private property.
- D. Take precautions to insure that tools which retard the flow of water or that use water pressure for cleaning will not cause damage or flooding to public or private property.
- E. Owner's water system may be used in accordance with Section 01500, Temporary Facilities.
- F. If the Contractor desires to utilize water from the Owner's potable water system, he must first gain authorization prior to use. The Owner will furnish water for cleaning purposes to the Contractor free of charge, but should it appear to the Engineer or Owner officials that the Contractor is abusing his privilege to use Owner water free of charge, then the Owner has the option at any time to refuse the Contractor use of the Owner's water supply at no additional cost to the owner.
- G. When fire hydrants are used, permission shall first be granted by the Director of Public Services and hydrants in use shall be fully opened at all times. Hydrants shall be immediately released to fire fighters in an emergency. Refiller pipe to the tank shall have a minimum 4-inch air gap to prevent backflow and contamination of the Owner water system.

- H. Collection of Refuse:
 - 1. Remove solid or semi-solid material resulting from the cleaning operations at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section shall not be permitted.
 - 2. If material is allowed to migrate to a lower manhole reach that is not scheduled for cleaning and rehabilitation, the lower manhole reach shall be cleaned in accordance with these specifications at no additional cost.
- 3.02 HYDRAULIC CLEANING:
 - A. Construct a suitable temporary weir or dam in the downstream manhole so that both liquid and solids are trapped. Pump trapped material, both solid and liquid, from the manhole into an above ground mobile retention chamber. Chamber shall be enclosed and contain not less than two baffles to allow settlement of the solids. Chamber may be equipped with a piping system to permit relatively clean liquid to return to the sewer.
- 3.03 CLEANING BY BUCKET MACHINE:
 - A. Provide a suitable container to receive the materials dumped from the buckets and return liquids to the sewer without spillage.
- 3.04 CLEANING OF MANHOLES:
 - A. All manholes within the wastewater line sections designated on to be cleaned shall have the walls and floor thoroughly cleaned to the bare masonry and concrete by means of the specified high velocity jet gun. When manholes are located in reaches of wastewater lines to be cleaned, both the first upstream manhole and the last downstream manhole in each system as well as all intermediate manholes shall be included in the wastewater line cleaning operation.
- 3.05 DISPOSAL OF REFUSE:
 - A. Dispose of dewatered sludge, sand and other solid material that results from the cleaning at a State approved sanitary landfill site.
 - B. Owner will provide a designated debris drying pad that the Contractor can use to dewater the material. Liquid must be decanted prior to dumping material at Owner provided site.
 - C. Comply with State of North Carolina, County, and local regulations, rules, and ordinances regarding the disposal of such materials. Pay fees arising from the disposal of the materials.
- 3.06 UNKNOWN OBSTRUCTIONS STOPPING CLEANING PROCESS:
 - A. Obstructions such as concrete in joints or badly collapsed pipe may exist that will prevent completing cleaning work. If this should occur, notify the Engineer of the condition and provide recommendation for repair. Engineer will make an assessment of the condition and provide instruction for further rehabilitation work as appropriate.
- 3.07 BY-PASSING OF SEWER
 - A. There will be no by-passing of sewage to any surface outside the sewer system.

3.08 TV INSPECTION

- A. Visually inspect sewer line reaches designated by means of closed-circuit television. Perform inspection on one manhole section at a time in accordance with National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification (PACP) standards and record on CD or DVD media.
- B. Inspection shall closely follow cleaning operation.
- C. Television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. Camera shall be operative in 100 percent humidity conditions. Components of the video system shall be capable of producing a minimum 300 line resolution. Lighting system shall minimize reflective glare.
- D. Move camera through the line in either direction at a uniform rate, but in no case at a speed greater than 30 feet per minute. Stop camera when necessary to insure proper documentation of the sewer's condition. Camera cables shall not obstruct the camera view or interfere with proper documentation of the sewer. If the camera will not pass through the entire sewer section, re-set the equipment to allow inspection from the opposite manhole.
- E. If the camera again fails to pass through the entire section,
 - 1. For pre-installation inspection of sewer pipe to be CIPP lined notify the City of Raleigh and perform point repairs, cut protruding service connections or clean to remove roots.
 - 2. For post-installation of new sewer pipe, or CIPP lining inspection perform point repairs, cut protruding service connections or clean to remove roots.
- F. There will be no additional cost to the Owner if re-cleaning is required. Point repairs and hammer tap repairs will be paid at the contract unit price.
- G. Whenever non-remote powered and controlled winches are used to pull the television camera through the line, suitable means of communication shall be set up between the two manholes of the inspected section to insure that good communications exist between members of the crew.
- H. Measurement for location of defects shall be above ground by means of a meter device. Marking on cable which would require interpolation for depth of manhole, will not be allowed. Measurement meters will be accurate to two tenths (0.2) of a foot over the length of the section being inspected. Accuracy of the measurement meters shall be checked daily by use of a walking meter, roll-a-tape or other suitable device.
- I. Prepare and maintain printed location records that clearly show the location, in relation to adjacent manholes, of each service lateral connection and defect requiring repair. Make visual and audio recordings of the data on the television monitor in a CD or DVD format during each inspection. Label copies of the recordings and logs as to the content. Labels shall include the sewer segment reach designation, street location and manhole facility identifications numbers on the tape.

END OF SECTION

SECTION 02700

PAVEMENT AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE

- A. Provide pavement, curb and gutter, and sidewalk sections as indicated on the Drawings and specified herein. Construction shall conform with the lines, grades, thickness, and typical cross-section indicated on the Drawings.

1.02 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 02300 Earthwork
 - 2. Section 02315 Trenching for Utilities
 - 3. Section 02510 Water Distribution System
 - 4. Section 02530 Sanitary Sewer System
 - 5. Section 02540 Reuse Water System

1.03 REFERENCED STANDARDS

- A. The latest revision, at the time of bidding, of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. N.C. Department of Transportation - Specifications for Roads and Structures (NCDOT).
- B. Paragraphs in the NCDOT standard regarding measurement and payment do not apply to this Project.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section, Submittal Procedures:
 - 1. Certificates of Compliance: Certificates shall attest that supplied products conform to the referenced standard and this specification, that all tests set forth in each applicable referenced publication have been performed, and that all test requirements have been met. Submit for each of the following materials:
 - a. Asphalt Concrete
 - b. Aggregate Base Course
 - c. Paint

1.05 PROTECTION OF EXISTING PAVEMENT, CURB AND GUTTER, AND SIDEWALK

- A. Existing pavement, curb and gutter, and sidewalks at the site are in good condition. Contractor, Owner, and Engineer shall inspect the entire site prior to the start of construction and mark existing damaged areas and note areas on Contractor's plan set to be used for the Record Drawings.
- B. Protect existing pavement, curb and gutter, and sidewalks during construction.
- C. Remove areas of existing curb and gutter, and sidewalks damaged during construction. Removal shall include to the nearest existing joint. Replace damaged areas with new curb and gutter, and sidewalks to match the existing section.

- D. Remove areas of existing pavement damaged during construction. New pavement patch shall consist of re-stabilizing the subgrade, and providing 8 inches of ABC and 2 inches of SF9.5A asphalt to match existing pavement surface.
- E. Repair damage to existing pavement, curb and gutter, and sidewalks.

PART 2 PRODUCTS

2.01 MATERIALS AND MIXES

- A. Asphalt Concrete Base Course - Type B-25.0B: Conforming to materials and compositions required in NCDOT Section 610, Asphalt Concrete Plant Mix Pavements.
- B. Tack Coat: Conforming to materials and compositions required in NCDOT Section 605, Asphalt Tack Coat.
- C. Asphalt Concrete Surface Course - Type SF9.5A: Conforming to materials and composition required in NCDOT Section 610, Asphalt Concrete Plant Mix Pavements.
- D. Concrete for Curb and Gutter, and Sidewalks: Conforming to materials and composition required in NCDOT Section 846, Concrete Curb, Curb and Gutter, Concrete Gutter, Shoulder Berm Gutter, Concrete Expressway Gutter, Concrete Valley Gutter and Concrete Flumes, and Section 848, Concrete Sidewalks and Driveways and Wheelchair Ramps.
- E. Base Course: Aggregate base course shall comply with requirements of NCDOT Section 520, Aggregate Base Course.
- F. Pavement Markings and Symbols: Conforming to materials and composition required in NCDOT Section 1205, Pavement Marking General Requirements.
- G. Brick pavers: Type ASTM C62 grade SW, modular size 2-1/4-inch high, 4-inch wide, and 8-inch long.

PART 3 EXECUTION

3.01 PREPARATION OF SUBGRADE

- A. Refer to applicable portions of Section 02300, Earthwork.
- B. Compaction shall be to at least 95 percent maximum density Standard Proctor Method.
- C. Remove unsuitable material to a depth of one foot and replace with an approved material. Loosen exceptionally hard spots and re-compact. Finish subgrade to provide uniform bearing surface.
- D. Maintain subgrade in satisfactory condition and properly drain until surface courses are placed.
- E. Preparation, shaping, and compaction shall be in accordance with NCDOT Section 500, Fine Grading Subgrade, Shoulders, and Ditches.

3.02 AGGREGATE BASE COURSE

- A. This applies to both the aggregate base course as indicated on the Drawings for paved and unpaved roads.
- B. The stone base shall be constructed in accordance with the applicable paragraphs of NCDOT Section 520.
- C. Compacted base shall be of the thickness indicated on the Drawings.

3.03 ASPHALT CONCRETE BASE COURSE

- A. Spreading, compaction, and finishing shall comply with the requirements of NCDOT Section 610, Asphalt Concrete Plant Mix Pavements.
- B. Compacted thickness shall be no less than the thickness indicated on the Drawings.

3.04 ASPHALT CONCRETE SURFACE COURSE

- A. Spreading, compaction, and finishing shall comply with the requirements of NCDOT Section 610 Asphalt Concrete Plant Mix Pavements.
- B. Compacted thickness shall be as indicated on the drawings.

3.05 TACK COAT

- A. Application rates, method of application, and curing shall be in accordance with the requirements of NCDOT Section 605.

3.06 CONCRETE CURB & GUTTER

- A. Provide concrete curb and gutter where indicated on the Drawings. Curb and Gutter shall conform to the section indicated on the Drawings.
- B. Construct Curb and Gutter in accordance with NCDOT Section 846 for new curb and gutter and match existing curb and gutter cross-sections when replacing.

3.07 CONCRETE DITCHES

- A. Provide concrete ditches where indicated on the Drawings. Cross section shall be as indicated on the Drawings.
- B. Construct ditches in accordance with NCDOT Section 850, Concrete Paved Ditch for new paved ditches, flumes or troughs and match existing cross sections of ditches, flumes or troughs when replacing.

3.08 CONCRETE SIDEWALKS

- A. Provide concrete sidewalks where indicated on the Drawings. Construction shall be in conformity with the materials, lines, grades, thickness, and typical section as indicated on the Drawings.
- B. Construct sidewalks in accordance with NCDOT, Section 848 for new sidewalks and match existing sidewalk cross sections when replacing, and the following specifications.
- C. Space contraction joints equal to the width.
- D. Place a 1/2 inch wide expansion joint at all intersections and wherever walks abut structures and other walks.
- E. Place additional expansion joints at each fifth contraction joint.

F. Walks shall receive a light broom finish.

3.09 PAVEMENT MARKINGS AND SYMBOLS

- A. Mark parking spaces in paved areas with 4 inch white paint stripe the length of the parking space.
- B. Stripe roads maintained by the NCDOT or the local municipality in accordance with the agency requirements.
- C. Provide painted pavement symbols as indicated on the Drawings and in accordance with NCDOT Standards.

3.10 BRICK PAVERS INSTALLATION

- A. Compact existing earth with mechanical tamper.
- B. Provide geotextile fabric on top of compacted earth.
 - 1. Fabric weight (oz/sq yd) D1910 6
 - 2. Grout tensile strength (lbs) D1682 200
 - 3. Mullen Burst Strength (psi) D3786 320
 - 4. Puncture Strength (lbs) D751 80
- C. Provide 2-inches of compacted sand base.
- D. Install pavers in a pattern as indicated on the Drawings. Coursing shall be in straight line and not deviate more than 1/8-inch 15 feet.
- E. Scatter sand screenings and sweep into cracks.

END OF SECTION

SECTION 02820

FENCING (CHAIN LINK)

PART 1 GENERAL

1.01 SCOPE

- A. Provide chain link fencing where indicated on the Drawings and specified herein.
- B. Work shall include, but not be limited to, the following major items and necessary accessories for a complete and operational system:
 - 1. Clearing as necessary for installation of fence.
 - 2. Fence post, frame, and concrete foundation.
 - 3. Chain link fabric and barbed wire.
 - 4. Gates.

1.02 SYSTEM DESCRIPTION

- A. Fencing Location
 - 1. Function: Temporary
 - 2. Fence Height: 6'
 - 3. Provide posts, bottom intermediate and top rails as indicated. Provide corner and brace assemblies.
 - 4. Provide fabric gauges as indicated and install fabric on outside of fence and anchor to framework such that fabric remains in tension after pulling force is released.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section, Submittal Procedures:
 - 1. Catalog Data: Submit manufacturer's standard drawings or catalog cuts for the following. Equipment to be furnished for the Project shall be clearly indicated including all options to be provided.
 - a. Individual components of the fencing system.
 - 2. Shop Drawings: Submit Project specific shop drawings for the following:
 - a. Layout drawing showing spacing of posts and location of gate, corner, end, and pull posts.
 - 3. Manufacturer's Installation Procedures.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer who has at least three years' experience and has completed at least five chain link fence projects with the same material and of similar scope to that indicated for this project with a successful construction record of in-service performance.

PART 2 PRODUCTS

2.01 FABRIC

- A. Selvage: Fabric shall be twisted and barbed at both selvages. Bottom tension wire shall be 7 gauge and shall terminate at posts.

- B. Galvanized Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufactures Institute (CLFMI) "Product Manual" and with requirements indicated below:
 1. Mesh and Wire Size: 2-inch mesh, 0.148-inch diameter (9 gauge-coated size).
 2. Coating: ASTM A 392-74, Class 2, galvanized.

2.02 FRAMING

- A. Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts are often referred to in ASTM standard specifications by Nominal pipe sizes (NPS) or the equivalent trade sized inches. The following indicates these equivalents all measured in inches:

Actual OD Size (in)	NPS Size	Trade
1.660	1 1/4	1 5/8
1.900	1 1/2	2
2.375	2	2 1/2
2.875	2 1/2	3
4.000	3 1/2	4

- B. Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669. Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per square foot. Type coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

Actual OD Size (in)	Weight (lb/ft)	NPS Size
1.660	2.27	1-1/4
1.900	2.72	1-1/2
2.375	3.65	2
2.875	5.79	2 1/2
4.000	9.11	3 1/2

- C. Top Rail: Manufacturer's longest lengths (21 feet) with expansion-type coupling, approximately 6 inches long for joining. Provide rail ends of other means for attaching top rail securely to each gate, corner, pull, and end post.
 1. Round Steel: 1.660-inch OD Type.
- D. Steel posts for fabric heights up to 6 feet:
 1. Round Line or Intermediate Posts: 2.375-inch OD Type I steel pipe.
 2. Round End, Corner, and Pull Posts: 2.875-inch OD Type I steel pipe.
- E. Steel posts for fabric heights over 6 feet:
 1. Round Line or Intermediate Posts: 2.375-inch OD Type I steel pipe.
 2. Round End, Corner, and Pull Posts: 2.875-inch OD Type I steel pipe.
- F. Swing Gate Posts: Furnish post to support single gate leaf, or one leaf of a double-gate installation, according to ASTM F 900, sized as follows.
 1. Steel posts for fabric height of 8 feet or less and gate leaf width:
 - a. Up to and including 4 feet: 2.875-inch OD pipe weighing at least 5.79 lb per feet.
 - b. Over 4 to 10 feet: 4.000-inch OD pipe weighing at least 9.11 lb per ft.

2.03 FITTINGS AND ACCESSORIES

- A. Material: Comply with ASTM F 626. Galvanized iron or steel to suit manufacturer's standards.
 - 1. Steel and Iron: Unless specified otherwise, hot-dip galvanize steel or cast-iron fence fittings and accessories with at least 1.2 oz. Zinc per sq. ft. as determined by ASTM A 90.
- B. Post and Line Caps: Provide weather-tight closure cap for each post. Provide line post caps with loop to receive top rail.
- C. Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast iron or cast-aluminum cap for each end.
 - 1. Round Steel: 1.6600-inch OD Type I steel pipe.
- D. Bottom and Center Rail: (Where indicated on drawings). Same material as top rail unless indicated otherwise. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.
- E. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 3/16 inch by 3/4, and a minimum of 1.2 oz of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.
- F. Tension and Brace Bands: 3/4 -inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of Zinc coating per sq. ft.
 - 1. Tension Bands: 0.074-inch thick (14 gauge) minimum.
 - 2. Brace Bands: 0.105 inch thick (gauge) minimum
- G. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.
 - 1. Coating Type II zinc in the following class as determined by ASTM A 90.
 - a. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.
- H. Tie Wire: (9-gauge) aluminum wire alloy 1350-H19 or equal.

2.04 BARB WIRE

- A. Provide three lines of 4 point pattern barbed wire. Barb wire shall be double strand 12-1/2 gauge twisted wire with 14 gauge, 4 point round aluminum barbs spaced on approximately 5 inch centers conforming to the requirements of ASTM A121. Extension arms to accommodate barbwire shall withstand a 250-pound pulldown load from end of arm and have a 3-inch apron around post. The top most barbed wire shall be approximately 18 inch above the fabric and approximately 18 inch out from fence line. Barbed wire shall be securely fastened in slots by heavy wire pins. Arms having projections to bend down over barbed wire will not be acceptable.

2.05 CONCRETE

- A. Concrete: Provide concrete consisting of Portland cement per ASTM C150, aggregates per ASTM C 33, and potable water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3000 psi. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

- B. Package Concrete Mix: Mix dry-packaged normal-weight concrete conforming to ASTM C 387 with clean water to obtain a 2- to 3- slump.

2.06 GATES

- A. General: Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members a maximum of 8 feet apart unless otherwise indicated.
 - 1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.
 - 2. Bracing: Install an adjustable truss rod diagonally on gates six foot wide and greater to prevent sagging.
- B. Swing Gates: Comply with ASTM F 900.
 - 1. Framework: Fabricate using 1.660-inch minimum OD Type I steel pipe or 1-inch-square galvanized steel tubing weighing 1.84 lb per sq. ft.
 - 2. Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:
 - a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.
 - b. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.
 - c. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
 - d. Gate stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
- B. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameter and spacings indicated, in firm, undisturbed or compacted soil.
 - 1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
 - 2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

- C. Setting Posts: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
 - 1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and hold in position during placement and finishing operations.
 - a. Crown concrete footings at top to shed water.
- D. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.
- E. Center Rails: Install center rails in one piece between posts and flush with post on fabric side, using rail ends and special offset fittings where indicated.
- F. Brace Assemblies: Install braces at end and gateposts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric. Install so posts are plumb when diagonal rod is under proper tension.
- G. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.
- H. Fabric: Pull fabric taut and tie to post, rails, and tension wires.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and Gateposts with tension bands spaced not over 15 inches o.c.
- J. Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.
 - 1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.
- K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.
- L. Netting Ties: Fasten safety netting to tension cable and fence top rail with cable ties at 12" o.c.
- M. Barbed Wire: Install three parallel wires on each extension arm on security side of fence, unless otherwise indicated. Pull wires taut.
- N. Gates: Install gates plumb, level and secure for full opening without interference. Install ground set items in concrete for anchorage as recommended by the manufacturer.

END OF SECTION

SECTION 02920

LAWNS AND GRASSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work shall include, but not be limited to, the following:
 - 1. Surface preparation of subsoil.
 - 2. Placing topsoil.
 - 3. Addition of lime and fertilizer.
 - 4. Seeding.
 - 5. Maintenance to produce a permanent stand of grass.

1.02 PAYMENT PROCEDURES

- A. Base bid for the work on the specified quantities of lime, fertilizer, and seed. After the specified soil tests have been made, Engineer may vary specified quantities. Should the actual quantities applied in the field vary appreciably from those specified, an adjustment in the contract price may be made.

1.03 RELATED SECTIONS

- A. The following Sections have work that is directly related to this Section. This does not relieve the Contractor of his responsibility of proper coordination of all the work:
 - 1. Section 02230 Clearing and Grubbing
 - 2. Section 02300 Earthwork
 - 3. Section 02315 Trenching for Utilities
 - 4. Section 02510 Water Distribution System
 - 5. Section 02530 Sanitary Sewer System
 - 6. Section 02540 Reuse Water System

1.04 REFERENCES

- A. N.C. Department of Agriculture - NCDA
- B. U.S. Department of Agriculture - USDA

1.05 PERFORMANCE REQUIREMENT

- A. Grassed area shall be considered established when it presents a green appearance from eye level 50 feet away and the grass is vigorous and growing well in each square foot of seeded area. It is not required that the seeded area be thick and heavy as an old established lawn.
- B. Should the permanent seed not germinate and produce a strand of grass, reseed affected areas until a permanent stand is established.

1.06 SUBMITTALS

- A. Not less than 6 weeks prior to seeding, obtain representative soil samples from areas to be seeded and deliver the properly packaged samples with an information sheet for each sample properly filled out to the Soils Division of the NC Department of Agriculture or a private laboratory. Based on the test results, submit to the Engineer a recommendation as to the quantity and type of lime, fertilizer and seed for the area covered by the test.

1.07 QUALITY ASSURANCE

- A. Quality of fertilizer, lime, and seed, and operations in connection with the furnishing of this material, shall comply with the requirements of the N.C. Fertilizer, Lime and Seed Law; and with the requirements of the rules and, regulations adopted by the NC Department of Agriculture in accordance with the provisions of the said law.
- B. Seed containers shall bear an official "Certified Seed" label as inspected by the N.C. Crop Improvement Association.
- C. Packages for soil conditioners and fertilizer shall bear manufacturer's guaranteed analysis.
- D. Do not apply lime, fertilizer or seed in strong wind, when the soil is extremely wet, or otherwise unworkable. No rolling shall be done if precipitation after seeding would make the operation detrimental to the seed bed.

1.08 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers showing percentage of seed mix, year of production, net production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.09 MAINTENANCE SERVICE

- A. Maintain seeded areas until grass is well established and exhibits a vigorous growing condition for a minimum of two cuttings. Mow grass at regular intervals to a maximum height of 3 inches. Hand clip where necessary.
- B. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- C. Water areas seeded between May 1 and July 15 at such intervals as to maintain the seeded area in a moist condition until the grass is established and accepted by the Engineer. Provide equipment to transport and distribute the water to the seeded areas. Areas seeded between September 1 and November 1 need not be irrigated beyond the initial watering specified above except that the Contractor may apply water at his own discretion.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds, and roots; pH value of minimum 5.4 and maximum of 7.0.
- B. Lime: Ground Dolomitic agricultural limestone, not less than 85 percent total carbonates, ground so that 50 percent passes 100 mesh sieve and 90 percent passes 30 mesh sieve. Coarser material will be acceptable, provided the specified rates of application are increased proportionately on the basis of quantities passing No. 100 mesh sieve.
- C. Fertilizer: Mixed, commercial, fertilizer containing 10-10-10 percentages of available nitrogen, phosphoric acid, and potash respectively, plus superphosphate with 20 percent P₂O₅ content. Fertilizer shall be dry, in granular (pellet) form, shall be

delivered to the site in the manufacturer's original bag or container which shall be plainly marked as to formula.

- D. Seed: Fresh seed guaranteed 95 percent pure with a minimum germination rate of 85 percent within one year of tests. Provide the following seed mixtures with lime and fertilizer in disturbed areas including NCDOT Rights-of-Way:

1. Permanent Seeding (Maximum slope 3:1)

<u>Planting Dates</u>	<u>Grass Type</u>	<u>Pounds/Acre</u>
Aug. 15 - Nov. 1	Tall Fescue	300
Nov. 1 -Mar. 1	Tall Fescue	300
&	Abruzzi Rye	25
Mar. 1 - Apr. 15	Tall Fescue	300
Apr. 15 - Jun. 30	Hulled Common	25
	Bermudagrass	
Jul. 1 - Aug. 15**	Tall Fescue	120
&	Browntop Millet	35
&	Sorghum-Sudan Hybrids	30
Lime		4,000
Fertilizer	10-10-10	1,000
Mulch	Straw	4,000

** Temporary seeding, reseed according to optimum season for permanent seeding.

2. Permanent Seeding (Slopes from 3:1 to 2:1)

<u>Planting Dates</u>	<u>Grass Type</u>	<u>Pounds/Acre</u>
Mar 1 - June 1	Sericea Lespedeza	50
	&	
Mar. 1 - Apr. 15	Add Tall Fescue	120
Mar. 1 - Jun. 30or	Add Weeping Lovegrass	10
Mar. 1 - Jun. 30or	Add Hulled Common Bermudagrass	25
Jun. 1 - Sept. 1**	Tall Fescue	120
	& Browntop Millet	35
	& Sorghum-Sudan Hybrids	30
Sept. 1 - Mar. 1	Sericea Lespedeza (unhulled-unscarified)	70
	& Tall Fescue	120
	&	
Nov. 1 - Mar. 1	Add Abruzzi Rye	25
	Lime	4,000
	Fertilizer 10-10-10	1,000
	Mulch Straw	4,000

** Temporary seeding, reseed according to optimum season for permanent seeding.

3. The Contractor shall provide seeding and follow fertilizing methods as required by the U.S. Army Corps of Engineers to reestablish disturbed areas in designated wetlands.

- E. Matting / Erosion Control Fabric (ECF): Matting and ECF shall be a 100% straw mulch encased in a medium weight plastic netting (both sides) with a minimum permissible shear stress of 1.75 lbs/ft². Matting shall be fully degradable but suitable until vegetation has been established. Installation of ECF shall be done with staples per temporary liner detail in the Drawings. Commercially available ECFs may be used upon approval of the engineer. Approval of fabrics will require manufacturer's design data regarding velocity, shear strength, ditch slopes, method of installation, decay cycle, repair techniques, and grass growth enhancement characteristics.
- F. Wire Staples: 16 gauge steel wire, with minimum of 3" top and 4" long legs.
- G. Mulch: Threshed straw of oats, wheat, or rye; free from seed of obnoxious weeds; or clean salt hay. Straw which is fresh and excessively brittle or straw which is in such an advanced stage of decomposition as to smother or retard growth of grass will not be acceptable.
- H. Water: Water shall be free from substances harmful to growth of grass.

PART 3 EXECUTION

3.01 PREPARATION OF SUBSOIL

- A. Complete operations in the area to be seeded and prepare subsoil to eliminate uneven areas and low spots. Bring surface to the approximate design contours.
- B. Scarify subsoil to a depth of 3 inches. Remove weeds, roots, stones and foreign materials 1-1/2 inches in diameter and larger.

3.02 PLACING TOPSOIL

- A. Place topsoil during dry weather and on dry unfrozen subsoil where indicated on Drawings.
- B. Spread topsoil to a minimum depth of 4 inches. Remove vegetable matter and foreign non-organic material from topsoil while spreading. Grade surface to provide positive drainage and prevent water ponding. Lightly compact topsoil with at least one pass of a cultipacker or similar equipment
- C. Maintain the finished surfaces by protecting, and replacing topsoil and subsoil as necessary until the area is accepted under the contract.

3.03 APPLICATION OF LIME

- A. Liming shall be done immediately after grading has reached the fine grading stage, even though actual seeding may not be done until several months later.
- B. Spread lime evenly by means of a mechanical distributor.
- C. When lime is distributed by commercial liming dealers, sales slips showing the tonnage delivered shall be filed with the Engineer and shall show the full tonnage required for the acres treated.
- D. Incorporate lime in the top 2 to 3 inches of soil by harrowing, disking, or other approved means.

3.04 APPLICATION OF FERTILIZER

- A. Spread fertilizer not more than 2 weeks in advance of seeding.
- B. To verify application rate, determine acreage to be fertilized and provide Engineer with total weight of fertilizer applied to the area.
- C. Provide mechanical spreader for even distribution and spread half of the rate in one direction, and the other half at right angles to the first. Mix thoroughly into upper 2 to 3 inches of soil by disking, harrowing or other approved methods.

3.05 SEEDING

- A. Accomplish seeding by means of an approved power-drawn seed drill, combination corrugated roller-seeder, approved hand operated mechanical seeder, or other approved methods to provide even distribution of seed.
- B. Do not seed when ground is excessively wet or excessively dry. After seeding, roll area with a roller, not less than 18 inches in diameter and weighing not more than 210 pounds per foot of width. Upon completion of rolling, water area with a fine spray.
- C. Immediately following seeding apply mulch or matting as listed below. Do not seed areas in excess of that which can be mulched on same day.

- D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil depth

3.06 MULCHING AND MATTING

- A. Apply mulch or matting as required to retain soil and grass, but no less than the following:
 1. Slopes from 0 to 20 percent by spreading a light cover of mulch over seeded area at the rate of not less than 85 lbs. per 1000 sq. ft. Use tack to prevent disruption of mulch.
 2. Slopes greater than 20 percent mulch with matting. Pin matting to the ground with wire staples at 5 foot intervals, immediately after seeding.
- B. For tack use an asphalt tie-down of emulsified asphalt grade AE-3 or cut-back asphalt grade RC-2 or other approved equal. The application rate shall be 0.10 gal/sy (11 gal / 1000 sq ft). An approved jute mesh or net may be used in lieu of tacking straw mulch.
- C. Other types of mulch and anchoring methods may be used upon approval by the Engineer.

3.07 PROTECTION

- A. Protect seeded areas from damage by barricades, signs, and other appropriate means. Maintain and protect slopes from weather damage.

3.08 STABILIZATION TIMELINE

- A. All disturbed areas must be vegetated or otherwise stabilized after being disturbed in accordance with the table below:

GROUND STABILIZATION*		
SITE AREA DESCRIPTION	STABILIZATION TIME FRAME	STABILIZATION TIME FRAME EXCEPTIONS
Perimeter Dikes, Swales, Ditches and Slopes	7 Days	None
High Quality Water (HQW) Zones	7 Days	None
Slopes Steeper than 3:1	7 Days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed
Slopes 3:1 or Flatter	14 Days	7 days for slopes greater than 50 feet in length
All Other Areas with Slopes Flatter than 4:1	14 Days	None (except for perimeters and HQW zones)
**EXTENSIONS OF TIME MAY BE APPROVED BY THE PERMITTING AUTHORITY BOASED ON WEATHER OR OTHER SITE-SPECIFIC CONDITIONS THAT MAKE COMPLIANCE IMPRACTICABLE." (SECTION II.B (2)(B))		

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Provide materials, labor, and equipment required for the design and construction of all concrete formwork, bracing, shoring and supports in accordance with the provisions of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 – Reinforcing Steel
- B. Section 03250 – Concrete Accessories
- C. Section 03290 – Joints in Concrete
- D. Section 03300 – Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. North Carolina Building Code
- 2. ACI 318 – Building Code Requirements for Structural Concrete
- 3. ACI 301 – Specifications for Structural Concrete for Buildings
- 4. ACI 347 – Recommended Practice for Concrete Formwork
- 5. U.S. Product Standard for Concrete Forms, Class I, PS 1
- 6. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Manufacturer's data on proposed form release agent

2. Manufacturer's data on proposed formwork system including form ties

1.05 QUALITY ASSURANCE

- A. Concrete formwork shall be in accordance with ACI 301, ACI 318, and ACI 347.

PART 2 – PRODUCTS

2.01 FORMS AND FALSEWORK

- A. All forms shall be smooth surface forms unless otherwise specified.
- B. Wood materials for concrete forms and falsework shall conform to the following requirements:
 1. Lumber for bracing, shoring, or supporting forms shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20. All lumber used for forms, shoring or bracing shall be new material.
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine high density overlaid (HDO) plywood manufactured especially for concrete formwork and shall conform to the requirements of PS1 for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8-inch thick.
- C. Other form materials such as metal, fiberglass, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade indicated may be submitted to the Engineer for approval, but only materials that will produce a smooth form finish equal or better than the wood materials specified will be considered.

2.02 FORMWORK ACCESSORIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 7/8-inch, and all such fasteners shall be such as to leave holes of regular shape for reaming.
- B. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. A preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.

- C. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "bug holes" in cast-in-place concrete.

PART 3 – EXECUTION

3.01 FORM DESIGN

- A. Forms and falsework shall be designed for total dead load, plus all construction live load as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.
- B. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.
- C. All forms shall be designed for predetermined placing rates per hour, considering expected air temperatures and setting rates.

3.02 CONSTRUCTION

- A. The type, size, quality, and strength of all materials from which forms are made shall be subject to the approval of the Engineer. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.
- B. Forms shall be smooth and free from surface irregularities. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.
- C. Forms shall be true to line and grade, and shall be sufficiently rigid to prevent displacement and sagging between supports. Curved forms shall be used for curved and circular structures. Straight panels joined at angles will not be acceptable for forming curved structures. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. Facing material shall be supported with studs or other backing which shall prevent both visible deflection marks in the concrete and deflections beyond the tolerances specified.

- D. Forms shall be mortar tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-1/2 inch diameter polyethylene rod held in position to the underside of the wall form.
- E. All vertical surfaces of concrete members shall be formed, and side forms shall be provided for all footings, slab edges and grade beams, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- F. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Wood forms shall be constructed for wall openings to facilitate loosening and to counteract swelling of the forms.
- G. Adequate clean-out holes shall be provided at the bottom of each lift of forms. Temporary openings shall be provided at the base of column forms and wall forms and at other points to facilitate cleaning and observation immediately before the concrete is deposited. The size, number and location of such clean-outs shall be as acceptable to the Engineer.
- H. Construction joints shall not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. For flush surfaces at construction joints exposed to view, the contact surface of the form sheathing over the hardened concrete in the previous placement shall be lapped by not more than 1 inch. Forms shall be held against hardened concrete to prevent offset or loss of mortar at construction joints and to maintain a true surface.
- I. The formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads. Set forms and intermediate screed strips for slabs accurately to produce the designated elevations and contours of the finished surface. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. When formwork is cambered, set screeds to a like camber to maintain the proper concrete thickness.
- J. Positive means of adjustment (wedges or jacks) for shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Shores and struts shall be securely braced against lateral deflections. Wedges shall be fastened firmly in

place after final adjustment of forms prior to concrete placement. Formwork shall be anchored to shores or other supporting surfaces or members to prevent upward or lateral movement of any part of the formwork system during concrete placement. If adequate foundation for shores cannot be secured, trussed supports shall be provided.

- K. Runways shall be provided for moving equipment with struts or legs. Runways shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

3.03 TOLERANCES

- A. Unless otherwise indicated in the Contract Documents, formwork shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in ACI 117.
- B. Structural framing of reinforced concrete around elevators and stairways shall be accurately plumbed and located within 1/4 in. tolerance from established dimensions.
- C. The Contractor shall establish and maintain in an undisturbed condition and until final completion and acceptance of the project, sufficient control points and bench marks to be used for reference purposes to check tolerances. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- D. Regardless of the tolerances specified, no portion of the building shall extend beyond the legal boundary of the building.

3.04 FORM ACCESSORIES

- A. Suitable moldings shall be placed to bevel or round all exposed corners and edges of beams, columns, walls, slabs, and equipment pads. Chamfers shall be 3/4 inch unless otherwise noted.
- B. Form ties shall be so constructed that the ends, or end fasteners, can be removed without causing appreciable spalling at the faces of the concrete. After ends, or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inches from the formed face of the concrete that is exposed to water or enclosed surfaces above the water surface, and not less than 1 inch from the formed face of all other concrete. Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified in Section 03 35 00 – Concrete Finishes. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete member. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. No snap ties

shall be broken off until the concrete is at least three days old. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste.

3.05 APPLICATION – FORM RELEASE AGENT

- A. Forms for concrete surfaces that will not be subsequently waterproofed shall be coated with a form release agent. Form release agent shall be applied on formwork in accordance with manufacturer's recommendations.

3.06 INSERTS AND EMBEDDED ITEMS

- A. Sleeves, pipe stubs, inserts, anchors, expansion joint material, waterstops, and other embedded items shall be positioned accurately and supported against displacement prior to concreting. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.07 FORM CLEANING AND REUSE

- A. The inner faces of all forms shall be thoroughly cleaned prior to concreting. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.08 FORM REMOVAL AND SHORING

- A. Forms shall not be disturbed until the concrete has attained sufficient strength. Sufficient strength shall be demonstrated by structural analysis considering proposed loads, strength of forming and shoring system, and concrete strength data. Shoring shall not be removed until the supported member has acquired sufficient strength to support its weight and the load upon it. Members subject to additional loads during construction shall be adequately shored to sustain all resulting stresses. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.
- B. Provided the strength requirements specified above have been met and subject to the Engineer's approval, forms may be removed at the following minimum times. The Contractor shall assume full responsibility for the strength of all such components from which forms are removed prior to the concrete attaining its full design compressive strength. Shoring may be required at the option of the Engineer beyond these periods.

Ambient Temperature (°F.) During Concrete Placement

	Over 95°	70°-95°	60°-70°	50°-60°	Below 50°
Walls	5 days	2 days	2 days	3 days	Do not remove until directed by Engineer (7 days minimum)
Columns	7 days	2 days	3 days	4 days	
Beam Soffits	10 days	7 days	7 days	7 days	
Elevated Slabs	12 days	7 days	7 days	7 days	

- C. When, in the opinion of the Engineer, conditions of the work or weather justify, forms may be required to remain in place for longer periods of time.
- D. An accurate record shall be maintained by the Contractor of the dates of concrete placings and the exact location thereof and the dates of removal of forms. These records shall be available for inspection at all times at the site, and two copies shall be furnished the Engineer upon completion of the concrete work.

3.09 RESHORING

- A. When reshoring is permitted or required the operations shall be planned in advance and subjected to approval by the Engineer.
- B. Reshores shall be placed after stripping operations are complete but in no case later than the end of the working day on which stripping occurs.
- C. Reshoring for the purpose of early form removal shall be performed so that at no time will large areas of new construction be required to support their own weight. While reshoring is under way, no construction or live loads shall be permitted on the new construction. Reshores shall be tightened to carry their required loads but they shall not be overtightened so that the new construction is overstressed. Reshores shall remain in place until the concrete has reached its specified 28-day strength, unless otherwise specified.
- D. For floors supporting shores under newly placed concrete, the original supporting shores shall remain in place or reshores shall be placed. The shoring or reshoring system shall have a capacity sufficient to resist the anticipated loads and, in all cases, shall have a capacity equal to at least one-half of the capacity of the shoring system above. Reshores shall be located directly under a reshore position above unless other locations are permitted.
- E. In multi-story buildings, reshoring shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live loads so the design superimposed loads of the floors supporting shores are not exceeded.

END OF SECTION

SECTION 03200
REINFORCING STEEL

PART 1 – GENERAL

1.01 THE REQUIREMENTS

- A. Provide all concrete reinforcing including all cutting, bending, fastening and any special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion in accordance with the requirements of this section.
- B. Provide deformed reinforcing bars to be grouted into reinforced concrete masonry walls.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork
- B. Section 03250 – Concrete Accessories
- C. Section 03300 – Cast-in-Place Concrete
- D. Section 03400 – Precast Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. North Carolina Building Code
 - 2. CRSI - Concrete Reinforcing Institute Manual of Standard Practice
 - 3. ACI SP66 - ACI Detailing Manual
 - 4. ACI 315 - Details and Detailing of Concrete Reinforcing
 - 5. ACI 318 - Building Code Requirements for Structural Concrete
 - 6. ICC-ES AC193 - Acceptance Criteria for Expansion and Screw Anchors (Concrete)
 - 7. WRI - Manual of Standard Practice for Welded Wire Fabric
 - 8. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing

9. ASTM A 1064 - Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 1. Detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66), shall be furnished for all concrete reinforcing. These drawings shall be made to such a scale as to clearly show joint locations, openings, and the arrangement, spacing and splicing of the bars.
 2. Mill test certificates - 3 copies of each.
 3. Description of the reinforcing steel manufacturer's marking pattern.
 4. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
 5. Proposed supports for each type of reinforcing.
 6. Request to use splices not shown on the Drawings.
 7. Request to use mechanical couplers along with manufacturer's literature on mechanical couplers with instructions for installation, and certified test reports on the couplers' capacity.
 8. Request for placement of column dowels without the use of templates.
 9. Request and procedure to field bend or straighten partially embedded reinforcing.
 10. International Code Council–Evaluation Services Report (ICC-ES ESR) for dowel adhesives.
 11. Certification that all installers of dowel adhesive are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.
 12. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

- A. If requested by the Engineer, the Contractor shall provide samples from each load of reinforcing steel delivered in a quantity adequate for testing. Costs of initial tests will be paid by the Owner. Costs of additional tests due to material failing initial tests shall be paid by the Contractor.
- B. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include the

installer name, date of training, products included in the training and trainer name and contact information.

- C. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.
- D. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injection, installation, and proof testing.

PART 2 – PRODUCTS

2.01 REINFORCING STEEL

- A. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.
- B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.
- C. A certified copy of the mill test on each load of reinforcing steel delivered showing physical and chemical analysis shall be provided, prior to shipment. The Engineer reserves the right to require the Contractor to obtain separate test results from an independent testing laboratory in the event of any questionable steel. When such tests are necessary because of failure to comply with this Specification, such as improper identification, the cost of such tests shall be borne by the Contractor.
- D. Field welding of reinforcing steel will not be allowed.
- E. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORIES

- A. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcing during concrete placement. Wire bar supports shall be plastic protected (CRSI Class 1).
- B. Concrete blocks (dobies), used to support and position bottom reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located.

2.03 MECHANICAL COUPLERS

- A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.
- C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.
- D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.
- B. All holes shall be drilled in accordance with the manufacturer's instructions except that core drilled holes shall not be permitted unless specifically allowed by the Engineer. Cored holes, if allowed by the manufacturer and approved by the Engineer, shall be roughened in accordance with manufacturer's requirements.
- C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer's instructions prior to installation of adhesive and reinforcing bar.
- D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.
- E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.
- F. Embedment Depth:
 - 1. The embedment depth of the bar shall be as shown on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer shall evaluate the required embedment and the

Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.
 3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.
- G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.
- H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. "SET-XP Epoxy Adhesive Anchors" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.
- I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

PART 3 – EXECUTION

3.01 TEMPERATURE REINFORCING

- A. Unless otherwise shown on the Drawings or in the absence of the concrete reinforcing being shown, the minimum cross sectional area of horizontal and vertical concrete reinforcing in walls shall be 0.0033 times the gross concrete area and the minimum cross sectional area of reinforcing perpendicular to the principal reinforcing in slabs shall be 0.0020 times the gross concrete area. Temperature reinforcing shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

3.02 FABRICATION

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
- B. The Contractor shall fabricate reinforcing bars for structures in accordance with the bending diagrams, placing lists and placing Drawings.

- C. No fabrication shall commence until approval of Shop Drawings has been obtained. All reinforcing bars shall be shop fabricated unless approved to be bent in the field. Reinforcing bars shall not be straightened or rebent in a manner that will injure the material. Heating of bars will not be permitted.
- D. Welded wire fabric with longitudinal wire of W9.5 size or smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only.

3.03 DELIVERY, STORAGE AND HANDLING

- A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
- B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.04 PLACING

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or plastic protected (CRSI Class 1) metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the reinforcing bars without settlement. In no case shall concrete block supports be continuous.
- B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Reinforcing bars additional to those shown on the Drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcing in position, shall be provided by the Contractor at no additional cost to the Owner.

- E. Reinforcing placing, spacing, and protection tolerances shall be within the limits specified in ACI 318 except where in conflict with the Building Code, unless otherwise specified.
- F. Reinforcing bars may be moved within one bar diameter as necessary to avoid interference with other concrete reinforcing, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed placing tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.
- H. Reinforcing shall not be straightened or rebent unless specifically shown on the drawings. Bars with kinks or bends not shown on the Drawings shall not be used. Coiled reinforcement shall not be used.
- I. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.
- J. All adhesive dowel installations in the horizontal or overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-11 9.2.2. Current AAI Certification must be submitted to the Engineer of Record for approval prior to commencement of any adhesive anchor installations.
- K. Adhesive Dowel Testing
 1. At all locations where adhesive dowels are shown on the Drawings, at least 25 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.
 2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.
 3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations

of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the in the State or Commonwealth in which the project is located. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.
5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.05 SPLICING

- A. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcing at points other than where shown, the splice shall be as acceptable to the Engineer.
- B. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318 for a class B splice.
- C. Laps of welded wire fabric shall be in accordance with ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- D. Mechanical splices shall be used only where shown on the drawings or when approved by the Engineer.
- E. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.

3.06 INSPECTION

- A. The Contractor shall advise the Engineer of his intentions to place concrete and shall allow him adequate time to inspect all reinforcing steel before concrete is placed.
- B. The Contractor shall advise the Engineer of his intentions to place grout in masonry walls and shall allow him adequate time to inspect all reinforcing steel before grout is placed.

3.07 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete without prior approval.

END OF SECTION

SECTION 03250
CONCRETE ACCESSORIES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor and equipment required to provide all concrete accessories including waterstops, expansion joint material, joint sealants, expansion joint seals, contraction joint inserts, and epoxy bonding agent.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100– Concrete Formwork
- B. Section 03290 – Joints in Concrete
- C. Section 03300 – Cast-in-Place Concrete
- D. Section 07900 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM C881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
 - 2. ASTM D412 – Standard Tests for Rubber Properties in Tension
 - 3. ASTM D 624 – Standard Test method for Rubber Property - Tear Resistance
 - 4. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics
 - 5. ASTM D1751 – Standard Specifications for Preformed Expansion Joint fillers for Concrete Paving and Structural Construction (nonextruding and resilient bituminous types)
 - 6. ASTM D 1752 – Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - 7. ASTM D 1171 – Standard Test Method for Ozone Resistance at 500 pphm
 - 8. ASTM D 471 – Standard Test Method for Rubber Properties

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Manufacturer's literature on all products specified herein including material certifications.
 - 2. Proposed system for supporting PVC waterstops in position during concrete placement.
 - 3. Samples of products if requested by the Engineer.

PART 2 – PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) WATERSTOPS

- A. PVC waterstops for construction joints shall be flat ribbed type, 6 inches wide with a minimum thickness at any point of 3/8 inches.
- B. Waterstops for expansion joints shall be ribbed with a center bulb. They shall be 9 inches wide with a minimum thickness at any point of 3/8 inch unless shown or specified otherwise. The center bulb shall have a minimum outside diameter of 1 inch and a minimum inside diameter of 1/2 inch.
- C. The waterstops shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material or pigment whatsoever. The properties of the polyvinyl chloride compound used, as well as the physical properties of the waterstops, shall exceed the requirements of the U.S. Army Corps. of Engineers' Specification CRD-C572. The waterstop material shall have an off-white, milky color.
- D. The required minimum physical characteristics for this material are:
 - 1. Tensile strength – 1,750 psi (ASTM D-638).
 - 2. Ultimate elongation – not less than 280% (ASTM D-638).
- E. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.
- F. PVC waterstops shall be as manufactured by BoMetals, Inc., DuraJoint Concrete Accessories, or Sika Greenstreak.
- G. All waterstop intersections, both vertical and horizontal, shall be made from factory fabricated corners and transitions. Only straight butt joint splices shall be made in field.

2.02 RETROFIT WATERSTOPS

- A. Retrofit waterstops shall be used where specifically shown on Drawings for sealing joints between existing concrete construction and new construction.
- B. Retrofit waterstops shall be PVC waterstops fabricated from material as described in Section 2.01 of this Specification.
- C. Retrofit waterstop shall be attached to existing concrete surface as shown on Drawings.
- D. Use of split waterstop in lieu of specially fabricated retrofit waterstop will not be acceptable.
- E. E. Retrofit Waterstop manufacturer must provide a complete system including all Waterstop, stainless steel anchoring hardware, and epoxy for installation.

For construction joints, retrofit waterstop shall be style number 609 by Sika Greenstreak, RF-638 by BoMetals, Inc., or approved equal. For expansion joints, retrofit waterstop shall be style number 667 by Sika Greenstreak, RF-912 by BoMetals, Inc., Type 36RT Retrofit Kit by DuraJoint Concrete Accessories, or approved equal.

2.03 WATERPROOF MEMBRANE PATCH

- A. Waterproof membrane patch shall be Sikadur Combiflex by Sika Corporation or approved equal. Minimum width of waterstop material shall be twelve (12) inches unless shown otherwise on Contract Drawings.

2.04 EXPANDING RUBBER WATERSTOP

- A. Expanding rubber shall be designed to expand under hydrostatic conditions. Waterstops shall be Adeka Ultra Seal MC-2010MN by Adeka Ultra Seal/OCM, Inc., or Hydrotite CJ-1020-2K by Sika Greenstreak, for concrete thickness greater than nine inches. For thicknesses less than nine inches, Adeka Ultra Seal KBA-1510FP or Hydrotite CJ-1020-2K shall be used.
- B. Waterstop shall be a chemically modified natural rubber product with a hydrophilic agent.
- C. Waterstop has a stainless steel mesh or coextrusion of non-hydrophilic rubber to direct expansion in the thickness direction and restrict the expansion in the longitudinal direction.

2.05 WATERSTOP ADHESIVE

- A. Adhesive between waterstops and existing concrete shall be Neoprene Adhesive 77-198 by JGF Adhesives, Sikadur 31 Hi-Mod Gel by Sika Corporation, DP-605 NS Urethane Adhesive by 3M Adhesive Systems.
- B. Hydrophilic, non-bentonite water swelling elastic sealant shall be used to bond expanding rubber waterstops to rough surfaces. Hydrophilic elastic sealant shall be P-

201 by Adeka Ultra Seal/OCM, Inc., Leakmaster LV-1 by Sika Greenstreak, or approved equal.

2.06 JOINT SEALANTS

- A. Joint sealants shall comply with Section 07 90 00 – Joint Fillers, Sealants, and Caulking.

2.07 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be of the following types:

1. Type I – Sponge rubber, conforming to ASTM D1752, Type I.
2. Type II –Cork, conforming to ASTM D1752, Type II.
3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III.
4. Type IV – Bituminous fiber, conforming to ASTM Designation D1751.

2.08 EXPANSION JOINT SEAL

- A. Expansion Joint Seal System shall consist of a preformed neoprene profile, installed using the same dimensions as the joint gap, bonded with a two-component epoxy adhesive and pressurized during the adhesive cure time.
- B. The expansion joint system shall be Hydrozo/Jeene Structural Sealing joint system by Hydrozo/Jeene, Inc.

2.09 CONTRACTION JOINT INSERTS

- A. Contraction joint inserts shall be Zip-Cap by Greenstreak Plastic Products, Zip-Joint by BoMetals, Inc. control joint formers.

2.10 EPOXY BONDING AGENT

- A. Epoxy bonding agent shall conform to ASTM C881 and shall be Sikadur 32 Hi-Mod, Sika Corporation, Lyndhurst, N.J.; Euco #452 Epoxy System, Euclid Chemical Company, Cleveland, OH, MasterInject 1500 by BASF Master Builder Solutions (BASF).

2.11 EPOXY RESIN BINDER

- A. Epoxy resin binder shall conform to the requirements of ASTM C-881, Type III, Grade 3, Class B and C for epoxy resin binder and shall be Sikadur 23, Low-Mod-Gel, manufactured by the Sika Corporation, Lyndhurst, N.J., Flexocrete Gel manufactured by DuraJoint Concrete Accessories or Euco #352 Gel, Euclid Chemical Company, MasterEmaco ADH 327 or 327 RS by BASF Master Builder Solutions.

PART 3 – EXECUTION

3.01 PVC WATERSTOPS

- A. PVC waterstops shall be provided in all construction and expansion joints in water bearing structures and at other such locations as required by the Drawings.
- B. Waterstops shall be carefully positioned so that they are embedded to an equal depth in concrete on both sides of the joint. They shall be kept free from oil, grease, mortar or other foreign matter. To ensure proper placement, all waterstops shall be secured in correct position at 12" on center along the length of the waterstop on each side, prior to placing concrete. Such method of support shall be submitted to the Engineer for review and approval. Grommets or small pre-punched holes as close to the edges as possible will be acceptable for securing waterstops.
- C. Splices in PVC waterstops shall be made with a thermostatically controlled heating element. Only straight butt joint splices will be allowed in the field. Factory fabricated corners and transitions shall be used at all intersections. Splices shall be made in strict accordance with the manufacturer's recommended instructions and procedures. At least three satisfactory sample splices shall be made on the site. The Engineer may require tests on these splices by an approved laboratory. The splices shall exhibit not less than 80 percent of the strength of the unspliced material.
- D. All splices in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, discoloration, charring, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review and all faulty material shall be removed from the site and disposed of by the Contractor at no additional cost to the Owner.
- E. Retrofit waterstops shall be installed as shown on Contract Drawings using approved waterstop adhesive and Type 316 stainless steel batten bars and expansion anchors.
- F. Waterstop installation and splicing defects which are unacceptable include, but are not limited to the following:
 - 1. Tensile strength not less than 80 percent of parent material.
 - 2. Overlapped (not spliced) Waterstop.
 - 3. Misalignment of Waterstop geometry at any point greater than 1/16 inch.
 - 4. Visible porosity or charred or burnt material in weld area.
 - 5. Visible signs of splice separation when splice (24 hours or greater) is bent by hand at sharp angle.

3.02 WATERPROOF MEMBRANE PATCH AND EXPANDING RUBBER WATERSTOPS

- A. Patches and waterstops shall be installed only where shown on the Drawings.
- B. Patches and waterstops shall be installed in strict accordance with manufacturer's recommendations.

3.03 WATERSTOP ADHESIVE

- A. Adhesive shall be applied to both contact surfaces in strict accordance with manufacturer's recommendations.
- B. Adhesive shall be used where waterstops are attached to existing concrete surfaces.

3.04 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

- A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.
- B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.
- C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.
- E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.
- F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.
- G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

3.05 EXPANSION JOINT SEAL

- A. The expansion joint seal system shall be installed as shown on the Drawings in strict accordance with the manufacturer's recommendations.

3.06 CONTRACTION JOINT INSERTS

- A. For contraction joints in slabs, inserts shall be floated in fresh concrete during finishing.
- B. For contraction joints in walls, inserts shall be secured in place prior to casting wall.
- C. Inserts shall be installed true to line at the locations of all contraction joints as shown on the Drawings.
- D. Inserts shall extend into concrete sufficient depth as indicated on the Drawings or specified in Section 03 15 16 – Joints in Concrete.
- E. Inserts shall not be removed from concrete until concrete has cured sufficiently to prevent chipping or spalling of joint edges due to inadequate concrete strength.

3.07 EPOXY BONDING AGENT

- A. The Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete as shown on the Drawings.
- B. Bonding surface shall be clean, sound and free of all dust, laitance, grease, form release agents, curing compounds, and any other foreign particles.
- C. Application of bonding agent shall be in strict accordance with manufacturer's recommendations.
- D. Fresh concrete shall not be placed against existing concrete if epoxy bonding agent has lost its tackiness.

3.08 EPOXY RESIN BINDER

- A. Epoxy resin binder shall be used to seal all existing rebar cut and burned off during demolition operations. Exposed rebar shall be burned back 1/2-inch minimum into existing concrete and the resulting void filled with epoxy resin binder.

END OF SECTION

SECTION 03290
JOINTS IN CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENTS

- A. Provide all materials, labor and equipment required for the construction of all joints in concrete specified herein and shown on the Drawings.
- B. Types of joints in concrete shall be as follows:
 - 1. Construction Joints - Joints between adjacent concrete placements continuously connected with reinforcement.
 - 2. Expansion Joints - Joints in concrete which allow thermal expansion and contraction of concrete. Reinforcement terminates within concrete on each side of joint.
 - 3. Contraction Joints - Joints formed in concrete to provide a weakened plane in concrete section to control formation of shrinkage cracks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork
- B. Section 03250 – Concrete Accessories
- C. Section 03300 – Cast-in-Place Concrete
- D. Section 07900 – Joint Fillers, Sealants and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings
 - 2. ACI 318 – Building Code Requirements for Structural Concrete
 - 3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
 - 4. ACI 224.3 – Joints in Concrete Construction

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Layout drawings showing location and type of all joints to be placed in each structure.
 - 2. Details of proposed joints in each structure.
 - 3. For sawcut contraction joints submit documentation indicating the following:
 - a. Proposed method of sawcutting indicating early entry or conventional sawing.
 - b. Description of how work is to be performed including equipment to be utilized, size of crew performing the work and curing methods.
 - c. Description of alternate method in case of time constraint issues or failure of equipment.

PART 2 – MATERIALS

2.01 MATERIALS

- A. All materials required for joint construction shall comply with Section 03250 - Concrete Accessories and Section 07900 – Joint Fillers, Sealants and Caulking.

PART 3 – EXECUTION

3.01 CONSTRUCTION JOINTS

- A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.
- B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
- C. Maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45'-0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25'-0".

- D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.
- E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.
- F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.02 EXPANSION JOINTS

- A. Size and location of expansion joints shall be as shown on the Drawings.
- B. All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop. Waterstop shall be as shown on Drawings and specified in Section 03 15 00 – Concrete Accessories.

3.03 CONTRACTION JOINTS

- A. Location of contraction joints shall be as shown on the Drawings.
- B. Contraction joints shall be formed either by sawcutting or with contraction joint inserts as specified in Section 03250 – Concrete Accessories. Sawcutting of joints will not be permitted unless specifically approved by the Engineer.
- C. If approved by the Engineer, sawcutting of contraction joints in lieu of forming shall conform to the following requirements:
 - 1. Joints shall be sawed as soon as the concrete can support foot traffic without leaving any impression, normally the same day as concrete is placed and in no case longer than 24 hours after concrete is placed.
 - 2. Curing shall be performed using wet curing methods as indicated in Section 03 39 00 – Concrete Curing. Curing mats, fabrics or sheeting materials shall remain in place to the extent possible while cutting of joint is being performed. Curing materials shall only be removed as required and shall be immediately reinstalled once cutting of the joint has been completed.
 - 3. Depth of joint shall be as shown on the drawings or noted in these specifications. At locations where the joint cannot be installed to full depth due to curbs or other stopping points hand tools shall be used to complete joints.
 - 4. Saw cut joints shall meet the requirements of ACI 224.3, Section 2.8, Jointing Practice.

- D. Unless noted otherwise on Drawings, depth of contraction joints shall be 1-1/2 inches in reinforced concrete and 1/3 of concrete thickness in unreinforced concrete.

3.04 JOINT PREPARATION

- A. No concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- B. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed by wire brushing, air or light sand blasting.
- C. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surface shall present a clean and even appearance.
- D. All joints shall be sealed as shown on the Drawings and specified in Section 03250 – Concrete Accessories.

END OF SECTION

SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Provide all labor, equipment, materials and services necessary for the manufacture, transportation and placement of all plain and reinforced concrete work, as shown on the Drawings or as ordered by the Engineer.

- B. The requirements in this section shall apply to the following types of concrete:
 - 1. Class A1 Concrete: Normal weight structural concrete to be used in all structures qualifying as environmental concrete structures that are designed in accordance with ACI 350 including pump stations, tanks, basins, process structures, and any structures containing fluid or process chemicals or other materials used in treatment process.

 - 2. Class A6 Concrete: Normal weight structural concrete to be used where specifically called for on Contract Drawings or areas where specifically requested by Contractor and approved by Engineer. Class A6 concrete is identical to Class A1 concrete except that coarse aggregate specified in Article 2.05 below shall be Size #8 in accordance with ASTM C33.

 - 3. Class B Concrete: Normal weight structural concrete used for duct bank encasements, catch basins, fence and guard post embedment, concrete fill, and other areas where specifically noted on Contract Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork

- B. Section 03200 – Reinforcing Steel

- C. Section 03250 – Concrete Accessories

- D. Section 03290 – Joints in Concrete

- E. Section 03350 – Concrete Finishes

- F. Section 03370 – Concrete Curing

- G. Section 03600 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work herein shall conform to or exceed the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
1. North Carolina Building Code
 2. ACI 214 – Guide to Evaluation of Strength Test Results of Concrete
 3. ACI 301 – Specifications for Structural Concrete
 4. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 5. ACI 305 – Guide to Hot Weather Concreting
 6. ACI 306 – Guide to Cold Weather Concreting
 7. ACI 309 – Guide for Consolidation of Concrete
 8. ACI 318 – Building Code Requirements for Structural Concrete and Commentary
 9. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures
 10. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field
 11. ASTM C 33 – Standard Specification for Concrete Aggregates
 12. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 13. ASTM C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 14. ASTM C 88 – Standard Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate
 15. ASTM C 94 – Standard Specification for Ready-Mixed Concrete
 16. ASTM C 114 – Standard Test Method for Chemical Analysis of Hydraulic Cement
 17. ASTM C 136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 18. ASTM C 138 – Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

19. ASTM C 143 – Standard Test Method for Slump of Hydraulic Cement Concrete
20. ASTM C 150 – Standard Specification for Portland Cement
21. ASTM C 172 – Standard Practice for Sampling Freshly Mixed Concrete
22. ASTM C 192 – Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
23. ASTM C 231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
24. ASTM C 260 – Standard Specification for Air-Entraining Admixtures for Concrete
25. ASTM C 295 – Standard Guide for Petrographic Examination of Aggregates for Concrete
26. ASTM C 457 – Standard Test Method for Microscopical Determination of the Air-Void System in Hardened Concrete
27. ASTM C 494 – Standard Specification for Chemical Admixtures for Concrete
28. ASTM C 595 – Standard Specification for Blended Hydraulic Cements
29. ASTM C 618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
30. ASTM C 989 – Standard Specification for Slag Cement for Use in Concrete and Mortars
31. ASTM C 1077 – Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
32. ASTM C 1260 – Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method)
33. ASTM C 1567 – Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
34. ASTM C 1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
35. ASTM C 1778 – Reducing the Risk of Deleterious Alkali – Aggregate Reaction in Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.

1. Sources of all materials and certifications of compliance with specifications for all materials.
2. Certified current (less than 1 year old) chemical analysis of the Portland Cement or Blended Cement to be used.
3. Certified current (less than 1 year old) chemical analysis of fly ash or slag cement to be used.
4. Aggregate test results showing compliance with required standards, i.e., sieve analysis, potential reactivity, aggregate soundness tests, petrographic analysis, mortar bar expansion testing, etc.
5. Manufacturer's data on all admixtures stating compliance with required standards.
6. Concrete mix design for each class of concrete specified herein.
7. Field experience records and/or trial mix data for the proposed concrete mixes for each class of concrete specified herein.

1.05 QUALITY ASSURANCE

- A. Tests on materials used in the production of concrete shall be required as specified in Part 2 – Products. These tests shall be performed by an independent testing laboratory approved by the Engineer at no additional cost to the Owner.
- B. Trial concrete mixes shall be tested when required in accordance with Article 3.01 at no additional cost to the Owner.
- C. Field quality control tests, as specified in Article 3.09, unless otherwise stated, will be performed by a materials testing consultant employed by the Owner. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. Any individual who samples and tests concrete to determine if the concrete is being produced in accordance with this Specification shall be certified as a Concrete Field Testing Technician, Grade I, in accordance with ACI CP-2. Testing laboratory shall conform to requirements of ASTM C-1077.

1.06 CONCRETE COORDINATION CONFERENCE

- A. Unless waived by the Engineer, prior to any concrete submittals and at least 35 days prior to the start of the concrete construction schedule, the Contractor shall conduct a meeting at the site. The purpose of the meeting is to review the proposed concrete mix designs, to discuss the proposed approaches and procedures for mixing, transporting, placing, testing, finishing, and curing of all aspects of concrete work to ensure the concrete construction is performed in accordance with the Specifications, and to clarify roles of the parties involved. The Contractor shall send a concrete coordination

conference agenda to all attendees 20 days prior to a mutually agreed upon date for the conference.

- B. As a minimum the agenda shall include:
1. Concrete Materials and Mix Designs
 2. Inspection Responsibilities
 3. Concrete Sampling and Testing Specification Requirements
 4. Cylinder Storage and Transportation
 5. Acceptance/Rejection Responsibility and Authority for Fresh Concrete
 6. Concrete finishing
 7. Concrete Curing
 8. Test Report Distribution
 9. Miscellaneous Items
- C. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
1. Contractor's superintendent
 2. Engineer
 3. Owner's representative (if he chooses to attend)
 4. Laboratory retained for trial batching and construction quality control testing for the concrete.
 5. Any subcontractors involved in placing, finishing, and curing of concrete
 6. Concrete supplier
 7. Concrete pumping subcontractor (if pumping is being proposed)
- D. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed to all attendees and any other concerned parties within five days of the meeting.

PART 2 – PRODUCTS

2.01 HYDRAULIC CEMENT

A. Portland Cement

1. Portland Cement shall be Type II conforming to ASTM C 150. Type I cement may be used provided either fly ash or slag cement is also included in the mix in accordance with Articles 2.02 or 2.03 respectively.
2. When potentially reactive aggregates as defined in Article 2.05 are to be used in concrete mix, cement shall meet the following requirements:
 - a. For concrete mixed with only Portland Cement, the total alkalis in the cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.40%.
 - b. For concrete mixed with Portland Cement and an appropriate amount of fly ash (Article 2.02) or slag cement (Article 2.03) the total alkalis in the Portland Cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%.
3. When non-reactive aggregates as defined in Article 2.05 are used in concrete mix, total alkalis in the cement shall not exceed 1.0%.
4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetracalcium aluminoferrite.

B. Blended Cement

1. Blended cements shall be Type IP (Portland Fly Ash Cement) or Type IS (Portland Slag Cement) conforming to ASTM C 595.
2. Type IP cement shall be an interground blend of Portland Cement and fly ash in which the fly ash constituent is between 15% and 25% of the weight of the total blend.
3. Type IS cement shall be an interground blend of Portland Cement and slag cement in which the slag constituent is between 35% and 50% of the weight of the total blend.
4. Fly ash and slag cement used in the production of blended cements shall meet the requirements of Articles 2.02 and 2.03, respectively.
5. When reactive aggregates as defined in Article 2.05 are used in concrete mix, the total alkalis in the Portland Cement (calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O) shall not exceed 0.85%. The percentage of fly ash or slag cement shall be set to meet provisions of Article 2.05.G.2.

- C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.
- D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.02 FLY ASH

- A. Fly ash shall meet the requirements of ASTM C 618 for Class F, except that the loss on ignition shall not exceed 4%. Fly ash shall also meet the optional physical requirements for uniformity as shown in Table 3 of ASTM C 618.
- B. For fly ash to be used in the production of type IP cement, the Pozzolan Activity Index shall be greater than 75% as specified in Table 3 of ASTM C 595.
- C. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash. The percentage of fly ash shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.
- D. For Type A1 and A6 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.
- E. Additional fly ash shall not be included in concrete mixed with Type IS or IP cement.

2.03 SLAG CEMENT

- A. Slag cement shall meet the requirements of ASTM C 989 including tests for effectiveness of slag in preventing excessive expansion due to alkali-aggregate reactivity as described in Appendix X-3 of ASTM C 989.
- B. Where reactive aggregates as defined in Article 2.05 are used in concrete mix, the slag cement constituent shall be between 35% and 40% of the total weight of the combined Portland Cement and slag. The percentage of slag cement shall be set to meet the mean mortar bar expansion requirements in provisions of Article 2.05.G.2.
- C. For Types A1 and A6 concrete as required for use in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash or slag cement in the concrete mix, is mandatory.
- D. Additional slag cement shall not be included in concrete mixed with type IS or IP cement.

2.04 WATER

- A. Water used for mixing concrete shall be clear, potable and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts and other impurities.
- B. Water shall not contain more than 100 PPM chloride.
- C. Water shall not contain more than 500 PPM dissolved solids.
- D. Water shall have a pH in the range of 4.5 to 8.5.
- E. Water shall meet requirements of ASTM C 1602.

2.05 AGGREGATES

- A. All aggregates used in normal weight concrete shall conform to ASTM C 33.
- B. Fine Aggregate (Sand) in the various concrete mixes shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the limits of ASTM C 33.
- C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 as graded within the limits given in ASTM C 33 unless otherwise specified.
- D. For Class A6 concrete, coarse aggregate shall be Size #8 in accordance with ASTM C33.
- E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C 136.
- F. Aggregates shall be tested for soundness in accordance with ASTM C 88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using either magnesium sulfate or sodium sulfate.
- G. All aggregates shall be evaluated in accordance with ASTM C 1778 to determine potential reactivity. All aggregates shall be considered reactive unless they meet the requirements below for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.
 - 1. Non-reactive aggregates shall meet the following requirements:
 - a. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents of the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

- 1) Optically strained, microfractured, or microcrystalline quartz, 5.0%, maximum.
 - 2) Chert or chalcedony, 3.0%, maximum.
 - 3) Tridymite or cristobalite, 1.0%, maximum.
 - 4) Opal, 0.5%, maximum.
 - 5) Natural volcanic glass in volcanic rocks, 3.0%, maximum.
2. Concrete mixed with reactive aggregates shall meet the following requirements:
- a. If aggregates are deemed potentially reactive as per ASTM C-1778 and fly ash or slag cement is included in proposed concrete mix design, proposed concrete mix including proposed aggregates shall be evaluated by ASTM C-1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.
 - b. If aggregates are deemed potentially reactive as per ASTM C-1778 and a straight cement mix without fly ash or slag cement is proposed for concrete mix design, aggregates shall be evaluated by ASTM C-1260. Mean mortar bar expansions at 16 days shall be less than 0.08%.
- H. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.06 ADMIXTURES

- A. Air entraining agent shall be added to all concrete unless noted otherwise. The agent shall consist of a neutralized vinsol resin solution or a purified hydrocarbon with a cement catalyst which will provide entrained air in the concrete in accordance with ASTM C 260. The admixture proposed shall be selected in advance so that adequate samples may be obtained and the required tests made. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.
- B. The following admixtures are required or used for water reduction, slump increase, and/or adjustment of initial set. Admixtures permitted shall conform to the requirements of ASTM C 494. Admixtures shall be non-toxic after 30 days and shall be compatible with and made by the same manufacturer as the air-entraining admixtures.
 1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are "Eucon Series" by the Euclid Chemical Company, "Master Pozzoloth Series" by BASF, and "Plastocrete Series" by Sika Corporation.

2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The high range water reducer shall be added to the concrete at either the batch plant or at the job site and may be used in conjunction with a water reducing admixture. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are "Eucon 37" or Plastol 5000 by the Euclid Chemical Company, "Master Rheobuild 1000 or Master Glenium Series" by BASF, and "Daracem 100 or Advaflow Series" by W.R. Grace.
 3. A non-chloride, non-corrosive accelerating admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "MasterSet AC 534 or MasterSet FP 20" by BASF Corporation, "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.
 4. A retarding admixture may be used where specifically approved by the Engineer. The admixture shall conform to ASTM C494, Type B or D. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "MasterSet R Series or MasterSet DELVO Series" by BASF Corporation, and "Plastiment" by Sika Corporation.
 5. Workability Retaining Admixture shall conform to ASTM C 494, Type S. The admixture shall retain concrete workability without affecting time of setting or early-age strength development. Acceptable products are "MasterSure Z 60" by BASF Corporation, or equal.
- C. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted. The addition of admixtures to prevent freezing is not permitted.
- D. The Contractor shall submit manufacturer's data including the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review.

2.07 CONCRETE MIX DESIGN

- A. The proportions of cement, aggregates, admixtures and water used in the concrete mixes shall be based on the results of field experience or preferably laboratory trial mixes in conformance with Section 5.3. "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350. When trial mixes are used they shall also

conform to Article 3.01 of this Section of the Specifications. If field experience records are used, concrete strength results shall be from concrete mixed with all of the ingredients proposed for use on job used in similar proportions to mix proposed for use on job. Contractor shall submit verification confirming this stipulation has been followed. Field experience records and/or trial mix data used as the basis for the proposed concrete mix design shall be submitted to the Engineer along with the proposed mix.

B. Structural concrete shall conform to the following requirements. Cementitious materials refer to the total combined weight of all cement, fly ash, and slag cement contained in the mix.

1. Compressive Strength (28-Day)

Concrete Class A1, A6	4,500 psi (minimum)
Concrete Class B	3,000 psi (minimum)

2. Water/cementitious materials ratio, by weight

	Maximum	Minimum
Concrete Class A1, A6	0.42	0.39
Concrete Class B	0.50	0.39

3. Slump range

- a. 4" nominal unless high range water reducing admixture is used
- b. 8" max if high range water reducing admixture is used.

4. Air Content

Concrete Class A1, A6	6% ±1.5%
Concrete Class B	3% Max (non air-entrained)

PART 3 – EXECUTION

3.01 TRIAL MIXES

A. When trial mixes are used to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318 and ACI 350, an independent qualified testing laboratory designated and retained by the Contractor shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The

trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the Owner.

- B. The independent testing laboratory shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. , Product ." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the Owner. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.

3.02 PRODUCTION OF CONCRETE

- A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready mix plant or from a site mixed plant. In selecting the source for concrete production the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.
- B. Ready-Mixed Concrete
 - 1. At the Contractor's option, ready-mixed concrete may be used meeting the requirements for materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
 - 2. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
 - 3. Each batch of concrete shall be mixed in a truck mixer for not less than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

4. Truck mixers and their operation shall be such that the concrete throughout the mixed batch, as discharged, is within acceptable limits of uniformity with respect to consistency, mix and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one inch when the specified slump is 3 inches or less, or if they differ by more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
5. Ready-mixed concrete shall be delivered to the site for the work and discharge shall be completed before the drum has been revolved 300 revolutions and within the time requirements stated in Article 3.03 of this Section.
6. Each and every concrete delivery shall be accompanied by a delivery ticket containing at least the following information:
 - a. Date and truck number
 - b. Ticket number
 - c. Mix designation of concrete
 - d. Cubic yards of concrete
 - e. Cement brand, type and weight in pounds
 - f. Weight in pounds of fine aggregate (sand)
 - g. Weight in pounds of coarse aggregate (stone)
 - h. Air entraining agent, brand, and weight in pounds and ounces
 - i. Other admixtures, brand, and weight in pounds and ounces
 - j. Water, in gallons, stored in attached tank
 - k. Water, in gallons, maximum that can be added without exceeding design water/cementitious materials ratio
 - l. Water, in gallons, actually used (by truck driver)
 - m. Time of loading
 - n. Time of delivery to job (by truck driver)

7. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the above information will be rejected and such truck shall immediately depart from the job site.
8. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the Engineer.

C. Site Mixed Concrete

1. Scales for weighing concrete ingredients shall be accurate when in use within ± 0.4 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.
2. Operation of batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances:
 - a. Cement, fly ash, or slag cement ± 1 percent
 - b. Water ± 1 percent
 - c. Aggregates ± 2 percent
 - d. Admixtures ± 3 percent
3. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.
4. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within the specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance therewith.
5. Mixers with a rate capacity of 1 cu.yd. or larger shall conform to the requirements of the Plant Mixer Manufacturers' Division of the Concrete Plant Manufacturers' Bureau.
6. Except as provided below, batches of 1 cu. yd. or less shall be mixed for not less than 1 minute. The mixing time shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity.

7. Shorter mixing time may be permitted provided performance tests made in accordance with of ASTM C 94 indicate that the time is sufficient to produce uniform concrete.
8. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three-quarters of the required mixing time shall take place after the last of the mixing water has been added.
9. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixer blades shall be replaced when they have lost 10 percent of their original height.
10. Air-entraining admixtures and other chemical admixtures shall be charged into the mixer as solutions and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water. Admixtures that cannot be added in solution may be weighed or may be measured by volume if so recommended by the manufacturer.
11. If two or more admixtures are used in the concrete, they shall be added separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.
12. Addition of retarding admixtures shall be completed within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Retarding admixtures shall not be used unless approved by the Engineer.
13. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C 94.

3.03 CONCRETE PLACEMENT

- A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.
- B. Prior to concrete placement, all reinforcement shall be securely and properly fastened in its correct position. Formwork shall be clean, oiled and form ties at construction joints shall be retightened. All bucks, sleeves, castings, hangers, pipe, conduits, bolts, anchors, wire, and any other fixtures required to be embedded therein shall be in place. Forms for openings to be left in the concrete shall be in place and anchored by the Contractor. All loose debris in bottoms of forms or in keyways shall be removed and all debris, water, snow, ice and foreign matter shall be removed from the space to be occupied by the concrete. The Contractor shall notify the Engineer in advance of placement, allowing sufficient time for a concurrent inspection and for any corrective measures which are subsequently required.
- C. On horizontal joints where concrete is to be placed on hardened concrete, flowing concrete containing a high range water reducing admixture or cement grout shall be

placed with a slump not less than 8 inches for the initial placement at the base of the wall. Concrete or cement grout shall meet all strength and service requirements specified herein for applicable class of concrete. This concrete shall be worked well into the irregularities of the hard surface.

- D. All concrete shall be placed during the daylight hours except with the consent of the Engineer. If special permission is obtained to carry on work during the night, adequate lighting must be provided.
- E. When concrete arrives at the project with slump below that suitable for placing, as indicated by the Specifications, water may be added to bring the concrete within the specified slump range provided that the design water-cementitious materials ratio is not exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Water may be added only to full trucks. On-site tempering shall not relieve the Contractor from furnishing a concrete mix that meets all specified requirements.
- F. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients. It shall be so deposited that rehandling will be unnecessary. Discharge of the concrete to its point of deposit shall be completed within 90 minutes after the addition of the cement to the aggregates. In hot weather, or under conditions contributing to quick stiffening of the concrete, the time between the introduction of the cement to the aggregates and discharge shall not exceed the requirements stated in Article 3.08 of this Section.
- G. Where concrete is conveyed to position by chutes, a practically continuous flow in the chute shall be maintained. The angle and discharge arrangement of the chute shall be such as to prevent segregation of the concrete ingredients. The delivery end of the chute shall be as close as possible to the point of deposit and in no case shall the free pour from the delivery end of the chute exceed five feet, unless approved otherwise.
- H. Special care must be exercised to prevent splashing of forms or reinforcement with concrete, and any such splashes or accumulations of hardened or partially hardened concrete on the forms or reinforcement above the general level of the concrete already in place must be removed before the work proceeds. Concrete shall be placed in all forms in such way as to prevent any segregation.
- I. Placing of concrete shall be so regulated that the pressure caused by the wet concrete shall not exceed that used in the design of the forms.
- J. All concrete for walls shall be placed through openings in the form spaced at frequent intervals or through tremies (heavy duct canvas, rubber, etc.), equipped with suitable hopper heads. Tremies shall be of variable lengths so the free fall shall not exceed five (5) feet and a sufficient number shall be placed in the form to ensure the concrete is kept level at all times.

- K. When placing concrete which is to be exposed, sufficient illumination shall be provided in the interior of the forms so the concrete, at places of deposit, is visible from deck and runways.
- L. Concrete shall be placed so as to thoroughly embed all reinforcement, inserts, and fixtures.
- M. When forms are removed, surfaces shall be even and dense, free from aggregate pockets or honeycomb. To achieve this, concrete shall be consolidated using mechanical vibration, supplemented by forking and spading by hand in the corners and angle of forms and along form surfaces while the concrete is plastic under the vibratory action. Consolidation shall conform to ACI 309.
- N. Mechanical vibration shall be applied directly to the concrete, unless otherwise approved by the Engineer. The bottom of vibrators used on floor slabs must not be permitted to ride the form supporting the slab. Vibration shall be applied at the point of deposit and in the area of freshly placed concrete by a vertical penetration of the vibrator. Vibrators shall not be used to move concrete laterally within the forms.
- O. The intensity of vibration shall be sufficient to cause settlement of the concrete into place and to produce monolithic joining with the preceding layer. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures with a vibrator transmitting not less than 7,500 impulses per minute. Since the duration of vibration per square foot of surface is dependent on the frequency (impulses per minute), size of vibrator, and slump of concrete, the length of time must therefore be determined in the field. Vibration, however, shall not be continued in any one location to the extent that pools of grout are formed.
- P. Care shall be taken to prevent cold joints when placing concrete in any portion of the work. The concrete placing rate shall be such as to ensure that each layer is placed while the previous layer is soft or plastic, so that the two layers can be made monolithic by penetration of the vibrators. Maximum thickness of concrete layers shall be 18 inches. The surface of the concrete shall be level whenever a run of concrete is stopped.
- Q. To prevent feathered edges, construction joints located at the tops of horizontal lifts near sloping exposed concrete surfaces shall be inclined near the exposed surface, so the angle between such inclined surface and the exposed concrete surface will be not less than 50°.
- R. In placing unformed concrete on slopes, the concrete shall be placed ahead of a non-vibrated slip-form screed extending approximately 2-1/2 feet back from its leading edge. The method of placement shall provide a uniform finished surface with the deviation from the straight line less than 1/8 inch in any concrete placement. Concrete ahead of the slip-form screed shall be consolidated by internal vibrators so as to ensure complete filling under the slip-form. Prior to placement of concrete on sloped walls or slabs, the Contractor shall submit a plan specifically detailing methods and sequence of placements, proposed concrete screed equipment, location of construction joints and

waterstops, and/or any proposed deviations from the aforementioned to the Engineer for review and approval.

- S. Concrete shall not be placed during rains sufficiently heavy or prolonged to wash mortar from coarse aggregate on the forward slopes of the placement. Once placement of concrete has commenced in a block, placement shall not be interrupted by diverting the placing equipment to other uses.

3.04 PLACING FLOOR SLABS ON GRADE

- A. The subgrade for slabs on ground shall be well drained and of adequate and uniform loadbearing nature. The in-place density of the subgrade soils shall be at least the minimum required by the specifications. No foundation, slab, or pavement concrete shall be placed until the depth and character of the foundation soils have been inspected and approved by the materials testing consultant.
- B. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50° long enough to remove all frost from the subgrade.
- C. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting, but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.
- D. Thirty-pound felt paper shall be provided between edges of slab-on-grade and vertical and horizontal concrete surfaces, unless otherwise indicated on the Drawings.
- E. Contraction joints shall be provided in slabs-on-grade at locations indicated on the Drawings. Contraction joints shall be installed as per Section 03 15 16 – Joints in Concrete.
- F. Floor slabs shall be screeded level or pitched to drain as indicated on the Drawings. Finishes shall conform with requirements of Section 03 35 00 – Concrete Finishes.

3.05 PLACING CONCRETE UNDER PRESSURE

- A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- B. Priming of the concrete pumping equipment shall be with cement grout only. Use of specialty mix pump primers or pumping aids will not be allowed.

- C. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.
- D. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a materials testing consultant proving the proposed mix meets all requirements. In addition, an actual pumping test under field conditions is required prior to acceptance of the mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated. All submissions shall be subject to approval by the Engineer.
- E. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- F. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
- G. The minimum diameter of the hose (conduits) shall be four inches.
- H. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.
- I. Concrete samples for quality control in accordance with Article 3.09 will be taken at the placement (discharge) end of the line.

3.06 ORDER OF PLACING CONCRETE

- A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. Where required on the Drawings and wherever else practical, the placing of such units shall be done in a strip pattern in accordance with ACI 302.1. A minimum of 72 hours shall pass prior to placing concrete directly adjacent to previously placed concrete.

3.07 CONCRETE WORK IN COLD WEATHER

- A. Cold weather concreting procedures shall conform to the requirements of ACI 306.
- B. The Engineer may prohibit the placing of concrete at any time when air temperature is 40°F. or lower. If concrete work is permitted, the concrete shall have a minimum temperature, as placed, of 55°F. for placements less than 12" thick, 50°F. for placements 12" to 36" thick, and 45°F. for placements greater than 36" thick. The temperature of the concrete as placed shall not exceed the aforementioned minimum values by more than 20°F, unless otherwise approved by the Engineer.

- C. All aggregate and water shall be preheated. Precautions shall be taken to avoid the possibility of flash set when aggregate or water are heated to a temperature in excess of 100°F. in order to meet concrete temperature requirements. The addition of admixtures to the concrete to prevent freezing is not permitted. All reinforcement, forms, and concrete accessories with which the concrete is to come in contact shall be defrosted by an approved method. No concrete shall be placed on frozen ground.

3.08 CONCRETE WORK IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirements of ACI 305.
- B. When air temperatures exceed 85°F., or when extremely dry conditions exist even at lower temperatures, particularly if accompanied by high winds, the Contractor and his concrete supplier shall exercise special and precautionary measures in preparing, delivering, placing, finishing, curing and protecting the concrete mix. The Contractor shall consult with the Engineer regarding such measures prior to each day's placing operation and the Engineer reserves the right to modify the proposed measures consistent with the requirements of this Section of the Specifications. All necessary materials and equipment shall be on hand and in position prior to each placing operation.
- C. Preparatory work at the job site shall include thorough wetting of all forms, reinforcing steel and, in the case of slab pours on ground or subgrade, spraying the ground surface on the preceding evening and again just prior to placing. No standing puddles of water shall be permitted in those areas which are to receive the concrete.
- D. The temperature of the concrete mix when placed shall not exceed 90°F.
- E. Temperature of mixing water and aggregates shall be carefully controlled and monitored at the supplier's plant, with haul distance to the job site being taken into account. Stockpiled aggregates shall, if necessary, be shaded from the sun and sprinkled intermittently with water. If ice is used in the mixing water for cooling purposes, it must be entirely melted prior to addition of the water to the dry mix.
- F. Delivery schedules shall be carefully planned in advance so that concrete is placed as soon as practical after it is properly mixed. For hot weather concrete work (air temperature greater than 85°F), discharge of the concrete to its point of deposit shall be completed within 60 minutes from the time the concrete is batched.
- G. The Contractor shall arrange for an ample work force to be on hand to accomplish transporting, vibrating, finishing, and covering of the fresh concrete as rapidly as possible.

3.09 QUALITY CONTROL

- A. Field Testing of Concrete

1. The Contractor shall coordinate with the Engineer's project representative the on-site scheduling of the materials testing consultant personnel as required for concrete testing.
2. Concrete for testing shall be supplied by the Contractor at no additional cost to the Owner, and the Contractor shall provide assistance to the materials testing consultant in obtaining samples. The Contractor shall dispose of and clean up all excess material.

B. Consistency

1. The consistency of the concrete will be checked by the materials testing consultant by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer and/or the materials testing consultant may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for any delays, material or labor costs due to such eventualities.
2. Slump tests shall be made in accordance with ASTM C 143. Slump tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.
3. Concrete with a specified nominal slump shall be placed having a slump within 1" (higher or lower) of the specified slump. Concrete with a specified maximum slump shall be placed having a slump less than the specified slump.

C. Unit Weight

1. Samples of freshly mixed concrete shall be tested for unit weight by the materials testing consultant in accordance with ASTM C 138.
2. Unit weight tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the materials testing consultant in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the materials testing consultant and each time compressive strength samples are taken.
3. In the event test results are outside the limits specified, additional testing shall occur. Admixture quantity adjustments shall be made immediately upon discovery of incorrect air entrainment.

E. Compressive Strength

1. Samples of freshly mixed concrete will be taken by the materials testing consultant and tested for compressive strength in accordance with ASTM C 172, C 31 and C 39, except as modified herein.
2. In general, one sampling shall be taken for each placement in excess of five (5) cubic yards, with a minimum of one (1) sampling for each day of concrete placement operations, or for each one hundred (100) cubic yards of concrete, or for each 5,000 square feet of surface area for slabs or walls, whichever is greater.
3. Each sampling shall consist of at least five (5) 6x12 cylinders or (8) 4x8 cylinders. Each cylinder shall be identified by a tag, which shall be hooked or wired to the side of the container. The materials testing consultant will fill out the required information on the tag, and the Contractor shall satisfy himself that such information shown is correct.
4. The Contractor shall be required to furnish labor to the Owner for assisting in preparing test cylinders for testing. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C 31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds and such that all specimen are shielded from direct sunlight and/or radiant heating sources. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours.
5. The Contractor shall be responsible for maintaining the temperatures of the curing box during the initial curing of test specimens with the temperature preserved between 60°F and 80°F as measured by a maximum-minimum thermometer. The Contractor shall maintain a written record of curing box temperatures for each day curing box contains test specimens. Temperature shall be recorded a minimum of three times a day with one recording at the start of the work day and one recording at the end of the work day.
6. When transported, the cylinders shall not be thrown, dropped, allowed to roll, or be damaged in any way.
7. Compression tests shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at seven days and two at 28 days. For 4x8 cylinders, three test cylinders will be tested at seven days, three at 28 days. The remaining cylinders will be held to verify test results, if needed.

F. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 214, ACI 318, and ACI 350.
 2. The strength level of concrete will be considered satisfactory if all of the following conditions are satisfied.
 - a. Every arithmetic average of any three consecutive strength tests equals or exceeds the minimum specified 28-day compressive strength for the mix (see Article 2.07).
 - b. No individual compressive strength test results falls below the minimum specified strength by more than 500 psi.
 3. In the event any of the conditions listed above are not met, the mix proportions shall be corrected for the next concrete placing operation.
 4. In the event that condition 2B is not met, additional tests in accordance with Article 3.09, Paragraph H shall be performed.
 5. When a ratio between 7-day and 28-day strengths has been established by these tests, the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths. Should the 7-day test strength from any sampling be more than 10% below the established minimum strength, the Contractor shall:
 - a. Immediately provide additional periods of curing in the affected area from which the deficient test cylinders were taken.
 - b. Maintain or add temporary structural support as required.
 - c. Correct the mix for the next concrete placement operation, if required to remedy the situation.
 6. All concrete which fails to meet the ACI requirements and these specifications is subject to removal and replacement at no additional cost to the Owner.
- G. When non-compliant concrete is identified, test reports shall be sent immediately to the Engineer for review.
- H. Additional Tests
1. When ordered by the Engineer, additional tests on in-place concrete shall be provided and paid for by the Contractor.
 2. In the event the 28-day test cylinders fail to meet the minimum strength requirements as outlined in Article 3.09, Paragraph F, the Contractor shall have concrete core specimens obtained and tested from the affected area immediately.
 - a. Three cores shall be taken for each sample in which the strength requirements were not met.

- b. The drilled cores shall be obtained and tested in conformance with ASTM C 42. The tests shall be conducted by a materials testing consultant approved by the Engineer.
 - c. The location from which each core is taken shall be approved by the Engineer. Each core specimen shall be located, when possible, so its axis is perpendicular to the concrete surface and not near formed joints or obvious edges of a unit of deposit.
 - d. The core specimens shall be taken, if possible, so no reinforcing steel is within the confines of the core.
 - e. The diameter of core specimens should be at least 3 times the maximum nominal size of the course aggregate used in the concrete, but must be at least 2-inches in diameter.
 - f. The length of specimen, when capped, shall be at least twice the diameter of the specimen.
 - g. The core specimens shall be taken to the laboratory and when transported, shall not be thrown, dropped, allowed to roll, or damaged in any way.
 - h. Two (2) copies of test results shall be mailed directly to the Engineer. The concrete in question will be considered acceptable if the average compressive strength of a minimum of three test core specimens taken from a given area equal or exceed 85% of the specified 28-day strength and if the lowest core strength is greater than 75% of the specified 28-day strength.
3. In the event that concrete placed by the Contractor is suspected of not having proper air content, the Contractor shall engage a materials testing consultant approved by the Engineer, to obtain and test samples for air content in accordance with ASTM Specification C 457.

3.10 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Care shall be exercised to avoid jarring forms or placing any strain on the ends of projecting reinforcing bars. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at no additional cost to the Owner.
- B. Areas of honeycomb shall be chipped back to sound concrete and repaired as directed.

- C. Concrete formwork blowouts or unacceptable deviations in tolerances for formed surfaces due to improperly constructed or misaligned formwork shall be repaired as directed. Bulging or protruding areas, which result from slipping or deflecting forms shall be ground flush or chipped out and redressed as directed.
- D. Areas of concrete in which cracking, spalling, or other signs of deterioration develop prior to final acceptance shall be removed and replaced or repaired as directed. This stipulation includes concrete that has experienced cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an approved epoxy injection system. Non-structural cracks shall be repaired using an approved hydrophilic resin pressure injected grout system, unless other means of repair are deemed necessary and approved. All repair work shall be performed at no additional cost to the Owner.
- E. Concrete which fails to meet the strength requirements as outlined in Article 3.09, Paragraph F, will be analyzed as to its adequacy based upon loading conditions, resultant stresses and exposure conditions for the particular area of concrete in question. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at no additional cost to the Owner. The method of strengthening or extent of replacement shall be as directed by the Engineer.

END OF SECTION

SECTION 03350
CONCRETE FINISHES

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork
- B. Section 03300 – Cast-in-Place Concrete
- C. Section 03600 – Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. ACI 301 – Specifications for Structural Concrete for Buildings
- 2. ACI 318 – Building Code Requirements for Structural Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Manufacturer's literature on all products specified herein.

PART 2 – PRODUCTS

2.01 CONCRETE FLOOR SEALER

- A. Floor sealer shall be Diamond Clear VOX or Super Diamond Clear VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

- A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing silicate based solution designed to harden, dustproof and protect

concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of which 50% is silicate. Acceptable products are Diamond Hard by the Euclid Chemical Company, Seal Hard by L&M Construction Chemicals and MasterKure HD 210 WB by BASF Master Builder Solutions.

2.03 NON-METALLIC FLOOR HARDENER

- A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. Acceptable products shall be "Surflex" by the Euclid Chemical Company, "Harcot" by Sonneborn, "Maximent" by BASF, and "Mastercon" by BASF.

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

- A. Non-oxidizing, heavy-duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or Masterplate by BASF Construction Chemicals.

2.05 NON-SLIP FLOORING ADDITIVE

- A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be Frictex NS by BASF Construction Chemicals, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

PART 3 – EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

- A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.06 - Concrete Finish Schedule. Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. See Article 3.05 for surfaces to receive paint or protective coatings. The Engineer shall be the sole judge of acceptability of all concrete finish work.
 - 1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than 1/4-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than 1/4-inch in any dimension. Honeycombs shall be

chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened over an extended amount of time to reach the condition of saturated surface dry (SSD), a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap.
3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities requires it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

- A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 - Concrete Finish Schedule. The Engineer shall be the sole judge of acceptability of all such finish work.
 1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2" minimum deep grooves prior to final set.
 2. Type "B" - Wood or Magnesium Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood or magnesium float or until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All

edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and any other irregularities.

3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.
4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.
5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.
6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03 60 00 – Grout shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations.
7. Type "G" Hardened Finish: This finish shall be applied after completion of a Type "B" or Type "C" finish and prior to application of a Type "D" finish. Hardeners shall be applied in strict accordance with the manufacturer's requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising 2/3 of the total amount. Type "D" finish shall be applied following completion of application of the hardener.
 - a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft.2.

- b. Non-oxidizing, heavy-duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft.2.
- 8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.
- 9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of $\pm 1/4$ inch.

3.03 CONCRETE SEALERS

- A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.
- B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer's requirements.
- C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.
- D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.
- E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

- A. Formed surfaces of equipment pads shall receive a Type III finish.
- B. Top surfaces of equipment pads, except those surfaces subsequently required to receive grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 FINISHES FOR SURFACES TO RECEIVE PAINT OR COATINGS

- A. Surfaces indicated or specified to receive paint or special coatings shall be prepared per specifications in Division 09. All products applied to the concrete surfaces during the placement, finishing, and curing process shall be compatible with the painting or coating system as required by the manufacturer.

3.06 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 1 feet below water surface to bottom of wall	I
From top of wall to 1 feet below water surface	II
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
All interior exposed concrete walls and vertical surfaces	III
Interior exposed ceiling, including beams	III
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E

END OF SECTION

SECTION 03370
CONCRETE CURING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Protect all freshly deposited concrete from premature drying and from the weather elements. The concrete shall be maintained with minimal moisture loss at a relatively constant temperature for a period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with the requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 – Concrete Formwork
- B. Section 03300 – Cast-In-Place Concrete
- C. Section 03350 – Concrete Finishes

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 – Specifications for Structural Concrete for Buildings
 - 2. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 305 – Hot Weather Concreting
 - 4. ACI 306 – Cold Weather Concreting
 - 5. ACI 308 – Standard Practice for Curing Concrete
 - 6. ASTM C171 – Standard Specifications for Sheet Materials for Curing Concrete
 - 7. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 8. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.

1. Proposed procedures for protection of concrete under wet weather placement conditions.
2. Proposed normal procedures for protection and curing of concrete.
3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
4. Proposed method of measuring concrete surface temperature changes.
5. Manufacturer's literature and material certification for proposed curing compounds.

PART 2 – PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

- A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m² when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company and Cure & Seal 30 Plus by Symons Corporation.
- B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

- A. Evaporation reducer shall be BASF, "MasterKure ER 50", or Euclid Chemical "Euco-Bar".

PART 3 – EXECUTION

3.01 PROTECTION AND CURING

- A. All freshly placed concrete shall be protected from the elements, flowing water and from defacement of any nature during construction operations.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 5-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.

- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.
- D. The Contractor shall use one of the following methods to ensure that the concrete remains in a moist condition for the minimum period stated above.
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150°F).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the Engineer, application of a curing compound in accordance with Article 3.04.
- E. The Contractor shall keep absorbent wood forms wet until they are removed. After form removal, the concrete shall be cured by one of the methods in paragraph D.
- F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

- A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Section 03 30 00 – Cast-In-Place Concrete, for concrete work in cold weather. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.
- B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.
- C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.

- D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

- A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.
- B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.
- C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.
- D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least six (6) additional days using one of the methods listed in paragraph 3.01D.
- E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

- A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.
- B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.
- C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and after finishing operations. Maximum coverage for the curing and sealing compound shall be 300 square feet per gallon for trowel finishes and 200 square feet per gallon for floated or broom surfaces. Maximum coverage for compounds placed where subsequent finishes will be applied shall be 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

- A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:
1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.
 2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

END OF SECTION

SECTION 03400
PRECAST CONCRETE

PART 1 – GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 – Reinforcing Steel
- B. Section 03300 – Cast-in-Place Concrete
- C. Section 03350 – Concrete Finishes
- D. Section 03370 – Concrete Curing
- E. Section 03600 – Grout
- F. Section 05010 – Metal Materials
- G. Section 05035 – Galvanizing
- H. Section 05050 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.
 - 1. North Carolina Building Code
 - 2. ACI 318 – Building Code Requirements for Structural Concrete
 - 3. PCI Standard MNL-116 – Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
 - 4. PCI Design Handbook

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1.04 SUBMITTALS

- A. The Contractor shall submit the following for review in accordance with Section 01300 – Submittals.
 - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.
 - 2. A list of the design criteria used by the manufacturer for all manufactured, precast items.
 - 3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the State of North Carolina.
 - 4. Certified reports for all lifting inserts, indicating allowable design loads.
 - 5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

- A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.
- B. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double-T members, etc.
- C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five years' experience in precast concrete work.

PART 2 – PRODUCTS

2.01 CONCRETE

- A. Concrete materials including portland cement, aggregates, water, and admixtures shall conform to Section 03300 – Cast-in-Place Concrete.
- B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi unless otherwise specified.

- C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4000 psi unless otherwise specified.

2.02 GROUT

- A. Grout for joints between panels shall be a cement grout in conformance with Section 03600 – Grout.
- B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

- A. Reinforcing steel used for precast concrete construction shall conform to Section 03200 – Reinforcing Steel.

2.04 STEEL INSERTS

- A. Steel inserts shall be in accordance with Section 05010 – Metal Materials.
- B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05035 – Galvanizing.

2.05 WELDING

- A. Welding shall conform to Section 05050 – Metal Fastening.

2.06 BEARING PADS

- A. Neoprene bearing pads shall conform to the requirements of A4-F3-T.063-B2, Grade 2, Method B, in accordance with the RMA Rubber Handbook. Pads shall be nonlaminated pads having a nominal Shore A durometer hardness of 70 in accordance with ASTM D2240. Adhesive for use with neoprene pads shall be an epoxy-resin compound compatible with the neoprene having a sufficient shear strength to prevent slippage between pads and adjacent bearing surfaces. Adhesive shall be 20+F Contact Cement by Miracle Adhesives Corporation, Neoprene Adhesive 77-198 by IGI Adhesives, Sikadur 31, Hi-Mod Gel by Sika Corporation, or DP-605 NS Urethane Adhesive by 3M Adhesive Systems.
- B. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 – EXECUTION

3.01 FABRICATION AND CASTING

- A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast members shall be

straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free from leakage during the casting operation.

- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.
- D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- E. Concrete shall be finished in accordance with Section 03350 – Concrete Finishes. Grout all recesses due to cut tendons which will not otherwise be grouted during erection.
- F. Curing of precast members shall be in accordance with Section 03370 – Concrete Curing. Use of a membrane curing compound will not be allowed.
- G. The manufacturer shall provide lifting inserts or other approved means of lifting members.

3.02 HANDLING, TRANSPORTING AND STORING

- A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.
- B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.
- C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.
- D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.
- E. Precast concrete members shall not be used as storage areas for other materials or equipment.
- F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

- A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools and materials required for proper execution of the work.
- B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.
- C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.
- D. Connections which require welding shall be properly made in accordance with Section 05 05 23 – Metal Fastening.
- E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.
- F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).
- G. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.
- H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

END OF SECTION

SECTION 03600

GROUT

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all grout used in concrete work and as bearing surfaces for base plates, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Requirements of related work are included in Division 1 and Division 2 of these Specifications.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. CRD-C 621 – Corps of Engineers Specification for Non-shrink Grout
2. ASTM C 33 – Standard Specification for Concrete Aggregates
3. ASTM C 109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm cube Specimens)
4. ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing
5. ASTM C 579 – Test Method for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
6. ASTM C 827 – Standard Test Method for Early Volume Change of Cementitious Mixtures
7. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.

1. Certified test results verifying the compressive strength and shrinkage and expansion requirements specified herein.
2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

1.05 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. The specimens will be made by the Engineer or its representative.
 - a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days, 28 days and any additional time period as appropriate.
 - b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at seven days and any other time period as appropriate.
2. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Engineer in obtaining specimens for testing. The Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens, at no additional cost to the Owner.
3. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Cement Grout

1. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall

consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

2. The minimum compressive strength at 28 days shall be 4000 psi.
3. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
4. Sand shall conform to the requirements of ASTM C33.

B. Non-Shrink Grout

1. Non-shrink grout shall conform to CRD-C 621 and ASTM C 1107, Grade B or C when tested at a max. fluid consistency of 30 seconds per CDC 611/ASTM C939 at temperature extremes of 45°F and 90°F and an extended working time of 15 minutes. Grout shall have a min. 28-day strength of 7,000 psi. Non-shrink grout shall be, "Euco N-S" by the Euclid Chemical Company, "SikagROUT 212" by Sika Corporation, "Conspec 100 Non-Shrink Non-Metallic Grout" by Conspec, "Masterflow 555 Grout" by BASF Master Builder Solutions.

C. Epoxy Grout

1. Epoxy grout shall be "Sikadur 32 Hi-Mod" by Sika Corporation, "Duralcrete LV" by Tamms Industries, or "Euco #452 Series" by Euclid Chemical, "MasterEmaco ADH 1090 RS" by BASF Master Builder Solutions.
2. Epoxy grout shall be modified as required for each particular application with aggregate per manufacturer's instructions.

D. Epoxy Base Plate Grout

1. Epoxy base plate grout shall be "Sikadur 42, Grout-Pak" by Sika Corporation, or "Masterflow 648" by BASF Master Builder Solutions.

2.02 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03370 – Concrete Curing for cement grout and as recommended by the manufacturer for prepackaged grouts.

PART 3 – EXECUTION

3.01 GENERAL

- A. The different types of grout shall be used for the applications stated below unless noted otherwise in the Contract Documents. Where grout is called for in the Contract Documents which does not fall under any of the applications stated below, non-shrink grout shall be used unless another type is specifically referenced.
 - 1. Cement grout shall be used for grout toppings and for patching of fresh concrete.
 - 2. Non-shrink grout shall be used for grouting beneath base plates of structural metal framing.
 - 3. Epoxy grout shall be used for bonding new concrete to hardened concrete.
 - 4. Epoxy base plate grout shall be used for precision seating of base plates including base plates for all equipment such as engines, mixers, pumps, vibratory and heavy impact machinery, etc.
- B. New concrete surfaces to receive cement grout shall be as specified in Section 03 35 00 – Concrete Finishes, and shall be cleaned of all dirt, grease and oil-like films. Existing concrete surfaces shall likewise be cleaned of all similar contamination and debris, including chipping or roughening the surface if a laitance or poor concrete is evident. The finish of the grout surface shall match that of the adjacent concrete. Curing and protection of cement grout shall be as specified in Section 03 39 00 – Concrete Curing.
- C. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- D. The Contractor, through the manufacturer of a non-shrink grout and epoxy grout, shall provide on-site technical assistance upon request, at no additional cost to the Owner.

3.02 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.

3.03 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

3.04 GROUT INSTALLATION

- A. Grout shall be placed quickly and continuously, shall completely fill the space to be grouted and be thoroughly compacted and free of air pockets. The grout may be poured in place, pressure grouted by gravity, or pumped. The use of pneumatic pressure or dry-packed grouting requires approval of the Engineer. For grouting beneath base plates, grout shall be poured from one side only and thence flow across to the open side to avoid air-entrapment.

END OF SECTION

SECTION 05010
METAL MATERIALS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05050 – Metal Fastening.
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM A36 – Standard Specification for Structural Steel
- B. ASTM A47 – Standard Specification for Malleable Iron Castings
- C. ASTM A48 – Standard Specification for Gray Iron Castings
- D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- E. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- F. ASTM A276 – Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- G. ASTM A307 – Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
- H. ASTM A446 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality
- I. ASTM A500 – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- J. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing

- K. ASTM A529 – Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)
- L. ASTM A536 – Standard Specification for Ductile Iron Castings
- M. ASTM A570 – Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- N. ASTM A572 – Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- O. ASTM A992 – Standard Specification for Structural Steel Shapes
- P. ASTM A666 – Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
- Q. ASTM A1085 – Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
- R. ASTM B26 – Standard Specification for Aluminum-Alloy Sand Castings
- S. ASTM B85 – Standard Specification for Aluminum-Alloy Die Castings
- T. ASTM B108 – Standard Specification for Aluminum-Alloy Permanent Mold Castings
- U. ASTM B138 – Standard Specification for Manganese Bronze Rod, Bar, and Shapes
- V. ASTM B209 – Standard Specification for Aluminum-Alloy Sheet and Plate
- W. ASTM B221 – Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- X. ASTM B308 – Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
- Y. ASTM B574 – Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
- Z. ASTM F468 - Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
- AA. ASTM F593 – Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

- A. Owner may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the Owner. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the Owner. In lieu of replacing materials, the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 – PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

- A. Material types and ASTM designations shall be as listed below:

Steel W Shapes	A992
Steel HP Shapes	A572 Grade 50
Steel M, S, C, and MC shapes and Angles, Bars, and Plates	A36
Rods	F 1554 Grade 36
Pipe - Structural Use	A53 Grade B
Hollow Structural Sections	A500 Grade C or A1085
Cold-Formed Steel Framing	A 653

2.02 STAINLESS STEEL

- A. All stainless steel fabrications shall be Type 316.
- B. Material types and ASTM designations are listed below:

Plates and Sheets	ASTM A167 or A666 Grade A
Structural Shapes	ASTM A276
Fasteners (Bolts, etc.)	ASTM F593

2.03 ALUMINUM

- A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

Structural Shapes	ASTM B308
Castings	ASTM B26, B85, or B108
Extruded Bars	ASTM B221 - Alloy 6061
Extruded Rods, Shapes and Tubes	ASTM B221 - Alloy 6063
Plates	ASTM B209 - Alloy 6061
Sheets	ASTM B221 - Alloy 3003

C. All aluminum shall be provided with mill finish unless otherwise noted.

D. Where bolted connections are indicated, aluminum shall be fastened with stainless steel bolts.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

Gray	ASTM A48 Class 30B
Malleable	ASTM A47
Ductile	ASTM A536 Grade 60-40-18

2.05 DISSIMILAR METALS

A. Dielectric isolation shall be installed wherever dissimilar metals are connected according to the following table.

	Zinc	Galvanized Steel	Aluminum	Cast Iron	Ductile Iron	Mild Steel/ Carbon Steel	Copper	Brass	Stainless Steel
Zinc			•	•	•	•	•	•	•
Galvanized Steel			•	•	•	•	•	•	•
Aluminum	•	•		•	•	•	•	•	•
Cast Iron	•	•	•				•	•	•

Ductile Iron	•	•	•				•	•	•
Mild Steel/ Carbon Steel	•	•	•				•	•	•
Copper	•	•	•	•	•	•			•
Brass	•	•	•	•	•	•			•
Stainless Steel	•	•	•	•	•	•	•	•	
1. "•" signifies dielectric isolation is required between the two materials noted. 2. Consult Engineer for items not listed in table.									

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 05035
GALVANIZING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Where galvanizing is called for in the Contract Documents, the galvanizing shall be performed in accordance with the provisions of this Section unless otherwise noted.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Further requirements for galvanizing specific items may be included in other Sections of the Specifications. See section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. North Carolina Building Code
2. ASTM A123 – Standard Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
5. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
6. ASTM A780 – Standard Practice of Repair of Damaged Hot-Dip Galvanized Coatings
7. ASTM F2329 – Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Certification that the item(s) are galvanized in accordance with the applicable ASTM standards specified herein. This certification may be included as part of any material certification that may be required by other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 GALVANIC COATING

- A. Material composition of the galvanic coating shall be in accordance with the applicable ASTM standards specified herein.

PART 3 – EXECUTION

3.01 FABRICATED PRODUCTS

- A. Products fabricated from rolled, pressed, and forged steel shapes, plates, bars, and strips, 1/8 inch thick and heavier which are to be galvanized shall be galvanized in accordance with ASTM A123. Products shall be fabricated into the largest unit which is practicable to galvanize before the galvanizing is done. Fabrication shall include all operations necessary to complete the unit such as shearing, cutting, punching, forming, drilling, milling, bending, and welding. Components of bolted or riveted assemblies shall be galvanized separately before assembly. When it is necessary to straighten any sections after galvanizing, such work shall be performed without damage to the zinc coating. The galvanizer shall be a member of American Galvanizers Association.
- B. Components with partial surface finishes shall be commercial blast cleaned prior to pickling.
- C. Sampling and testing of each lot shall be performed prior to shipment from the galvanizer's facility per ASTM A123.

3.02 HARDWARE

- A. Iron and steel hardware which is to be galvanized shall be galvanized in accordance with ASTM A153 and ASTM F2329.

3.03 ASSEMBLED PRODUCTS

- A. Assembled steel products which are to be galvanized shall be galvanized in accordance with ASTM A123. All edges of tightly contacting surfaces shall be completely sealed by welding before galvanizing.
- B. Assemblies shall be provided with vent and drain holes as required by the fabricator. Vent and drain hole sizes and locations shall be included in the structural steel shop drawings for approval. All vent and drain holes shall be plugged and finished to be flush

with and blend in with the surrounding surface. Where water intrusion can occur, the plug shall be carefully melted into the surrounding zinc coating using an appropriate fluxing agent.

3.04 REPAIR OF GALVANIZING

- A. Galvanized surfaces that are abraded or damaged at any time after the application of zinc coating shall be repaired by thoroughly wire brushing the damaged areas and removing all loose and cracked coating, after which the cleaned areas shall be painted with 2 coats of zinc rich paint meeting the requirements of Federal Specification DOD-P-21035A and shall be thoroughly mixed prior to application. Zinc rich paint shall not be tinted. The total thickness of the 2 coats shall not be less than 6 mils. In lieu of repairing by painting with zinc rich paint, other methods of repairing galvanized surfaces in accordance with ASTM A780 may be used provided the proposed method is acceptable to the Engineer.

END OF SECTION

SECTION 05050
METAL FASTENING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 – Galvanizing
- C. Section 05061 – Stainless Steel

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

1. North Carolina Building Code
2. AC 193 – Acceptance Criteria for Mechanical Anchors in Concrete Elements
3. AC 308 – Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
4. ACI 318 – Building Code Requirements for Structural Concrete
5. ACI 355.2 – Qualifications of Post-Installed Mechanical Anchors in Concrete
6. ACI 355.4 – Qualifications of Post-Installed Adhesive Anchors in Concrete
7. AISC 348 – The 2009 RCSC Specification for Structural Joints
8. AISC – Code of Standard Practice
9. AWS D1.1 – Structural Welding Code – Steel
10. AWS D1.2 – Structural Welding Code – Aluminum
11. AWS D1.6 – Structural Welding Code – Stainless Steel

12. Aluminum Association – Specifications for Aluminum Structures
13. ASTM A572/A572M-94C – Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14. ASTM A36 – Standard Specification for Carbon Structural Steel
15. ASTM A489 – Standard Specification for Eyebolts
16. ASTM A563 – Standard Specifications for Carbon and Alloy Steel Nuts
17. ASTM D1785 – Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
18. ASTM E488 – Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
19. ASTM F436 – Standard Specification for Hardened Steel Washers
20. ASTM F467 – Standard Specification for Nonferrous Nuts for General Use
21. ASTM F593 – Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
22. ASTM F594 – Standard Specification for Stainless Steel Nuts
23. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
24. ASTM F3125 – Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimension

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of North Carolina. Only required if design not shown on Contract Drawings.
 3. A current Evaluation Report shall be submitted for all anchors that will be considered for use on this project.
 4. Manufacturer's installation instructions.
 5. Copy of valid certification for each person who is to perform field welding.

6. Certified weld inspection reports, when required.
7. Welding procedures.
8. Installer qualifications.
9. Certification of Installer Training.
10. Inspection Reports.
11. Results of Anchor Proof Testing.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Evaluation Report: A current Evaluation Report from an independent testing and evaluation agency (ITEA) shall be submitted for all anchors that will be used on this project. The ITEA producing the evaluation report shall be accredited in accordance with the requirements for ITEA's in ACI 355.2 (for mechanical anchors) or 355.4 (for adhesive anchors). Acceptable ITEA's include but are not necessarily limited to the International Code Council Evaluation Service (ICC-ES) and the International Association of Plumbing and Mechanical Officials Uniform Evaluation Service (IAPMO-UES).
- C. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Concrete adhesive anchor installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- D. Installer Training: For concrete anchors, 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 to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Concrete adhesive anchor preparation and installation.
 5. Proof loading/torquing.
 6. Provide a list of names of all installers who are trained by the Manufacturer's Field Representative on this jobsite prior to installation of products. Record must include

the installer name, date of training, products included in the training and trainer name and contact information

7. Provide a copy of the current ACI/CRSI "Adhesive Anchor Installer" certification cards for all installers who will be installing adhesive anchors in the horizontal to vertically overhead orientation.
- E. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- F. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04.
- G. The Owner may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the Owner.
- H. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.
- I. Inspections of the adhesive dowel system shall be made by the Engineer or other representatives of the Owner in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 – PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. Anchor rods shall conform to ASTM F1554 Grade 55 except where stainless steel or other approved anchor rods are shown on the Drawings. Anchor rods shall have hexagonal heads and shall be supplied with hexagonal nuts meeting the requirements of ASTM A563 Grade A. Washers shall meet the requirements of ASTM A436.
- B. All anchors into concrete shall be cast-in-place anchors unless specifically referenced otherwise on Drawings.
- C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized in accordance with ASTM F1554.

- D. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 40 PVC plastic piping meeting the requirements of ASTM D1785.

2.02 HIGH STRENGTH BOLTS

- A. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125, Grade A325 Type 1 or Grade F1852 Type 1. Bolts, nuts and washers shall meet the requirements of RCSC Specification for Structural Joints Using High Strength Bolts”.
- B. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

2.03 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593 Grade A325 or F1852. All fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel unless noted otherwise. Fasteners for aluminum and stainless-steel members not subject to the above conditions shall be Type 304 stainless steel unless otherwise noted.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

2.04 CONCRETE ANCHORS

A. General

- 1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:
 - a. Mechanical anchors include any of the following anchors:
 - i. Expansion anchors shall be mechanical anchors of the wedge, sleeve, or drop-in type that are set by expanding against the sides of the drilled hole.
 - ii. Screw anchors are mechanical anchors that derive tensile holding strength by the mechanical interlock provided by threads cutting into the concrete during installation. Screw anchors shall be one piece, heavy duty screw anchors with a finished head.

- b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.
2. Mechanical anchors shall not be used to hang items from above or in any other situations where direct tension forces are induced in anchor.
3. Mechanical anchors shall not be used in exterior locations or any other locations subjected to water intrusion and freezing.
4. Unless otherwise noted, all concrete anchors which are submerged or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
5. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC 308. Mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.
6. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.
7. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.

B. Concrete Anchor Design:

An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.

- a. The Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State or Commonwealth in which the project is located. Anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Chapter 17.
- b. Embedment Depth

- a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. If the contractor submits one of the other concrete adhesive anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.
- b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).
- c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

C. Anchors:

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Power-Stud+SD1" or "Power-Stud+ SD-2" by DeWalt.
- b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" or "Stainless Steel Titen HD" by Simpson Strong-Tie Co., or "Screw-Bolt+" by DeWalt. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
- c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by DeWalt.
- d. Shallow Embedment Internally Threaded Insert (3/4" max embedment): "Mini-Undercut +Anchor" by DeWalt, "HSC-A" by Hilti, Inc. or approved equal.
- e. Mechanical anchor systems shall comply with ACI 355.2 or alternatively the latest revision of AC 193, and shall have a valid evaluation report in accordance with the applicable building code.

2. Adhesive Anchors:

- a. Adhesive anchors shall be "HIT HY-200 Adhesive Anchoring System" by Hilti, Inc., "SET-3G Epoxy Adhesive Anchors" by Simpson Strong-Tie Co., or "Pure 110+ Epoxy Adhesive Anchor System" by DeWalt.
- b. Adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Adhesive anchor systems shall comply with ACI 355.4 or alternatively the latest revision of AC308, and shall have a valid evaluation report in accordance with the applicable building code. No or equal products will be considered unless prequalified and approved by the Engineer and Owner.

D. Concrete Anchor Materials:

1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (f_y) less than 58 ksi nor an ultimate strength (f_u) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.05 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.06 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.07 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.08 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be C5-A Anti-Seize by Loctite Corporation, Molykote P-37 Anti-Seize Paste by Dow Corning, 3M Anti-Seize by 3M, or equal.

PART 3 – EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

A. Anchor Rods, Concrete Anchors, and Masonry Anchors

1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.
2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.
4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with RCSC "Specification for Structural Joints Using High Strength Bolts". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.
2. Concrete Anchor Testing:
 - a. At all locations, at least 25 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one

tested anchor per anchor group. If no test value is indicated on the Drawings, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.

- b. Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Proof testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.
 - c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State or Commonwealth in which the project is located. The Contractor's Engineer shall also submit documentation indicating the Contractor's proof testing procedures have been reviewed and the proposed procedures are acceptable. Proof testing procedures shall be in accordance with ASTM E488.
 - d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.
 - e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all proof testing, including additional testing required due to previously failed tests.
3. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.
 4. All holes shall be drilled in accordance with the manufacturer's instructions except that cored holes shall not be allowed unless specifically approved by the Engineer. If cored holes are allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with the manufacturer's instructions prior to installation of adhesive and threaded rod unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer. . Injection of

adhesive into the hole shall be performed to minimize the formation of air pockets in accordance with the manufacturer's instructions. Wipe rod free from oil that may be present from shipping or handling.

5. All adhesive anchor installations in the horizontal to vertically overhead orientation shall be conducted by a certified Adhesive Anchor Installer as certified by ACI/CSRI per ACI 318-14 17.8.2.2. Current AAI Certificate must be submitted to the Engineer of Record prior to commencement of any adhesive anchor installations.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal.
2. All stainless steel bolts shall be coated with antiseize lubricant.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
- C. Post-installed concrete anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION

SECTION 05061
STAINLESS STEEL

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. The Contractor shall furnish, install and erect the stainless steel work as shown on the Contract Drawings and specified herein.
- B. Stainless steel work shall be furnished complete with all accessories, mountings and appurtenances of the type of stainless steel and finish as specified or required for a satisfactory installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals
- B. Section 05010 – Metal Materials
- C. Section 05050 – Metal Fastening
- D. Section 05500 – Metal Fabrications

1.03 REFERENCES

- A. ASTM A193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- B. ASTM A194 – Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
- C. ASTM A262 – Practice for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steel
- D. ASTM A276 – Stainless and Heat-Resisting Steel Bars and Shapes
- E. ASTM A314 – Stainless and Heat-Resisting Steel Billets and Bars for Forging
- F. ASTM A380 – Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems
- G. ASTM A473 – Stainless and Heat-Resisting Steel Forgings
- H. ASTM A666 – Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar
- I. ASTM A774 – Stainless Steel Pipe Fittings

- J. ASTM A778 – Stainless Steel Pipe
- K. ASTM F593 – Stainless Steel Bolts, Hex Cap Screws and Studs
- L. ASTM F594 – Stainless Steel Nuts
- M. ANSI/ASME B1.1 – Unified Inch Screw Thread (UN and UNR Thread Form)

1.04 TESTS

- A. All stainless steel materials including stainless test welds, shall be checked for compliance with tests for susceptibility to intergranular attack. Such tests shall be Practices A, B and E of ASTM A262. Detailed procedures for the tests shall be submitted to the Engineer for approval prior to start of work. Practice A shall be used only for acceptance of materials but not for rejection of materials, and shall be used for screening material intended for testing in Practice B and Practice E. The maximum acceptable corrosion rate under Practice B shall be 0.004 inch per month, rounded off to the third decimal place. If the certified mill report indicates that such test has been satisfactory performed, the fabricator may not be required to repeat the test. Material passing Practice E shall be acceptable.
- B. Sample selection for the susceptibility to intergranular attack tests shall be as follows:
 - 1. One (1) sample per heat treatment lot for plates and forgings;
 - 2. One (1) sample per each Welding Procedure Qualification regardless of the joint design;
 - 3. If tests indicate a reduction in corrosion resistance, welding procedure shall be adjusted or heat treatment determined as needed to restore required corrosion resistance.
 - 4. The samples so chosen shall have received all the post-weld heat treatments identical to the finished part.

1.05 SUBMITTALS

- A. The Contractor shall prepare and submit for approval shop drawings for all stainless steel fabrication in accordance with Section 01300 – Submittals.
- B. Submittals shall include, but not be limited to, the following:
 - 1. Certified test reports for susceptibility to intergranular attack.
 - 2. Affidavit of compliance with type of stainless steel shown on the Contract Drawings or specified herein.
 - 3. Certified weld inspection reports.

4. Cleaning and handling of stainless steel in accordance with Paragraph 3.04, Cleaning and Handling.

C. Samples of finish, on each type of stainless steel to be furnished, shall be submitted to the Engineer upon request.

1.06 QUALITY ASSURANCE

A. Shop inspections may be made by the Engineer. The Contractor shall give ample notice to the Engineer prior to the beginning of any stainless steel fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the works.

B. Inspectors shall have the authority to reject any materials or work which does not meet the requirements of the Contract Drawings or the Specifications.

C. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship.

1.07 HANDLING, STORAGE AND DELIVERY

A. Mechanical damage (e.g., scratches and gouges) to the stainless steel material shall not be permitted and is cause for rejection. Care shall be taken in the material handling since such mechanical damage will result in the passive oxide film being "punctured" leading to a possible lower resistance to the initiation of corrosion than the surrounding chemically-passivated surface.

B. Stainless steel plates and sheets shall be stored vertically in racks and not be dragged out of the racks or over one another. Racks shall be protected to prevent iron contamination.

C. Heavy stainless steel plates shall be carefully separated and chocked with wooden blocks so that the forks of a fork-lift could be inserted between plates without mechanically damaging the surface.

D. Stainless steel plates and sheets laid out for use shall be off the floor and be divided by wooden planks to prevent surface damage and to facilitate subsequent handling.

E. Plate clamps, if used, shall be used with care as the serrated faces can dig in, indent and gouge the surface.

F. Stainless steel fabrications shall be loaded in such a manner that they may be transported and unloaded without being overstressed, deformed or otherwise damaged.

G. Stainless steel fabrications and packaged materials shall be protected from corrosion and deterioration and shall be stored in a dry area. Materials stored outdoors shall be

supported above ground surfaces on wood runners and protected with approved effective and durable covers.

- H. Stainless steel fabrications shall not be placed in or on a structure in a manner that might cause distortion or damage to the fabrication. The Contractor shall repair or replace damaged stainless steel fabrications or materials as directed by the Engineer.

1.08 FIELD MEASUREMENTS

- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of the work.
- B. The Contractor shall review the Contract Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

PART 2 – PRODUCTS

2.01 MATERIALS AND FINISHES

- A. Stainless steel shall be Type 316. Minimum mechanical finish shall be No. 4 as stated in Table 2 unless otherwise noted on the Contract Drawings.
- B. The basic mill forms (sheet, strip, plate and bar) are classified by size as shown on Table 1. Tables 2, 3 and 4 identify finishes and conditions in which sheet, bar and plate are available.
- C. Tables 2, 3 and 4 show numbered finishes and conditions for sheet, bar and plate. While there are no specific designations for polished finishes on bar or plate, the sheet finish designations are used to describe the desired effect. This also applies to finishes on ornamental tubing.
- D. There are three standard finishes for strip, which are broadly described by the finishing operations employed:
 - 1. No. 1 Strip Finish
 - a. No. 1 strip finish is approximately the same as No. 2D Sheet Finish. It varies in appearance from dull gray matte to a fairly reflective surface, depending largely on alloy composition and amount of cold reduction.
 - 2. No. 2 Strip Finish is approximately the same as a No. 2B sheet finish. It is smoother, more reflective than No. 1, and likewise varies with alloy composition.
 - 3. Bright annealed finish is a highly reflective finish that is retained by final annealing in a controlled atmosphere furnace.

Table 1: Classification of Stainless Steel Product Form

Item	Description	Dimensions		
		Thickness	Width	Diameter or Size
Sheet	Coils and cut length:			
	Mill finishes Nos. 1, 2D and 2B	under 3/16"	24" and over all widths	-
	Polished finishes Nos. 3, 4, 6, 7 & 8			
Strip	Cold finished, coils or cut lengths:			
	Polished finishes Nos. 3, 4, 6,7 & 8	under 3/16"	under 24" all widths	-
Plate	Flat rolled or forged	3/16" and over	over 10"	-
Bar	Hot finished rounds, squares, octagons and hexagons	-	-	1/4" and over
	Hot finished flats	1/8" to 8" incl.	1/4" to 10" incl.	-
	Cold finished rounds, squares, octagons and hexagons	-	-	over 1/8"
	Cold finished flats	1/8" to 4-1/2"	3/8" to 4-1/2"	-
Wire	Cold finishes only: (in coil)			
	Round, square, octagon, hexagon and flat wire	under 3/16"	under 3/8"	-
Pipe & Tubing	Several different classifications, with differing specifications, are available.			
Extrusion	Not considered "standard" shapes. Currently limited in size to approximately 6-1/2" diameter or structurals.			

Table 2: Standard Mechanical Sheet Finishes

Unpolished or Rolled Finishes		Polished Finishes	
No. 1	A rough dull surface which results from hot rolling to the specified thickness followed by annealing and descaling.	No. 3	An intermediate polish surface obtained by finishing with a 100 grit abrasive. Generally used where a semi-finished polished surface is required. A No. 3 finish usually receives additional polishing during fabrication
No. 2D	A dull finish which results from cold rolling followed by annealing and descaling, and may perhaps get a final light roll pass through unpolished rolls. A 2D finish is used where appearance is of no concern.	No. 4	A polished surface obtained by finishing with a 120-150 mesh abrasive, following initial grinding with coarser abrasives. This is a general purpose bright finish with a visible "grain" which prevents mirror reflection.
No. 2B	A bright cold-rolled finish resulting in the same manner as No. 2D finish, except that the annealed and descaled sheet receives a final light roll pass through polished rolls. This is the general purpose cold-rolled finish that can be used as is, or as a preliminary step to polishing.	No. 6	A dull satin finish having lower reflectivity than No. 4 finish. It is produced by Tampico brushing the No. 4 finish in a medium of abrasive and oil. It is used for architectural applications and ornamentation where a high luster is undesirable, and to contrast with brighter finishes.
		No. 7	A high reflective finish that is obtained by buffing finely ground surfaces but not to the extent of completely removing the "grit" lines. It is used chiefly for architectural and ornamental purposes.
		No. 8	The most reflective surface, which is obtained by polishing with successively finer abrasives and buffing extensively until all grit lines from preliminary grinding operations are removed. It is used for applications such as mirrors and reflectors.

Table 3: Conditions and Finishes for Bar

Conditions	Surface Finishes ¹
Hot worked only	(a) Scale not removed (excluding spot conditioning) (b) Rough turned ² (c) Pickled or blast cleaned and pickled.
Annealed or otherwise heat treated	(a) Scale not removed (excluding spot conditioning) (b) Rough turned (c) Pickled or blast cleaned and pickled (d) Cold drawn or cold rolled (e) Centerless ground (f) Polished
Annealed and cold worked to high tensile strength ³	(a) Cold drawn or cold rolled (b) Centerless ground (c) Polished

Table 4: Conditions and Finishes for Plate

Condition and Finish	Description and Remarks
Hot rolled	Scale not removed. Not heat treated. Plates not recommended for final use in this condition. ⁴
Hot rolled, annealed or heat treated	Scale not removed. Use of plates in this condition is generally confined to heat resisting applications. Scale impairs corrosion resistance. ¹
Hot rolled, annealed or heat treated, blast cleaned or pickled	Condition and finish commonly preferred for corrosion resisting and most heat resisting applications.
Hot rolled, annealed, descaled and temper passed	Smoother finish for specialized applications.
Hot rolled, annealed, descaled cold rolled, annealed, descaled, optionally temper passed	Smooth finish with greater freedom from surface imperfection than the above.
Hot rolled, annealed or heat treated, surface cleaned and polished	Polished finishes refer to Table 2.

¹ Surface finishes (b), (e) and (f) are applicable to round bars only.

² Bars of the 4xx series stainless steels which are highly hardenable, such as Types 414, 420, 420F, 431, 440A, 440B and 440C, are annealed before rough turning. Other hardenable grades, such as Types 403, 410, 416 and 416Se, may also require annealing depending on their composition and size.

³ Produced in Types 302, 303Se, 304 and 316.

⁴ Surface inspection is not practicable on plates which have not been pickled or otherwise descaled.

PART 3 – EXECUTION

3.01 FABRICATION

- A. Holes for bolts and screws shall be drilled. Fastenings shall be concealed where practicable. Joints exposed to the weather shall be formed to exclude water.
- B. As far as practicable, all fabricated units shall be fitted and assembled in the shop, with all cuts and bends made to precision measurements in accordance with details shown on approved shop drawings.
- C. Work shall be fabricated so that it is installed in a manner that will provide for expansion and contraction, prevent the shearing of bolts, screws and other fastenings, ensure rigidity, and provide close fitting of sections.
- D. All finished and/or machined faces shall be true to line and level. Stainless steel sections shall be well formed to shape and size with sharp lines and angles; curved work shall be sprung evenly to curves.
- E. All work shall be fitted together at the shop as far as possible, and delivered complete and ready for erection. Proper care shall be exercised in handling all work so as not to injure the finished surfaces.

3.02 WELDING

- A. Welding shall be done in a manner that will prevent buckling and in accordance with Section 05050 – Metal Fastening, and as modified hereinafter.
- B. All welds exposed in the work shall be ground smooth and finished to match the finish of the adjacent stainless steel surfaces.
- C. Select weld rods that provide weld filler metal having corrosion resistant properties as nearly identical or better than the base metal to insure preservation of the corrosion-resistant properties. Provide heat treatment at welds where testing of weld procedure indicates it is required to restore the corrosion resistance.
- D. Thermal conductivity of stainless steel is about half that of other steels; and the following methods may be used to accommodate this situation:
 - 1. Use lower weld current setting.
 - 2. Use skip-weld techniques to minimize heat concentration.
 - 3. Use back-up chill bars or other cooling techniques to dissipate heat.
- E. Edges of the stainless steel to be welded shall be cleaned of contaminants.

3.03 FASTENERS

- A. Stainless steel fasteners shall be used for joining stainless steel work.
- B. Stainless steel fasteners shall be made of alloys that are equal to or more corrosion resistant than the materials they join.

3.04 CLEANING AND HANDLING

- A. All stainless steel surfaces shall be precleaned, descaled, passivated and inspected before, during and after fabrication in accordance with the applicable sections of ASTM A380 and as detailed in the procedures to be submitted to the Engineer for approval prior to start of work. Degreasing and passivation of stainless steel articles shall be conducted as the last step after fabrication.
- B. Measures to protect cleaned surfaces shall be taken as soon as final cleaning is completed and shall be maintained during all subsequent handling, storage and shipping.
 - 1. The Contractor shall submit for approval specific procedures listing all the steps to be followed in detecting contamination and in descaling, cleaning, passivation and protecting of all stainless steel.
 - 2. Area showing clear indications of contamination shall be recleaned, repassivated and reinspected.
- C. At approved stages in the shop operations, contaminants such as scale, embedded iron, rust, dirt, oil, grease and any other foreign matter shall be removed from the metal, as directed or approved by the Engineer. The adequacy of these operations shall be checked by the Engineer. Operations in the shop shall be conducted so as to avoid contamination of the stainless steel and to keep the metal surfaces free from dirt and foreign matter.
- D. In order to prevent incipient corrosion during fabrication, special efforts shall be made at all times to keep all stainless steel surfaces from coming in contact with other metals.
 - 1. Stainless steel and stainless steel welds shall be cleaned with clean sand free of iron, stainless steel wool, stainless steel brushes, or other approved means and shall be protected at all times from contamination by any materials, including carbon steel, that shall impair its resistance to corrosion.
 - 2. Approved methods of cutting, grinding and handling shall be used to prevent contamination. If air-arc, or carbon-arc cutting is used, additional metal shall be removed by approved mechanical means so as to provide clean, weldable edges. All grinding of stainless steel shall be performed with aluminum oxide or silicon carbide grinding wheels bonded with resin or rubber. Grinding wheels used on carbon steel shall not be used on stainless steel.

3. Sand, grinding wheels, brushes and other materials used for cleaning stainless steel shall be checked periodically by the Engineer for contaminants. Cleaning aids found to contain contaminants shall not be used on the work.

3.05 INSTALLATION

- A. All stainless steel fabrications shall be erected square, plumb and true, accurately fitted, adequately anchored in place, set at proper elevations and positions.
- B. All inserts, anchor rods and all other miscellaneous work specified in the Detailed Specifications or shown on the Contract Drawings or required for the proper completion of the work, which are embedded in concrete, shall be properly set and securely held in position in the forms before the concrete is placed.
- C. All stainless steel fabrications shall be installed in conformance with details shown on the Contract Drawings or on the approved shop drawings.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 – GENERAL

1.01 REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.
- B. Work shall include but may not be limited to guard posts.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05050 – Metal Fastening
- C. Section 05035 – Galvanizing
- D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. North Carolina Building Code
 - 2. AISC – Specification for Structural Steel Buildings
 - 3. AISI – Specifications for the Design of Cold-Formed Steel Structural Members
 - 4. Aluminum Association Specifications for Aluminum Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Complete fabrication and erection drawings of all metalwork specified herein.
 - 2. Other submittals as required in accordance with Section 05010 – Metal Materials and Section 05050 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used in metal fabrications shall conform to Section 05010 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used in metal fabrication shall conform to Section 05050 – Metal Fastening, unless noted otherwise.

2.03 GUARD POSTS (BOLLARDS)

- A. Guard posts shall be 6-inch diameter Schedule 40 galvanized steel pipe in accordance with ASTM A53.
- B. Guard posts shall be concrete filled and crowned, as detailed in the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050 – Metal Fastening. All fastenings shall be concealed where practicable.
- G. Fabricated items shall be shop painted when specified in Section 09900 – Painting.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.
- C. Metal work shall be field painted when as specified in accordance with Section 09900 – Painting.

END OF SECTION

SECTION 05531
GRATINGS, CHECKERED FLOOR PLATES, AND ACCESS DOORS

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all gratings, floor plates, and access doors in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 – Galvanizing
- C. Section 05050 – Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. North Carolina Building Code
 - 2. Aluminum Association Specifications for Aluminum Structures
 - 3. Occupational Safety and Health Administration (OSHA) Regulations
 - 4. ANSI/NAAMM MBG 531 – NAAMM Metal Bar Grating Manual
 - 5. ASTM C1802 – Design, Testing, Manufacture, Selection, and Installation of Fabricated Metal Access Hatches for Utility, Water, and Wastewater Structures

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Complete fabrication and erection Drawings of all gratings, floor plates, and access doors specified herein.
 - 2. For checkered floor plates, structural calculations signed and sealed by a currently registered Professional Engineer in the State of North Carolina verifying the proposed floor plate meets the minimum load and deflection requirements stipulated herein.

3. For access doors provided by a manufacturer not specifically named herein, structural calculations signed and sealed by a Professional Engineer currently registered in the State of North Carolina verifying the proposed access door meets the minimum load and deflection requirements stipulated herein. For access doors provided by a named manufacturer, sealed calculations are not required provided the applicable ASTM C1802 load rating is clearly indicated in the submittal for each proposed product.
4. Other submittals as required in accordance with Section 05010 – Metal Materials, and Section 05050 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for gratings, floor plates, and access doors shall conform to Section 05010 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used for gratings, floor plates, and access doors shall conform to Section 05050 – Metal Fastening, unless noted otherwise.

2.03 GRATING

- A. General - Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation, shall be furnished as indicated on the Drawings.
 1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and material as the main bars, including ends at all cutouts.
 2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No fasteners shall be permitted to project above the walking surface.
 3. Grating shall be designed for a loading of 150 psf unless otherwise required by the Drawings. Grating deflection shall not exceed 1/4 inch under a uniform load of 100 psf. Minimum grating depth shall be 1-1/2 inches, unless structural requirements based on clear span require more depth.
 4. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall be extruded frames with continuous means of anchoring frames to concrete around entire perimeter of frame. Support frames shall be fabricated from the same material as the grating.

B. Aluminum Grating

1. Aluminum grating shall be of I-bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating attachment to frames and any other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.
2. Grating shall be "19-SI-4 I-Bar Swage Locked" by Alabama Metal Industries Corporation (AMICO), "IB" by Harsco Industrial IKG, "I-Bar 19SGI4", by Ohio Grating Inc., or "I-Bar" by Thompson Fabricating LLC.

C. Aluminum Plank Grating

1. Aluminum plank grating shall be unpunched planks of extruded aluminum welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. All support members shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.
2. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Heavy Duty Steel Grating

1. Heavy duty steel grating shall be galvanized according to Section 05035 – Galvanizing.
2. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating. Provide embedded galvanized steel support frames for cast-in-place concrete installations.
3. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.
4. Grating shall be manufactured by Harsco Industrial IKG, Alabama Metal Industries Corporation (AMICO), and Ohio Gratings, Inc.

2.04 CHECKERED FLOOR PLATES

- A. Floor plates shall meet the requirements of ASTM C1802 for Load Level 1 – Light Pedestrian Load, minimum, unless otherwise indicated on the Drawing.
- B. Floor plates shall be aluminum unless noted otherwise.

- C. All floor plates shall be checkered plate with an approved raised pattern, non-skid surface.
- D. Openings greater than 42 inches in either direction shall require two plates opening via hinges in opposite directions.
- E. Floor plates shall be designed to carry a minimum service level live load of 150 psf, or a concentrated load of 300 pounds applied over a 5.50 inch by 5.50 inch area, whichever produces the greatest stress, unless indicated otherwise on the Drawings. Loading shall be positioned to produce the greatest stresses, both due to maximum moment and maximum shear load conditions.
- F. All components of checkered floor plates shall have a minimum tensile yield strength of 23,000 psi and a minimum compressive yield strength of 21,000 psi. Yield strengths shall be indicated on both the structural calculations and the fabrication drawings.
- G. Live load deflection shall be limited to $L/200$ of the span, but no greater than 3/16 inch.
- H. All checkered floor plates shall be fabricated from 1/4" plate, minimum and shall be stiffened as required to maintain allowable stress and deflection requirements specified herein.
- I. Stiffeners shall consist of angles or bars welded to the bottom of the plate.
- J. Checkered floor plate hinges shall be either stainless steel or aluminum with stainless steel pins and fasteners.
- K. All checkered floor plates shall be provided with recessed handles. Handle material shall be as shown on the Contract Drawings.
- L. Air-tight and water-tight checkered floor plates shall be provided with a 1/8-inch-thick neoprene gasket between the checkered plate and the support frame. Gasket material shall be bonded to the support frame and checkered floor plates shall be bolted to the structural support frame with countersunk stainless-steel flathead screws.
- M. All floor plates shall be clearly marked with the information listed below. Markings shall be indicated on metal or plastic tags permanently attached to the floor plate or frame or shall be permanently painted or printed.
 - 1. The manufacturer's name or trademark, location, and telephone contact number.
 - 2. The manufacturer's model number and ASTM designation.
 - 3. The design load level as indicated in ASTM C1802. If the design requires deviation from the Load Level requirements specified in ASTM C1802, a description of the modifications shall be included.
 - 4. Date of manufacture and/or serial number.

2.05 ACCESS DOORS

A. General

1. Door opening sizes, number and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings shall indicate the clear opening dimensions.
2. All doors shall be aluminum unless otherwise noted.
3. All door components shall have a minimum tensile yield strength of 23,000 psi and a minimum compressive yield strength of 21,000 psi. Yield strengths shall be indicated on both the structural calculations and the fabrication drawings.
4. Openings larger than 42 inches in either direction shall have double leaf doors.
5. Doors shall be designed for flush mounting and for easy opening from both inside and outside.
6. All doors shall be provided with an automatic hold-open arm with release handle.
7. Double leaf doors shall be provided with safety bars to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.
8. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be stainless steel.
9. All doors specifically required to be watertight shall be installed with a continuous gasket.
10. Access door frames with integral gutter systems shall be equipped with a 1-1/2 inch minimum drain pipe located by the manufacturer. The drain pipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.
11. All doors shall be clearly marked with the information listed below. Markings shall be indicated on metal or plastic tags permanently attached to the door or frame or shall be permanently painted or printed.
 - a. The manufacturer's name or trademark, location, and telephone contact number.
 - b. The manufacturer's model number and ASTM designation.
 - c. The design load level as indicated in ASTM C1802. If the design requires deviation from the Load Level requirements specified in ASTM C1802, a description of the modifications shall be included.

- d. The nominal door opening dimensions and/or the manufacturer's model number.
- e. Date of manufacture and/or serial number.

B. Floor, Wet Well and Dry Pit Access Doors

1. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.
2. Doors shall be designed for flush mounting and for easy opening from both inside and outside
3. All doors shall have an enclosed compression spring assist and open to 90 degrees.
4. Doors not required to support traffic loading shall meet the requirements of ASTM C1802 for Load Level 2 – Pedestrian Load as a minimum and the following:
 - a. Doors shall be designed to carry a minimum service level live load of 300 psf or a concentrated load of 600 pounds applied over a 5.50 inch by 5.50 inch area, whichever produces the greatest stress, unless indicated otherwise on the Drawings. Loading shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.
 - b. Live load deflection shall be limited to L/200 of the span, but not greater than 3/16 inch.
 - c. Unless otherwise noted, exterior doors shall have an integral gutter system and be Type "FDDP" by Nystrom, Type "W1S" or "W2S" by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., or Type "THG" or "THG-D", by Thompson Fabricating LLC, or Type "J-AL" or "JD_AL" by the Bilco Company.
 - d. Unless otherwise noted, interior doors shall be Type "FDNP" by Nystrom, Type "S1S" or "S2S" by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., or Type "TH" or "TH-D", by Thompson Fabricating LLC.
5. Doors required to support traffic loadings shall meet the requirements of ASTM C1802 for Load Level 4 – Occasional Truck Traffic, unless otherwise indicated on the Drawings.
 - a. For openings less than or equal to 48 inches, the design loading shall consist of a service level 16,000 pound load applied over a 10 inch by 20

inch area with traffic both parallel and perpendicular to the span considered. Loadings shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.

- b. For openings greater than 48 inches, two load cases shall be considered. Load Case 1 shall consist of two service level 16,000 pound loads spaced at 48 inches on center with each load applied over a 10 inch by 20 inch area and assuming the traffic direction is perpendicular to the span of the door. Load Case 2 shall consist of two service level 12,500 pound loads spaced at 48 inches on center with each load applied over a 10 inch by 20 inch area and assuming the traffic direction is parallel to the span of the door. Loadings for both cases shall be positioned to produce the maximum stresses, both due to maximum moment and maximum shear load conditions.
- c. Live load deflections shall be limited to $L/250$ of the span, but not greater than $3/16$ inch, and shall be determined based off a service level 16,000 pound load.
- d. Unless otherwise noted, doors rated for H-20 traffic loading shall have an integral gutter system and be Type "FDDH" by Nystrom, Type "H1C" or "H2C" by Halliday Products, Inc., Type "THS" or "THD" by U.S.F. Fabrication Inc., Type "THG-H20" by Thompson Fabricating LLC, or "Type JAL-H20" or "JDAL-H20" by the Bilco Company.

C. Roof Access Doors

1. Doors shall be designed for 50 psf live load unless noted otherwise.
2. Doors for service stairs shall be Bilco Type L roof Scuttles.
3. Doors for ladder access shall be Bilco Type S or SS Roof Scuttles.

D. Fixed Ladders

1. Where the Contract Documents indicate fixed ladders are required under access doors, they shall be provided with "LadderUp, Model LU-4" by Bilco Company, "L1E Ladder Extension" by Halliday Products Inc., or "Ladder Climb-out Device" by Thompson Fabricating.
2. The safety posts shall be manufactured of the same material as the access door with telescoping tubular sections that lock automatically when fully extended.
3. Upward and downward movement shall be controlled by a stainless steel balancing mechanism.
4. Safety posts shall be assembled in strict accordance with manufacturer's recommendations.

2.06 FALL THROUGH PREVENTION SYSTEM

- A. All floor plates and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except where noted on the Contract Drawings. Floor plates and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum live load, unless noted otherwise.

PART 3 – EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05 05 23 – Metal Fastening. All fastenings shall be concealed where practicable.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All gratings, floor plates, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions. Embedded support frames shall be set level and square.
- C. Grating shall not be field cut or modified unless approved by Engineer.

D. Grating shall not be used for equipment support or anchorage.

END OF SECTION

SECTION 05540
CASTINGS

PART 1 – GENERAL

1.01 REQUIREMENT

- A. Furnish all materials, labor, and equipment required to provide all castings in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. North Carolina Building Code

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 – Submittals.
 - 1. Complete fabrication and erection drawings of all castings specified herein.
 - 2. Other submittals as required in accordance with Section 05010 – Metal Materials and Section 05050 – Metal Fastening.

PART 2 – PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for castings shall conform to Section 05010 – Metal Materials, unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used for castings shall conform to Section 05050 – Metal Fastening, unless noted otherwise.

041310

2.03 IRON CASTINGS

- A. General - Iron Castings shall include, but not be limited to frames, covers, and grates for trench drains, catch basins, and inlets/.
 - 1. Castings shall be of gray iron of uniform quality, free from defects, smooth and well cleaned by shotblasting.
 - 2. Catalog numbers on the Drawings are provided only to show required types and configuration. All covers shall be cast with raised letters as designated on the Drawings.
 - 3. Castings shall be as manufactured by Dewey Brothers, or Neenah Foundry Company.
- B. Covers and Grates
 - 1. Covers and grates shall be provided with matching frames. Cover shall fit flush with the surrounding finished surface. The cover shall not rock or rattle when loading is applied.
 - 2. Round covers and frames shall have machined bearing surfaces.
 - 3. Design loadings:
 - a. Where located within a structure, a minimum design loading of 300 psf shall be used, unless noted otherwise.
 - b. At all locations not within a structure, the design loading shall be a standard AASHTO H-20 truck loading, unless otherwise noted.
- C. Watertight gasketing, bolting, locking devices, patterns, lettering, pickholes, vents, or self-sealing features shall be as detailed on the Drawings.

PART 3 – EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.

- C. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All castings shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.

END OF SECTION

SECTION 07900
JOINT FILLERS, SEALANTS AND CAULKING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for the complete execution of Work shown on the Drawings and specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03250 – Concrete Accessories
- B. Section 03290 – Joints in Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.

- 1. ASTM C-920 – Elastomeric Joint Sealants
- 2. ASTM D-1056 – Flexible Cellular Materials – Sponge or Expanded Rubber
- 3. SWRI – Sealant and Caulking Guide Specification

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
 - 1. Manufacturers literature and installation instructions. Label each product submitted with Type as indicated in paragraph 2.01 A.
 - 2. Color samples of each type of sealant.

1.05 QUALITY ASSURANCE

- A. Applicator shall be a company specializing in the installation of sealants with a minimum of five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened labeled packages.

- B. Store materials in location protected from freezing or damages.
- C. Reject and remove from the site materials within broken or damaged packaging.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Sealants

1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or Sonolastic NP-2, Sonneborn, or DynaTrol II by Pecora Corporation.
 2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation, DynaTrol 1-XL by Pecora Corporation, or Sonolastic NP-1 by BASF Construction Chemicals.
 3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, Sonolastic Omni Seal by BASF Construction Chemicals.
 4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, Sonolastic Omni Plus by BASF Construction Chemicals.
 5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, Sonneborn Sonolac by BASF Construction Chemicals.
 6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or equal.
 7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Deck-O-Seal by W.R. Meadows, Tammsflex by DuraJoint Concrete Accessories, or Synthacalk GC2+ by Pecora Corporation.
 8. Type 8: Nonsag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation, Sonolastic Ultra by BASF Construction Chemicals.
- B. Primer: Non-staining primer recommended by sealant manufacturer for the substrates on this project.

- C. Backer Rod: Closed cell foam, nonreactive with caulking materials, non-oily, and approved by the sealant manufacturer. Minimum density shall be 2.00 pounds per cubic foot. Use no asphalt or bitumen-impregnated fiber with sealants.
- D. Joint Cleaner: Recommended by sealant or caulking compound manufacturer.
- E. Bond breaker: Either polyethylene film or plastic tape as recommended by the sealant manufacturer.
- F. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 – EXECUTION

3.01 QUALITY CONTROL

- A. Coordinate work with details shown on approved shop drawings prepared by other trades.
- B. Verify conditions in the field.
- C. Schedule work to follow closely the installation of other trades.
- D. Apply sealants and related items in temperatures and dry conditions recommended by the manufacturers.
- E. Do not paint sealant, unless recommended by sealant and paint manufacturer.

3.02 PREPARATION

- A. Protect finished surfaces adjoining by using masking tape or other suitable materials.
- B. Clean and prime joints before starting any caulking or sealing work.
- C. Thoroughly clean joints and spaces of mortar and other foreign materials. Cleaning agent shall be Xylol or similar non-contaminating solvent to remove any film from metal surfaces. Masonry or concrete surfaces shall be brushed or air jet cleaned.
- D. Joint Requirements
 - 1. All joints and spaces to be sealed in exterior work shall be less than 1/2-inch deep and not less than 1/4 inch wide. If joints in masonry are less than that specified herein, the mortar shall be cut out to the required width and depth. All joints and spaces to receive sealant shall be completely prepared and thoroughly dry before installation of sealant.
 - 2. Unless otherwise specified, joints and spaces which are open to a depth of 1/2 inch or greater shall be solidly filled with back-up material to within 1/4 inch of the

surface. Back-up material shall be packed tightly and made continuous throughout the length of the joints. Bond breaker shall be applied as required. If joints are less than ¼-inch deep, the back-up material may be omitted, a bond breaker substituted and the joint completely filled with sealant. The back-up material shall not project beyond the ¼-inch depth of the open space in any joint. The following width-to-depth ratio table shall be adhered to, unless otherwise recommended by manufacturer.

Joint Width	Sealant Depth	
	Minimum	Maximum
¼ inch	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 1 inch	1/2 inch	Equal to width
Over 1 inch to 2 inches	1/2 inch	1/2 of width

3.03 APPLICATION

- A. Exercise care before, during, and after installation so as not to damage any material by tearing or puncturing. All finished work shall be approved before covering with any other material or construction.
- B. Apply sealant by an approved type of gun except where the use of a gun is not practicable, suitable hand tools shall be used. Avoid applying the compound to any surface outside of the joints or spaces to be sealed. Mask areas where required to prevent overlapping of sealant.
- C. All joints shall be waterproof and weathertight.
- D. Point sealed joints to make a slightly concave joint, the edges of which are flush with the surrounding surfaces. Exposed joints in the interior side of the door and other frames shall be neatly pointed flush or to match adjacent jointing work.
- E. Adjacent materials which have been soiled shall be cleaned immediately and the work left in neat and clean condition.
- F. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.04 ADJUSTMENT AND CLEANING

- A. Remove misplaced sealant compounds promptly using methods and materials recommended by the manufacturer, as the work progresses.

- B. Allow sealants to cure and remove protective edging, of doors, louvers, saddles windows etc. as directed by the Engineer.

3.05 SCHEDULE

Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal expansion and construction joints in concrete structures unless noted otherwise herein or on Drawings.	Type 1	To closely match adjacent surfaces or mortar and as selected by the Owner.
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the Owner.

¹ Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.

² Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07 84 00.

³ Sealants which will come in contact with potable water shall meet the requirements of NSF 61.

⁴ Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

END OF SECTION

SECTION 09801
MIC COATING SYSTEM

PART 1 – GENERAL

1.01 THE REQUIREMENTS

- A. Furnish and install special coating systems in accordance with the Contract Documents.
- B. MIC Coating System
 - 1. Install Microbiologically Influenced Corrosion (MIC) coating system on the interior of all cast-in-place concrete for the Dropshaft Structure and the Weir Structures (Junction Structures 1 and 2).

1.02 NOT USED

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these Specifications the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC-SP13/NACE No. 6 Surface Preparation of Concrete
 - 2. NACE National Association of Corrosion Engineers
 - 3. SSPC The Society of Protective Coatings
 - 4. ASTM American Society of Testing and Materials
 - 5. ICRI International Concrete Repair Institute

1.04 SUBMITTALS

- A. Shop Drawings including the following items shall be submitted in accordance with Section 01300.
 - 1. Manufacturer's product data and material safety data sheets for each coating product provided. Include manufacturer's color chart for each product supplied.
 - 2. Manufacturer's installation instructions and recommendations specific to environmental conditions, surface preparation, substrate conditions, and application procedures.
 - 3. Complete shop drawings including location and details for all terminations, transitions and cant coves.
 - 4. Manufacturer's instructions and recommendations for repair of holidays or other coating issues.

5. Certifications:
 - a. Furnish affidavits from the manufacturer certifying that materials furnished conform to the requirements specified.
 - b. Certify concrete repair and coating products have been checked for compatibility.
 - c. Certification from manufacturer stating the applicator and applicator's assigned personnel are certified and have received specific training for the application of the MIC coating system.
 - d. Certificate from applicator stating the assigned personnel have received specific training for the application of the MIC coating system.
 - e. Submit manufacturer's representative or independent inspector's NACE or SSPC certification.
6. Submit manufacturer's representative name, address and telephone number who will inspect work.
7. Provide list of at least 10 applications in high H2S environments in Southeast States including contact names, address, phone numbers and date of installation for both the coating system and the applicator.
8. Field Data Records and Installation Reports.
9. Product Warranty.
10. Closeout Submittals:
 - a. As-built drawings which include coating application limits, transitions, and terminations.
 - b. Photos
 - c. Quality assurance records, field data records and installation reports
 - d. Certificate of Surface Preparation
 - e. Test and evaluation reports including pull-off strength (adhesion) and spark testing.
 - f. Final Report
 - g. Final Certified Warranty

1.05 QUALIFICATIONS

- A. Products shall be manufactured by company specializing in manufacturing the products specified in this section with a minimum of five continuous years of experience for performance in similar applications in wastewater treatment plants and wastewater collection systems.

- B. The Contractor performing the work shall be fully qualified, experienced and equipped to complete this work expeditiously and in a satisfactory manner and shall be an approved installer of the coating system as certified and licensed by the manufacturer. The Contractor shall have successfully installed a minimum of 50,000 square feet of the proposed system and shall have a minimum of five (5) years service for applying the selected lining or coating system as documented by verifiable references. There shall be no exceptions to this experience requirement. The Contractor shall submit the following information to the Engineer for review and approval before any work is performed. The following information is required.
 - 1. The number of years of experience in performing this type of specialized work and in installing the specified coating system.
 - 2. Name of the manufacturer and supplier for this work and previous work listed below.
 - 3. A list of municipal clients that the Contractor has performed this type of work including names, phone numbers, and square feet of material installed.
 - 4. The Contractor shall submit a certified statement from the manufacturer that he/she is a certified and/or licensed installer of the coating.

1.06 QUALITY ASSURANCE

- A. The supplier shall be responsible for the provisions of all test requirements specified in the referenced ASTM Standards as applicable. The supplier shall also bear the cost of all tests specified in Paragraph 3.05, Field Testing and Acceptance of MIC Coating System. In addition, all coating products to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all products and materials approved for this Contract shall be borne by the Owner.
- B. Inspections of the coating products and materials may also be made by the Engineer or other representatives of the Owner after delivery. The products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Materials rejected after delivery shall be marked for identification and shall be removed from the job at once.
 - 1. Provide adequate time and access for inspections for the following major activities:
 - a. Pre-surface preparation
 - b. Monitoring of surface preparation
 - c. Post-surface preparation
 - d. Monitoring of repair and resurfacing product application
 - e. Post repair and resurfacing products
 - f. Monitoring of coating application

- g. Post application inspection and testing
- h. Corrective actions and final inspection

C. Pre-installation Meeting

1. At least two weeks prior to beginning work, the Contractor shall conduct a Pre-installation Meeting to discuss coating procedures and submittals. Attendees shall include the Coating Applicator, Owner, Engineer, Manufacturer's Technical Representative, Testing and Inspection Agencies (if applicable), Concrete Repair subcontractor (if applicable) and the Contractor. The minimum agenda includes:
 - a. Environmental condition requirements
 - b. Surface temperature requirements
 - c. Surface pH requirements
 - d. Surface preparation procedures
 - e. Cleaning procedures
 - f. Testing procedures to determine moisture content of concrete
 - g. Proper procedures to fill substrate
 - h. Application equipment
 - i. Proper application of primer
 - j. Proper application of coating system
 - k. Proper termination, transition and cant cove details
 - l. Coating application at concrete control joints and expansion joints
 - m. Inspection of coating during and after application
 - n. Testing of coating.
 - o. Repair methods
 - p. Documentation requirements
 - q. Approval Procedures

D. Field Data Records

1. Maintain daily Quality Assurance Records including the following:
 - a. Date
 - b. Atmospheric Temperature and Humidity
 - c. Substrate pH

- d. Substrate Temperature
- e. Dew Point
- f. Product Batch Numbers
- g. Mixing Time for Each Part and the Combined Parts of a Coating System
- h. Pot Life
- i. Curing Time of Primer and Finish Layers
- j. Holiday Test Results and Repair Data
- k. Foreman or Supervisor's Signature

1.07 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Provide the services of a qualified manufacturer's technical representative who shall adequately supervise the surface preparation and application of the coating and lining products. The manufacturer's representative shall be available to evaluate the coating at each step through the process and shall supervise the lining or coating application until the installer has shown through the proper surface preparation and application of the lining or coating that the system will be installed in accordance with all manufacturer recommendations. ICRI Concrete Surface Profile Sample Chips shall be used for evaluation of concrete surface profiles and cleaning. SSPC VIS Guides shall be used for evaluation of metal surface profiles and cleaning. Contractor shall provide sample chips and guides on site during evaluation of surface preparation.
- B. Manufacturer's technical representative or authorized inspector shall be currently certified by NACE or SSPC.
- C. A manufacturer's technical representative shall observe the application of the complete system a minimum of two days at the beginning of the application at each structure specified to receive MIC coating system. The manufacturer's technical representative shall provide guidance to ensure proper application of the system.
- D. The manufacturer's technical representative shall submit to the Engineer a final report, at the completion of the work, identifying the products used, verifying and certifying that surfaces and lining systems were properly applied, free of pinholes, blisters and other blemishes that will compromise the coating performance and that the coating systems were proper for the exposure and surface. Discrepancies that are found during the final inspection shall be repaired and reinspected until system is completely satisfactory.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Care shall be taken in shipping, handling and placing to avoid damaging the products. Extra care may be necessary during cold weather construction. Any product or material damaged in shipment shall be replaced as directed by the Engineer.
- B. Products shall be delivered to the site in clearly labeled containers and packaging. While stored, the products shall be adequately packaged and protected. Products shall be stored in a manner as recommended by manufacturer.

- C. Any product showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

1.09 WARRANTY

- A. All lining and coatings installed shall be guaranteed by the Contractor for a period of two years from the date of final acceptance. During this period, all defects discovered in the coating, as determined by the Owner or Owner's Engineer shall be repaired or replaced in a satisfactory manner by the Contractor at no cost to the Owner.
- B. The Contractor is responsible for properly preparing the structures for coating prior to the installation of the systems, including stopping all leaks, patching voids, protecting or removing and handling all mechanical equipment such as valves and valve assemblies and weirs, cleaning surfaces, removing rubble, etc.

PART 2 – PRODUCTS

2.01 PRIMER

- A. Primer shall be moisture tolerant, suitable for the environmental conditions, and compatible with the MIC coating. Primer shall be conductive for purposes of holiday testing, shall meet the requirements of NFPA 99/ASTM F150 and shall comply with the requirements for conductive underlayments in ASTM D4787, Standard Practice for Continuity Verification of Liquid or Sheet Linings applied to Concrete Surfaces. Primer shall be as recommended and preferably manufactured by the manufacturer of the MIC Coating System.
- B. Primer shall be as recommended by the coating manufacturer to achieve a superior coating system performance. Manufacturer shall select primer based on substrate moisture, environmental conditions and humidity, substrate temperature, pH, and other properties.

2.02 MIC COATING SYSTEM

- A. Provide MIC Coating System on surfaces indicated to receive MIC Coatings in this specification and on drawings. MIC Coating System is to be applied only by Factory Trained and Certified Applicators.
- B. The MIC Coating shall be one of the following amine based epoxy mortar systems:
 - 1. Tnemec Series 217 Mortarcrete resurfacer over properly prepared concrete surface profile followed by manufacturer's recommended primer and Tnemec Series 434 Perma-Shield H2S aggregate reinforced mortar coat at 80 to 90 mils DFT. Apply a top coat of Tnemec Series 435 Perma-Glaze at 20 to 30 mils DFT over Series 434 mortar coat.
 - 2. A.W. Cook Silatec MSM resurfacer over properly prepared concrete surface profile followed by manufacturer's recommended primer and Sherwin-Williams Duraplate 5900 aggregate reinforced mortar coat at 80 to 90 mils DFT. Apply a top coat of unreinforced Duraplate 5900 at 20 to 30 mils DFT.

3. A.W. Cook Silatec MSM resurfacer over properly prepared concrete surface profile followed by manufacturer's recommended primer and Stonhard Stonchem 510 aggregate reinforced mortar coat at 80 to 90 mils DFT. Apply a top coat of unreinforced Stonchem 510 at 20 to 30 mils DFT.
- C. The MIC Coating shall be applied in a minimum of two (2) coats as noted above for a total DFT of 100 to 120 mils, not including resurfacer thickness. In addition to MIC Coating, fill bugholes, depressions, and irregularities in surfaces with any dimension greater than 0.0625 inch with epoxy filler recommended by manufacturer and apply primer at 10 mils recommended by manufacturer to achieve superior performance.
 - D. MIC Coating System shall meet the following minimum characteristics:
 1. Total Film Thickness of System including primers shall not be less than 100 mils (unless otherwise noted).
 2. Chemical Resistance of 10% of sulfuric acid.
 3. Water Vapor Permeance of 0.002 perms per ASTM E96, Method E.
 4. Concrete Tensile Pull Strength 350 psi ASTM D4541.
 5. Tensile Strength of 2,750 psi ASTM D412.
 6. Abrasion Resistance, CS17 Wheel <120mg loss, ASTM D4060, 1000 gm load/1000 cycles.
 7. Minimum Shore Hardness D50, ASTM D2240.
 8. Resistant to negative water infiltration.
 9. 100% solids epoxy mortar system containing aggregate and/or fiber reinforcement.

PART 3 – EXECUTION

3.01 PROTECTION OF IN-PLACE CONDITIONS

- A. Equipment, vehicles, buildings, and other finished items shall be protected from damage and overspray. Sensitive equipment shall be wrapped in plastic and tape.

3.02 SURFACE PREPARATION

- A. Surfaces to receive coating shall be clean and free of dirt, oil, grease, and other foreign materials.
- B. Concrete and masonry surfaces shall cure for 28 days minimum at 75° F prior to coating. Additional time at lower temperatures shall be provided if requested by Engineer or Coating Manufacturer to ensure proper application of coatings. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or

as required by the coating manufacturer. Moisture vapor transmission shall not exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.

- C. Concrete and spall repair materials shall be cured in accordance with concrete and spall repair materials manufacturer's printed cure time prior to coating with epoxy coatings.
- D. Test surfaces to ensure they are within requirements of the manufacturer. Do not begin coating work until moisture is within manufacturer's recommended range. Any leaks shall be repaired as all surfaces shall be free of visible moisture and floating water.
- E. All surface preparation of concrete shall be in accordance with NACE 6/SSPC-SP-13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Surface preparation of concrete shall be performed with an abrasive blast, shot blast, water jetting, or mechanical abrading to obtain a minimum ICRI-CSP 5 surface profile or profile as specified by the coating manufacturer. Remove all laitance, weak concrete, dirt, and other contaminants. Remove all fins, protrusions, and similar imperfections to allow a uniform surface after surface preparation. Under no circumstance shall surface preparation be less than manufacturer's recommendation to provide the best possible installation. Following completion of surface preparation, substrates to be coated shall be evaluated by manufacturer's representative based on ICRI Concrete Surface Profile Chips for concrete surfaces and SSPC Vis Guides for metal surfaces prior to application of coatings. In addition, moisture levels of concrete shall be tested and documented and within acceptable ranges prior to application of coating.
- F. Bugholes, depressions, and irregularities in surfaces with any dimension greater than 0.0625 inch shall be filled with epoxy filler recommended by manufacturer.
- G. Apply epoxy filler to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured epoxy filler as recommended by coating manufacturer for proper coating adhesion.
- H. To ease coating around outside corners, provide ¾-inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of ¾-inch.
- I. Unless recommended otherwise by the coating manufacturer, provide ¼" deep by ¼" wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.

- J. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.
- K. Where the surface deterioration is less than or equal to 1/2 inch (as measured from the final finished surface to the prepared surface to be repaired) skim coats of epoxy modified cementitious mortar shall be applied to restore and smooth surface irregularities to the final finished surface. Epoxy modified mortar system shall be manufactured by same manufacturer of MIC Coating System.
- L. Where the surface deterioration is greater than 1/2 inch the surface shall be repaired to final finished surface using Spall Repair Patching Material, in accordance with Section 03732. Surface material shall be applied in strict accordance with manufacturer's printed instructions and recommendations. Materials shall be cured a minimum of 10-days or as recommended by the repair material manufacturer for the site conditions. Manufacturer of MIC Coating System shall confirm proposed spall repair patching material is compatible with MIC Coating System.
- M. Where manufacturer requires additional surface preparation, to provide best possible installation, additional requirements shall be performed.
- N. Provided written certification on the coating manufacturer's letterhead, signed by an officer of the company that the surface preparation meets the requirements of the coating manufacturer.
- O. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07900.

3.03 PRIMER APPLICATION

- A. Apply tolerant conductive primer at 10 mils or as recommended by manufacturer to achieve superior performance. Test moisture and pH levels of concrete and document. Apply primer when surface is within acceptable ranges prior to application of primer.

3.04 MIC COATING APPLICATION

- A. All methods, procedures of mixing, application and curing of the coating material shall be accomplished in strict accordance with manufacturer's printed instructions and recommendations.
- B. Apply MIC Coating in a minimum of two coats in addition to primer and filler. Apply MIC coating in a minimum of two (2) coats for a total DFT of 100 to 120 mils in strict accordance with manufacturer's printed instructions and recommendations. Thinning of coating material is prohibited unless written manufacturer approval with project specific directions is provided and approved by Engineer.
- C. Application shall be by certified and experienced personnel only. Application of coating systems shall take place when surface temperature is at least 50°F. and at least 5°F [3°C] above dew point, and relative humidity is 85 percent or lower. Surface temperature shall stable or falling to ensure a minimal amount of out gassing by concrete. Coatings shall not be applied in direct sunlight or when the temperature of the concrete is rising. Use

dehumidification units, fans or other means to provide an adequate environment for application and cure when the environment is not adequate for application or cure.

- D. Application shall produce at a minimum a totally bonded coating, corrosion proof, free of blisters, pinholes and any and all blemishes that may be precursors to failure. Promptly correct or remove, and repair areas that fail visual inspection or testing. Recoat time between coats shall be documented and shall not exceed manufacturer's requirements. Where recoat times are exceeded the coating shall be prepared in strict accordance with manufacturer's recommendations including scarification to provide sufficient profile.

3.05 FIELD TESTING AND ACCEPTANCE OF MIC COATING

- A. Field acceptance of the MIC coating system shall be based on the Engineer's evaluation of the appropriate installation of each coat per field inspections, on observation of the measurements of the wet film thickness, and on the observation of spark testing and adhesion testing conducted on the cured liner.
- B. Pre-application testing shall be conducted by applying the MIC Coating at 20 mil thickness over a 5 square foot area where directed to demonstrate the coating application to the inspector(s).
- C. During application of each layer of the MIC coating, the Contractor shall measure the thickness and uniformity of the coating by the use of a wet film thickness gage meeting the requirements of ASTM D4414. The wet film thickness shall be tested continuously for the Contractor's own use. At least three such tests will be observed by the Engineer or Owner for each coat in each 500 square feet.
- D. The MIC coating shall provide a continuous monolithic surfacing with uniform thickness throughout and be free of pinholes, slumps and drips.
- E. All surfaces shall be inspected via high voltage spark testing when all coating work is complete and the coating is hard to the touch.
 - 1. The structure environment shall be properly vented prior to testing to ensure hazardous conditions do not exist.
 - 2. High voltage spark testing shall be performed in accordance with ASTM D4787. The spark testing equipment shall be initially set at 100 volts per 1 mil of applied film thickness of the coating and then adjusted as necessary per ASTM D 4787.
 - 3. All detected holidays shall be marked and the area of the liner shall be repaired. The surface area around the coating shall first be abraded using an appropriate grit paper or other hand abrasion tool. After abrading and cleaning the area, the area shall be patched by hand application of the coating material. All repair procedures shall follow manufacturer's recommended procedures.
- F. The pull-off strength (adhesion) of the liner shall be tested using any one of the five Test Methods (B, C, D, E or F) described in ASTM D-4541 for coatings on metal substrates and ASTM D-7234 for coatings on concrete. The Contractor shall propose the method and equipment to be used in the tests. The liner adhesion shall be tested in one area for each structure or each 1000 square feet of coated area. At least three replicate pull-off tests shall be performed for each area. The Contractor shall also submit his proposed method for

reinstatement of the area of the coating affected by the test. Repair of test areas shall be made by the Contractor at no additional cost to the Owner.

- G. There shall be no groundwater infiltration or other leakage through the structure walls after coating. If leakage is found, it shall be eliminated with an appropriate method as recommended by the coating manufacturer and approved by the Engineer at no additional cost to the Owner.
- H. All pipe connections shall be open and clear.
- I. There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations or other type defects in the lining.
- J. If any defective coating is discovered after it has been installed, it shall be repaired or replaced in a satisfactory manner within 72 hours and at no additional cost to the Owner. This requirement shall apply for the entire guarantee period.

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SECTION 09900
PAINTING

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on Drawings and Specified herein.
- B. Section Includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 RELATED SECTIONS

- A. Section 15030 – Piping and Equipment Identification Systems
- B. Section 07900 – Joint Fillers, Sealants, and Caulking

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications, the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC – The Society for Protective Coatings Standards
 - a. SSPC-Vis 1 – Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 – Hand Tool Cleaning
 - c. SSPC-SP3 – Power Tool Cleaning

- d. SSPC-SP5/NACE 1 – White Metal Blast Cleaning
 - e. SSPC-SP6/NACE 3 – Commercial Blast Cleaning
 - f. SSPC-SP7/NACE 4 – Brush-off Blast Cleaning
 - g. SSPC-SP10/NACE 2 – Near-White Metal Blast
 - h. SSPC-SP11 – Power Tool Cleaning to Bare Metal
 - i. SSPC-SP13/NACE6 – Surface Preparation of Concrete
- 2. ICRI – International Concrete Repair Institute
 - 3. NACE – National Association of Corrosion Engineers
 - 4. NAFP – The National Association of Pipe Fabricators
 - 5. ASTM D1737 – Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
 - 6. ASTM B117 – Method of Salt Spray (Fog) Testing
 - 7. ASTM D4060 – Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
 - 8. ASTM D3359 – Method for Measuring Adhesion by Tape Test

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 – Submittals, submit the following:
 - 1. Manufacturer's literature and Material Safety Data Sheets for each product.
 - 2. Painting schedule identifying surface preparation and paint systems proposed. Cross-reference with Tables 9-1 and 9-2. Provide the name of the paint manufacturer, and name, address, and telephone number of manufacturer's representative who will inspect the work. Submit schedule for approval as soon as possible following the Award of Contract, so approved schedule may be used to identify colors and specify shop paint systems for fabricated items.

1.05 SYSTEM DESCRIPTION

- A. Work shall include surface preparation, paint application, inspection of painted surfaces and corrective action required, protection of adjacent surfaces, cleanup and appurtenant work required for the proper painting of all surfaces to be painted. Surfaces to be painted are designated within the Painting Schedule and may include new and existing piping,

miscellaneous metals, equipment, buildings, exterior fiberglass, exposed electrical conduit and appurtenances.

- B. Perform Work in strict accordance with manufacturer's published recommendations and instructions, unless the Engineer stipulates that deviations will be for the benefit of the project.
- C. Paint surfaces which are customarily painted, whether indicated to be painted or not, with painting system applied to similar surfaces, areas and environments, and as approved by Engineer.
- D. Piping and equipment shall receive color coding and identification. Equipment shall be the same color as the piping system.

1.06 QUALITY ASSURANCE

- A. Painting operations shall be accomplished by skilled craftsman and licensed by the state to perform painting work.
- B. Provide a letter indicating that the painting applicator has five years of experience, and 5 references which show previously successful application of the specified or comparable painting systems. Include the name, address, and the telephone number for the Owner of each installation for which the painting applicator provided services.

1.07 STORAGE AND DELIVERY

- A. Bring materials to the job site in the original sealed and labeled containers.
- B. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

PART 2 – MATERIALS

2.01 GENERAL INFORMATION

- A. The term "paint" is defined as both paints and coatings including emulsions, enamels, stains, varnishes, sealers, and other coatings whether organic or inorganic and whether used as prime, intermediate, or finish coats.
- B. Purchase paint from an approved manufacturer. Manufacturer shall assign a representative to inspect application of their product both in the shop and field. The manufacturer's representative shall submit a report to the Engineer at the completion the Work identifying products used and verifying that surfaces were properly prepared,

products were properly applied, and the paint systems were proper for the exposure and service.

- C. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.
- D. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- E. Use painting materials suitable for the intended use and recommended by paint manufacturer for the intended use.
- F. Require that personnel perform work in strict accordance with the latest requirements of OSHA Safety and Health Standards for construction. Meet or exceed requirements of regulatory agencies having jurisdiction and the manufacturer's published instructions and recommendations. Maintain a copy of all Material Safety Data Sheets at the job site of each product being used prior to commencement of work. Provide and require that personnel use protective and safety equipment in or about the project site. Provide respiratory devices, eye and face protection, ventilation, ear protection, illumination and other safety devices required to provide a safe work environment.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Tnemec Company Inc.
 - 2. Ameron
 - 3. CARBOLINE
 - 4. Sherwin-Williams
 - 5. International

PART 3 – EXECUTION

3.01 SHOP PAINTING

- A. Shop prime fabricated steel and equipment with at least one shop coat of prime paint compatible with finish paint system specified. Prepare surface to be shop painted in strict accordance with paint manufacturer's recommendations and as specified. Finish coats may be shop applied, if approved by the Engineer. Package, store and protect shop painted items until they are incorporated into Work. Repair painted surfaces damaged

during handling, transporting, storage, or installation to provide a painting system equal to the original painting received at the shop.

- B. Identify surface preparation and shop paints on Shop Drawings. Verify compatibility with field applied paints.

3.02 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale, and foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless approved by the Engineer.
2. Protect or remove, during painting operations, hardware, accessories, machined surfaces, nameplates, lighting fixtures, and similar items not intended to be painted prior to cleaning and painting. Reposition items removed upon completion of painting operations.
3. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.
4. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
5. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch-up coats are in addition to the specified applied systems, and not considered a field coat.
6. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken.
7. Field paint shop painted equipment in compliance with Color Coding and as approved by Engineer.

B. Metal Surface Preparation

1. Prepare all welds to a minimum NACE weld preparation level "C" per NACE Standard SP0178. Provide additional weld preparation where required by the

coating manufacturer. Contractor shall provide NACE SP0178 weld mold visual aids on site for evaluation of all weld preparation.

2. Conform to current The Society for Protective Coatings Standards (SSPC) Specifications for metal surface preparation. Use SSPC-Vis-1 pictorial standards or NACE visual standards TM-01-70 or TM-01-75 to determine cleanliness of abrasive blast cleaned steel.
3. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.
 - b. Relative humidity is below 80%.
 - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - d. Painting or drying of paint is not being performed in the area.
 - e. Equipment is in good operating condition.
 - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
4. Abrasive blast ferrous metals to be shop primed, or component mechanical equipment in accordance with SSPC-SP5, White Metal Blast.
5. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP10, Near White Metal Blast, where metal is to be submerged, in a corrosive environment, or in severe service. Provide a 3.0 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
6. Abrasive blast field prepared ferrous metals in accordance with SSPC-SP6 Commercial Blast, where metal is to be used in mild or moderate service, or non-corrosive environment. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
7. Clean nonferrous metals, copper, or galvanized metal surfaces in accordance to SSPC-SP1, Solvent Cleaning, or give one coat of metal passivator or metal conditioner compatible with the complete paint system. Abrasive blast clean to increase mechanical adhesion in accordance with ASTM D6386, Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting when required by coating manufacturer. Provide a 1.5 mil minimum angular anchor profile unless recommended otherwise by the coating manufacturer in writing.
8. Abrasive blast clean internal and external ductile iron pipe surfaces prior to coating in accordance with NAPF 500-03-04, Surface Preparations Standard for Abrasive

Blast Cleaning of Ductile Iron Pipe. Abrasive blast clean internal and external cast ductile iron and cast-iron fitting surfaces in accordance with NAPF-03-05.

9. Prime cleaned metals immediately after cleaning to prevent rusting.
10. Clean rusted metals down to bright metal by abrasive blasting and immediately field primed.

C. Concrete Surface Preparation

1. Cure concrete a minimum of 28 days at 75° F before surface preparation, and painting begins. Allow more time at lower temperatures if specified by paint manufacturer.
2. Test concrete for pH and salts using test methods recommended by the paint manufacturer. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer. Do not begin surface preparation, or painting until acceptable to manufacturer.
3. Moisture content of concrete and masonry surfaces shall conform to manufacturer's recommended limits, and as listed in SSPC-SP13/NACE 6 Section 6 Acceptance Criteria Table 1. Floor surfaces to be coated shall be tested in accordance with ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride or as required by the coating manufacturer. Moisture vapor transmission shall not exceed three pounds per 1,000 square feet in a 24-hour period or less if specified by Coating Manufacturer. Vertical and horizontal overhead surfaces shall be tested in accordance with ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete using in situ Probes (relative humidity shall not exceed 80% or as required by the coating manufacturer) or with ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Test Method (test results shall be no moisture present). Engineer or Coating Manufacturer Representative shall specify all test locations. A minimum of one test per 1000 square feet of area to be coated shall be performed unless approved otherwise by Engineer.
4. Prepare concrete surfaces to receive coatings in accordance with NACE 6/SSPC-13 – Joint Surface Preparation Standards and ICRI Technical Guidelines. Remove contaminants, open bugholes, surface voids, air pockets, and other subsurface irregularities using abrasive blasting, shot blasting, water jetting or mechanical abrading. Use dry, oil-free air for blasting operations. Surface texture after blasting shall achieve profile as required by manufacturer or where not defined by manufacturer, profile shall be a minimum ICRI-CSP 5 surface profile. Remove residual abrasives, dust, and loose particles by vacuuming or other approved method.
5. Surface defects, such as hollow areas, bugholes, honeycombs, and voids shall be filled with polymeric filler compatible with painting system. Complete fill coats may

be used in addition to specified painting system and as approved by the Engineer. Fins, form marks, and all protrusions or rough edges shall be removed.

6. Repair existing concrete surfaces which are deteriorated to the point that surface preparation exposes aggregate with fill coats or patching mortar as recommended by paint manufacturer and as directed by the Engineer.
7. Clean concrete of all dust, form oils, curing compounds, oil, tar, laitance, efflorescence, loose mortar, and other foreign materials before paints are applied.
8. To ease coating around outside corners, provide $\frac{3}{4}$ -inch chamfered edges on all new concrete outside corners and grind existing concrete outside corners to a minimum radius of $\frac{3}{4}$ -inch.
9. Unless recommended otherwise by the coating manufacturer, provide $\frac{1}{4}$ " deep by $\frac{1}{4}$ " wide tool cut terminations at 1-inch maximum from all coating edges for anchorage. Provide terminations around all equipment, piping, openings, gates, top and bottom of walls, stop locations of each day's work and overlap onto previously completed work. Transition coating 3-inches onto interior lining of piping except where coating compatibility concerns are noted by coating manufacturer.
10. Apply epoxy or polymeric filler compatible with painting system to all inside corners of areas to be coated with a margin trowel to form a continuous 45-degree cant cove across corners with a minimum dimension of 1.5-inch. Roughen or prepare cured filler as recommended by coating manufacturer for proper coating adhesion.
11. All equipment grouting shall be installed and cured prior to starting coating work. Coating shall be applied over grout up to the edges of all equipment, gates and uninterrupted piping unless specifically noted otherwise.

D. Castings

1. Prepare castings for painting by applying a brush or a knife-applied filler. Fillers are not to be used to conceal cracks, gasholes, or excessive porosity.
2. Apply one coat of primer with a minimum thickness of 1.2 mils in addition to coats specified. Allow sufficient drying time before further handling.

E. Previously-Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.

3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.03 APPLICATION OF PAINT

- A. Apply paint by experienced painters with brushes or other applicators approved by the Engineer, and paint manufacturer.
- B. Apply paint without runs, sags, thin spots, or unacceptable marks.
- C. Apply at rate specified by the manufacturer to achieve at least the minimum dry mil thickness specified. Apply additional coats, if necessary, to obtain thickness.
- D. Special attention shall be given to nuts, bolts, edges, angles, flanges, etc., where insufficient film thicknesses are likely. Stripe paint prior to applying prime coat. Stripe painting shall be in addition to coats specified.
- E. Perform thinning in strict accordance with the manufacturer's instructions, and with the full knowledge and approval of the Engineer and paint manufacturer.
- F. Allow paint to dry a minimum of twenty-four hours between application of any two coats of paint on a particular surface, unless shorter time periods are a requirement by the manufacturer. Longer drying times may be required for abnormal conditions as defined by the Engineer and paint manufacturer. Do not exceed manufacturer's recommended drying time between coats.
- G. Suspend painting when any of the following conditions exist:
 1. Rainy or excessively damp weather.
 2. Relative humidity exceeds 85%.
 3. General air temperature cannot be maintained at 50°F or above through the drying period, except on approval by the Engineer and paint manufacturer.
 4. Relative humidity will exceed 85% or air temperature will drop below 40°F within 18 hours after application of paint.
 5. Surface temperature of item is within 5 degrees of dewpoint.

6. Dew or moisture condensation are anticipated.
 7. Surface temperature exceeds the manufacturer's recommendations.
- H. Where application of coating across concrete control joints or expansion joints has the potential to crack, turn coating into joints and caulk joints with a sealant compatible with coating rated for the intended service per Section 07 90 00.

3.04 INSPECTION

- A. Each field coat of paint will be inspected and approved by the Engineer or his authorized representative before succeeding coat is applied. Tint successive coats so that no two coats for a given surface are exactly the same color. Tick-mark surfaces to receive black paint in white between coats.
- B. Use magnetic dry film thickness gauges and wet film thickness gauges for quality control. Furnish magnetic dry film thickness gauge for use by the Engineer.
- C. Coatings shall pass a holiday detector test.
- D. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
- E. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 1. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 2. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such

as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

- F. Paint manufacturer or his representative shall provide their services as required by the Engineer. Services shall include, but not be limited to, inspecting existing paint, determination of best means of surface preparation, inspection of completed work, and final inspection of painted work 11 months after the job is completed.

3.05 PROTECTION OF ADJACENT PAINT AND FINISHED SURFACES

- A. Use covers, masking tape, other method when protection is necessary, or requested by Owner or Engineer. Remove unwanted paint carefully without damage to finished paint or surface. If damage does occur, repair the entire surface adjacent to and including the damaged area without visible lapmarks and without additional cost to the Owner.
- B. Take all necessary precautions to contain dispersion of sandblasting debris and paint to the limits of the work. Take into account the effect of wind and other factors which may cause dispersion of the sandblasting debris and paint. Suspend painting operations when sanding debris or paint cannot be properly confined. Assume all responsibilities and cost associated with damage to adjacent structures, vehicles, or surfaces caused by the surface preparation and painting operations.

3.06 PIPING AND EQUIPMENT IDENTIFICATION

- A. Piping and equipment identification shall be in accordance with Section 15030 – Piping and Equipment Identification Systems.

3.07 SCHEDULE OF COLORS

- A. Match colors indicated. Piping and equipment colors are indicated in Section 15030 – Piping and Equipment Identification Systems. Colors which are not indicated shall be selected from the manufacturer's full range of colors by the Engineer. No variation shall be made in colors without the Engineer's approval. Color names and numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.

3.08 WORK IN CONFINED SPACES

- A. Provide and maintain safe working conditions for all employees. Supply fresh air continuously to confined spaces through the combined use of existing openings, forced-draft fans and temporary ducts to the outside, or direct air supply to individual workers. Exhaust paint fumes to the outside from the lowest level in the contained space. Provide explosion-proof electrical fans, if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done. Follow OSHA, state and local regulations at all times.

3.09 OSHA SAFETY COLORS

- A. Paint wall around wall-mounted breathing or fire apparatus with the appropriate safety red color; area not exceed 2-feet wide by 3-feet high, unless apparatus covers the area. Fire apparatus include fire hoses, extinguisher, and hydrants.
- B. Paint hazardous areas and objects in accordance with OSHA regulations.

Table 1: Painting Schedule

Surface	Application	Painting System and No. of Coats	Product Reference (Table 2)	Total Min. Dry Film Thickness (Mils)
Concrete and Masonry				
Interior masonry and concrete walls and ceilings	All new structures	1 coat sealer 2 coats acrylic epoxy	101 116	75-85 sq.ft./gal. 4-6/coat
Interior masonry and concrete walls in chemical rooms		1 coat sealer 2 coats epoxy polyamide	117 102	60-80 sq.ft./gal. 4-6/coat
Exterior masonry cavity walls on cavity face of inner wythe	All new structures	Dampproofing	See Section 07 11 00	
Exterior below grade if interior is dry	Accessible areas (e.g. pipe galleries, pump rooms, basements, etc.)	Waterproofing	See Section 07 13 50	
Submerged water	Water retaining side of new wall surfaces where opposite side of wall is interior and dry and where indicated "epoxy waterproofing" on drawing	2 coats NSF approved epoxy polyamide Provide filler as required and recommended by manufacturer	105	4-6/coat
Submerged wastewater		2 coats high solids epoxy Provide filler as required and recommended by manufacturer	119	6-10/coat
Containment Liner ¹	Interior and exterior secondary containment floors, tank supports and walls	2 coats high solids epoxy coating	119	6-10/coat
Metals				
Interior and exterior nonsubmerged (gloss)	All new blowers, pumps, motors and mechanical equipment, piping, etc.	1 coat epoxy polyamide primer 1 coat epoxy polyamide 1 coat aliphatic polyurethane	104 102 115	4-6 4-6 3-5
Interior insulated		1 coat acrylic latex	103	4
Submerged water	All metal piping, and mechanical equipment, etc.	2 coats NSF approved epoxy polyamide	105	4-6/coat
Submerged Wastewater		2 coats high solids epoxy	119	8-10/coat
Steel doors, windows and door frames, steel stairs, monorails, structural steel, misc. metals (steel)		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4
Aluminum surfaces in contact with concrete		2 coats coal tar	107	26
Shop Primed Structural Steel	Pre-Engineered Buildings	1 barrier coat 1 coat epoxy 1 coat epoxy	113 114 120	2-3 3-4 3-4
Other				
Interior: Gypsum Wallboard	All new structures	2 coats acrylic latex matte or satin	103	2-3/coat
Interior: Tar-dipped piping where color is required		2 coats epoxy resin sealer 2 coats epoxy polyamide	112 102	5-8/coat 5-8/coat
PVC Piping		1 coat epoxy polyamide 1 coat aliphatic polyurethane	102 115	5-8 3-4

¹ Painting manufacturer shall verify compatibility of containment liner and chemical to be contained. Where incompatible substitute a compatible coating system.

Table 2: Product Listing

Ref.	System	Purpose	Product			
			Tnemec Series	PPG/AMERON	CARBOLINE	Sherwin-Williams
101	Acrylic filler	Primer-sealer	130-6601	BLOXFIL 4000	Sanitile 100	Cement-Plex 875
102	Epoxy polyamide	Finish coat semi-gloss or gloss	N69	AMERLOCK 2	Carboguard 890	Dura-Plate 235
103	Acrylic latex	Sealer	1028/1029	PITT TECH PLUS	Carbocrylic 3359DTM	DTM Acrylic Primer/Finish
104	Epoxy Polyamide – metal	Primer	66	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
105	Epoxy	Primer/Finish	20	AMERLOCK 2	Carboguard 561/56LT	Macropoxy 646 PW
106	Coal tar epoxy	Finish high-coat build	46H-413	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
107	Coal tar	Sealer	46-465	AMERCOAT 78HB	Bitumastic 300M	Hi-Mil Sher Tar Epoxy
108	Alkyd-medium oil	Finish coat	2H	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
109	Alkyd-long oil	Finish coat	1029	DEVGUARD 4308	Carbocoat 8215	Industrial Enamel
110	Epoxy polyamide	Primer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 646
112	Epoxy polyamide	Sealer	66-1211	AMERCOAT 385	Carboguard 893SG	Macropoxy 920 Pre-Prime
113	Urethane	Barrier coat	530	AMERLOCK SEALER	Rustbond	-
114	Polyamine Epoxy	Intermediate coat	27	AMERLOCK 385	Carboguard 893SG	-
115	Aliphatic Polyurethane	Finish coat	1074 or 1075	AMERCOAT 450 HS	Carbothane 134HG	Acrolon 218HS
116	Acrylic epoxy	Finish coat	113 or 114	AQUAPON WB	Sanitile 255	Water-Based Catalyzed Epoxy
117	Epoxy block filler	Sealer	1254	AMERLOCK 114	Sanitile 600	Kem Cati-Coat HS Epoxy Filler
118	Catalyzed epoxy	Finish coat	84	AMERLOCK 2/400	Carboguard 890	Macropoxy 646
119	High solids epoxy	Finish coat	104	AMERLOCK 400	Carboguard 890	Dura-Plate 235
120	Epoxy	Top coat	N69	AMERLOCK 2/400	Carboguard 890	-

END OF SECTION

SECTION 11000

EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, test, and place in acceptable operation all mechanical equipment and all necessary accessories as specified herein, as shown on the Drawings, and as required for a complete and operable system.
- B. The mechanical equipment shall be provided complete with all accessories, special tools, spare parts, mountings, and other appurtenances as specified, and as may be required for a complete and operating installation.
- C. It is the intent of these Specifications that the Contractor shall provide the Owner complete and operational equipment/systems. To this end, it is the responsibility of the Contractor to provide necessary ancillary items such as controls, wiring, etc., to make each piece of equipment operational as intended by the Specifications.

1.02 (NOT USED)

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, materials, and installations shall conform to the requirements of the most recent editions with latest revisions, supplements, and amendments of the specifications, codes, and standards listed.

1.04 PERFORMANCE AFFIDAVITS

- A. When required in the appropriate equipment Specifications, the Contractor shall submit manufacturer's Performance Affidavits for equipment to be furnished.
- B. By these affidavits, each manufacturer must certify to the Contractor and the Owner, jointly, that he has examined the Contract Documents and that the equipment, apparatus, or process he offers to furnish will meet in every way the performance requirements set forth or implied in the Contract Documents.
- C. The Contractor must transmit to the Engineer three (3) copies of the affidavit given him by the manufacturer or supplier along with the initial Shop Drawing submittals.
- D. The Performance Affidavit must be signed by an officer of the basic corporation, partnership, or company manufacturing the equipment and witnessed by a notary public.
- E. Shop Drawings, if required, will not be reviewed prior to receipt of an acceptable Performance Affidavit.
- F. The Performance Affidavit shall have the following format:

Addressed to: City of Raleigh

Reference: Neuse River East Parallel Interceptor

Text: (Manufacturer's Name) has examined the Contract Documents and hereby state that the (Product) meets in every way the performance requirements set forth or implied in Section _____ of the Contract Documents.

Signature: Corporate Officers shall be Vice President, or higher. (Unless statement authorizing signature is attached.)

1.05 SHOP DRAWINGS

- A. Shop Drawings, descriptive data, dimensions, parts, performance characteristics, material Specifications, construction details, piping and wiring diagrams, and associated items, as appropriate, showing conformance of all equipment to the Contract Documents, shall be submitted to the Engineer for review in accordance with Section 01300, Submittals. Additional required information shall include: the horsepower, voltage, and rotative speed of the motor along with other pertinent motor data, and the total weight of the equipment plus the approximate weight of the shipped materials. Shop Drawings shall also include complete erection, installation, and adjustment instructions, and recommendations.
- B. SHOP DRAWINGS ON ITEMS REQUIRING PERFORMANCE AFFIDAVITS WILL NOT BE REVIEWED UNTIL ACCEPTABLE PERFORMANCE AFFIDAVITS ARE RECEIVED.

1.06 OPERATION AND MAINTENANCE INSTRUCTION/MANUALS

- A. The Contractor, through manufacturer's representatives or other qualified individuals, shall provide instruction to designated employees of the Owner in the operation and care of all equipment installed hereunder. A written report by the representative covering instructions given shall be sent to the Owner, Engineer, and Contractor.
- B. The Contractor shall furnish and deliver to the Engineer, prior to the 80% completion point of construction, five (5) complete sets of instructions, technical bulletins, and any other printed matter such as wiring diagrams and schematics, prints or drawings, containing full information required for the proper operation, maintenance, and repair of the equipment. Included in this submission shall be a spare parts diagram and complete spare parts list. These requirements are a prerequisite to the operation and acceptance of equipment.
- C. Each set of instructions shall be bound together in appropriate three-ring binders.
- D. A detailed Table of Contents shall be provided for each set of instructions.
- E. Written operation and maintenance instructions shall be required for all equipment items supplied for this project. The amount of detail shall be commensurate with the complexity of the equipment item.
- F. Information not applicable to the specific piece of equipment installed on this project shall be struck from the submission.

- G. Information provided shall include a source of replacement parts and names of service representatives, including address and telephone number.
- H. Extensive pictorial cuts of equipment are required for operator reference in servicing.
- I. When written instructions include Shop Drawings and other information previously reviewed by the Engineer, only those editions thereof which were approved by the Engineer, and which accurately depict the equipment installed, shall be incorporated in the instructions.

1.07 CONTRACTOR'S RESPONSIBILITY

- A. The Contractor shall coordinate all details, locations, and other conditions with various equipment suppliers, so that the equipment supplied functions as part of a complete system.
- B. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Owner's operating personnel in its maintenance and operation as outlined in Division 1, General Requirements and below. The Contract prices for equipment shall include the cost of furnishing the manufacturer's technical representative for the number of days specified. The manufacturer's technical representative shall provide the following services.
 - 1. Provide necessary assistance and instruction for installation, adjustment, and field testing of equipment.
 - 2. Submit written certification jointly to the Owner, the Engineer, and the General Contractor, that the equipment supplied or manufactured by their organization has been installed and tested to their satisfaction, and that all final adjustments thereto have been made. Certification shall include date of final acceptance field test, as well as a listing of all persons present during tests.
- C. Any additional time required to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Engineer's Resident Project Representative on each day he is at the project.
- D. A written report covering the representative's findings and installation approval shall be mailed directly to the Engineer covering all inspection and outlining in detail any deficiencies noted.
- E. The times specified for services by the manufacturer's technical representative in the equipment Specifications are exclusive of travel time to and from the facility and shall not be construed as to relieve the manufacturer of any additional visits to provide sufficient service to place the equipment in satisfactory operation.
- F. The Contractor shall notify manufacturers or suppliers that they will be required to state and guarantee a firm delivery date for all equipment which they offer to furnish. Delivery dates shall be as required by the Contractor to meet the approved progress schedule.

1.08 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the mechanism furnished shall, be amply designed and constructed for the maximum stresses occurring during fabrication, erection, and continuous operation. All materials shall be new, and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the units are to be subjected and shall conform to all applicable sections of these Specifications.
- B. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- C. Equipment and appurtenances shall be designed in conformity with ASTM, ASME, AIEE, NEMA, and other generally accepted applicable standards and shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions of operation.
- D. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for adequate lubrication by readily accessible devices.
- E. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.
- F. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings.
- G. All machinery and equipment shall be safeguarded in accordance with the safety codes of the USA and the State of North Carolina.
- H. All rotating shafts, couplings, or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh, neatly and rigidly supported. Guards shall be removable as required to provide access for repairs.
- I. All equipment greater than 100 pounds shall have lifting lugs, eyebolts, etc., for ease of lifting, without damage or undue stress exerted on its components.

PART 2 -- PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. The materials covered by these Specifications are intended to be standard equipment of proven reliability, and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Drawings and operated per manufacturer's recommendations.

2.02 ANCHORS AND SUPPORTS

- A. The Contractor shall furnish, install, and protect all necessary guides, bearing plates, anchor and attachment bolts, and all other appurtenances required for the installation of the devices

included in the equipment specified. Working Drawings for installation shall be furnished by the equipment manufacturer, and suitable templates shall be used by the Contractor when required in the detailed equipment Specifications.

- B. Anchor bolts and fasteners shall be of size, strength, and material required for the purpose intended and with the detailed equipment Specifications. The Contractor shall provide all concrete pedestals required for equipment furnished. All equipment pedestals shall be doweled.
- C. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or required. Equipment shall be leveled by first using sitting nuts on the anchor bolts, and then filling the space between the equipment base and concrete pedestal with non-shrink grout, unless alternate methods are recommended by the manufacturer and are acceptable to the Engineer (such as shim leveling pumps).

2.03 STANDARDIZATION OF GREASE FITTINGS

- A. The grease fittings on all mechanical equipment shall be such that they can be serviced with a single type of grease gun. Fittings shall be hydraulic type, Alemite.

2.04 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection, and continuous operation. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the unit is to be subjected and shall conform to all applicable sections of these Specifications. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these Specifications.
- B. Not used
- C. Structural steel used in fabricated parts shall conform to requirements of "Standard Specifications for Structural Steel" ASTM Designation A36. All shop welding shall conform to the latest standards of the American Welding Society.
- D. All anchor bolts, handrail bolts, washers, clips, clamps, and fasteners of any type shall be constructed of 316 stainless steel. All anchor bolts shall be a minimum of 1/2-inch diameter.

2.05 STRUCTURAL STEEL

- A. All materials used in fabricating structural steel shall be new and undamaged.
- B. All materials shall conform to applicable provisions of the AISC Specifications for the design and fabrication of structural steel, AWS Welding Specification, and to pertinent ASTM Standard Specifications, including the following:

Material	ASTM Standard Specifications for	Designation
Structural steel not welded	Steel for bridges	A-36
Welded structural steel	Structural steel for welding	A-36

Cast Iron
Machine bolts

Gray iron castings
Low carbon steel standard
fasteners

A-48
A-325 High
Strength

PART 3 -- EXECUTION

3.01 SHOP TESTING

- A. All equipment so noted in the detailed equipment Specifications, shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents and that it will operate in the manner specified or implied.
- B. Not Used
- C. Where multiple units of an identical design are specified to be tested, unless otherwise noted, only one of each group shall require testing.
- D. No such equipment shall be shipped to the project until the Engineer has been furnished a certified copy of test results and has notified the Contractor, in writing, that the results of such tests are acceptable.
- E. When called for in the detailed equipment Specifications, arrangements shall be made for the Engineer to witness performance tests in the manufacturer's shop. The Engineer shall be notified ten working days before shop testing commences. Expenses are to be paid by Owner.
- F. Five (5) certified copies of the manufacturer's actual test data and interpreted results thereof, shall be forwarded to the Engineer for review.

3.02 STORAGE OF EQUIPMENT AND MATERIALS

- A. Contractor shall store his equipment and materials at the job site in accordance with the manufacturer's recommendations and as directed by the Owner or Engineer, and in conformity to applicable statutes, ordinances, regulations, and rulings of the public authority having jurisdiction.
- B. Material or equipment stored on the job site is stored at the Contractor's risk. Any damage sustained of whatever nature shall be repaired to the Engineer's satisfaction at no expense to the Owner.
- C. Contractor shall not store unnecessary materials or equipment on the job site and shall take care to prevent any structure from being loaded with a weight which will endanger its security or the safety of persons.
- D. Contractor shall enforce the instructions of the Owner and Engineer regarding the posting of regulatory signs for loadings on structures, fire safety, and smoking areas.
- E. Contractor shall not store materials or encroach upon private property without the written consent of the owners of such private property.

3.03 FIELD TESTING

- A. All equipment shall be set, aligned, and assembled in conformance with the manufacturer's drawings and instructions.
- B. Field tests shall be performed by the Contractor and shall consist of the following:
 - 1. Check equipment for alignment. Direct coupled shafts with flexible or rigid couplings shall be checked for parallel and angular misalignment using dial indicators. Maximum allowable misalignment in either direction shall be 0.002-inch unless otherwise indicated by the Engineer.
 - 2. All bearings, gear housing, etc., shall be flushed in accordance with the manufacturer's recommendations to remove any foreign matter accumulated during shipment, storage, or installation. Lubricants shall be added in strict conformance with the manufacturer's recommendation.
 - 3. Check equipment for proper rotation and check motor for no-load current draw.
- C. Upon completion of the above, and at a time approved by the Engineer, the equipment will be tested by operating it as a unit with all related piping, controls, and other ancillary facilities. Operating field tests shall consist of the following:
 - 1. Check equipment for excessive vibration and noise.
 - 2. Check motor current draw under load conditions. The rated motor nameplate current shall not be exceeded.
 - 3. Check all pumps at maximum speed for at least four points on the pump curve for capacity, head, and electric current draw.
 - 4. Recheck alignment with dial indicators where applicable, after unit has run under load for a minimum of 24 hours.
- D. When the field tests have been completed and are acceptable, the Engineer will issue an Equipment Checkout Form with all pertinent data from the tests.
- E. In addition to the above described field tests, any other tests specifically required by the individual equipment Specifications or by the manufacturer shall be performed by the Contractor.
- F. All costs in connection with field testing of equipment such as light, lubricants, instruments, labor, equipment, etc., shall be borne by the Contractor. Energy, fuel, chemicals, water, etc. normally consumed by specific equipment shall be supplied to the Owner.
- G. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

3.04 INSTALLATION

- A. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation. Equipment shall be installed strictly in accordance with recommendations of the manufacturer. A copy of all installation instructions shall be furnished the Engineer's field representative one week prior to installation.
- B. The Contractor shall have on hand sufficient personnel, proper construction equipment, and machinery of ample capacity to facilitate the work and to handle all emergencies normally encountered in work of this character. To minimize field erection problems, mechanical units shall be factory-assembled insofar as practical.
- C. Equipment shall be erected in a neat and workmanlike manner on the foundations at the locations and elevations shown on the Drawings.
- D. For equipment such as pumping units, which require field alignment and connections, the Contractor shall provide the services of the manufacturer's qualified mechanic, millwright, or machinist, to align the pump and motor prior to making piping connections or anchoring the pump base.
- E. Workmanship shall be of first-class quality.
- F. All equipment sections and loose items shall be match-marked prior to shipping.

3.05 FAILURE OF EQUIPMENT TO PERFORM

- A. Any defects in the equipment, or failure to meet the guarantees or performance requirements of the Specifications shall be promptly corrected by the Contractor by replacements or otherwise.
- B. If the Contractor fails to make these corrections, or if the improved equipment shall fail again to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.
- C. The Contractor shall then obtain specified equipment to meet the contract requirements or upon mutual agreement with the Owner, adjust the contract price to reflect not supplying the specific equipment item.
- D. In case the Owner rejects said equipment, then the Contractor hereby agrees to repay to the Owner all sums of money paid to him for said rejected equipment on progress certificates or otherwise on account of the lump sum prices herein specified.
- E. Upon receipt of said sums of money, the Owner will execute and deliver to the Contractor a bill of sale of all his rights, title, and interest in and to said rejected equipment; provided, however, that said equipment shall not be removed from the premises until the Owner obtains from other sources other equipment to take the place of that rejected.
- F. Said bill of sale shall not abrogate Owner's right to recover damages for delays, losses, or other conditions arising out of the basic contract.

3.06 ACCESSORIES, SPARE PARTS, AND SPECIAL TOOLS

- A. Spare parts for equipment shall be furnished where indicated in the equipment Specifications or where recommended by the equipment manufacturer.
- B. Spare parts shall be identical and interchangeable with original parts.
- C. Parts shall be supplied in clearly identified containers, except that large or bulky items may be wrapped in polyethylene.
- D. Painting requirements for spare parts shall be identical to those for original, installed parts.
- E. Spare parts shall be stored separately in a locked area, maintained by the Contractor, and shall be turned over to the Owner in a group prior to substantial completion. All of these materials shall be properly packed, labeled, and stored where directed by the Owner and Engineer.
- F. Contractor shall submit, for approval by the Engineer, a complete list of the special tools and appliances to be furnished. Such tools and appliances shall be furnished in approved painted steel cases, properly labeled and equipped with good grade cylinder locks and duplicate keys.
- G. The Contractor shall furnish all special tools and appliances necessary to operate, disassemble, service, repair, and adjust the equipment and shall furnish a one year supply of all recommended lubricating oils and greases. The manufacturer shall submit a list of at least four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. All of these materials shall be properly packed, labeled and stored where directed by the Engineer.

3.07 Note Used

3.08 WELDING

- A. The Equipment Manufacturer's shop welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirement of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.
- B. The Equipment Manufacturer's shop drawings shall clearly show complete information regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society. Special conditions shall be fully explained by notes and details.
- C. The Contractor's welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of AWS D1.1 "Structural Welding Code - Steel" or AWS D1.2 "Structural Welding Code - Aluminum" of the American Welding Society, as applicable.

- D. The Contractor shall perform all field welding in conformance with the information shown on the Equipment Manufacturer's drawings regarding location, type, size, and length of all welds in accordance with "Standard Welding Symbols" AWS A2.0 of the American Welding Society, and special conditions, as shown by notes and details.

3.09 EQUIPMENT IDENTIFICATION

- A. All mechanical equipment shall be provided with a substantial brass or stainless steel nameplate, securely fastened in a conspicuous place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, and principal rating data.
- B. Each pump and other piece of mechanical equipment shall also be identified as to name and number by a suitable laminated plastic or metal nameplate attached to the unit; for example, "Raw Water Pump #1". Coordinate name and number with same on remotely located controls, control panel, etc.
- C. Nameplates shall not be painted over.

3.10 GUARANTEE

- A. All equipment shall be guaranteed in accordance with Article 6.19 of the General Conditions.
- B. Guarantee requirements may be added to or modified in the detailed equipment Specifications of other Sections.

- END OF SECTION

SECTION 15200

GATE OPERATORS AND ELECTRIC GATE ACTUATORS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions and Section 15000 – Basic Mechanical Requirements.
- B. Reference Section 15390 – Schedules for additional information on gates and operators/actuators.
- C. The electric gate actuators shall meet the signal requirements described in Specification 17060 – Signal Coordination Requirements, 17920 – Control System Input/Output Schedule, and 17950 – Functional Control Descriptions.
- D. Gate operators and electric gate actuators shall be designed to unseat, open or close, and seat the gate under the most adverse operating condition to which the gates will be subjected.
- E. Operator mounting arrangements shall be as indicated on the Drawings or as directed by the manufacturer and/or Engineer. There shall be no mounting restrictions on the electric gate operator.
- F. The gate operators and electric actuators shall be the full and undivided responsibility of the gate manufacturer in order to ensure complete coordination of the components and to provide unit responsibility.

1.02 SUBMITTALS

- A. Shop Drawings shall be submitted in accordance with Section 01300.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Electric actuators shall be provided on all gates.
- B. Electric actuators shall be mounted on a floorstand.
 - 1. Floorstands shall consist of a cast iron pedestal designed to position the input shaft or handwheel approximately 36-inches above the operating floor. Floorstands shall be of the straight or offset design as specified herein or as shown on the Drawings.
 - 2. Benchstands shall be provided with a rectangular cast iron base machined and drilled for mounting purposes.

- C. All operators/actuators shall be provided with a clear, butyrate plastic rising stem cover which shall not discolor or become opaque for a minimum of five (5) years after installation.
 - 1. "Fully Open" and Fully Closed" positions shall be marked on each cover with mylar labels.
 - 2. Covers shall be graduated in one (1) inch increments.
 - 3. The top of the stem cover shall be closed and the bottom shall be mounted in an adapter plate or housing for easy field mounting to the gear housing.

2.03 ELECTRIC GATE ACTUATORS

- A. Electric Actuators shall be open/close service or modulating service as specified in the Gate Schedule in Section 15390 – Schedules.
 - 1. Open/Close (non-modulating) gate actuators shall be IQ series as manufactured by Rotork, SA series as manufactured by AUMA, or Series 2000 as manufactured by EIM Controls.
 - 2. Modulating gate actuators shall be Type IQM as manufactured by Rotork, Type SAR as manufactured by AUMA, or Series 2000 Futronic as manufactured by EIM Controls.
- B. Performance Requirements
 - 1. The actuators shall be designed for indoor and outdoor service and shall be capable of mounting in any position.
 - 2. Torque capacity of the actuators shall be sufficient to operate the gates with the maximum pressure differential, as indicated in the Gate Schedule in Section 15390, with a safety factor of 1.5. Actuators in modulating service will be selected such that the required dynamic gate torque is no more than 60% of the electric actuator's maximum rated breakaway of torque.
 - 3. The electric actuator shall provide for a gate travel speed of 12" per minute unless otherwise approved by Engineer.
 - 4. Actuators shall be capable of operating in ambient temperatures ranging from 0 degrees F – 160 degrees F.
 - 5. For open/close (non-modulating) actuators, the gearing, motor and contactor shall be capable of 60 starts per hour without overheating.
 - 6. For modulating actuators, the gearing, motor and contactor shall be capable of 1200 starts per hour without overheating.
- C. The actuators shall include, in one integral housing, individual compartments for the motor, gearing, wiring terminals, and control circuits (including auxiliary switches plus position sensing device where required). The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal. The inner seal shall protect the motor and all other internal electrical elements of the actuator

from entrance of moisture and dust when the terminal cover is removed. Double cartridge shaft seals shall be provided on the hand wheel and output shafts for weatherproof protection. All external fasteners shall be stainless steel. Compartments shall be provided with moisture and dust-proof rigid cast covers meeting NEMA 6, certified to submergence in 6 ft of water for 30 minutes. Actuators located in classified areas shall be suitable for use in Class 1, Division 1, Group D environments.

- D. The actuators shall be provided with externally operable and lockable 480VAC circuit breakers integral to the control housing.
- E. All gearing shall be hardened alloy steel or bronze and shall be rated at twice the output torque of the operator and shall be designed to withstand the stall torque of the motor without failure. Output drive gearing shall consist of a worm shaft and worm gear pinion operating in an oil bath. The worm gear pinion shall be alloy bronze. Worm gear drive shall be self-locking to prevent creeping of the gate in an intermediate position. Heavy-duty grease shall protect gearing and sealed ball bearings of the main shaft for five years without changing. Motor reduction gearing shall be spur or planetary gearing and shall allow for field repair and change in gear ratio.
- F. A mechanical dial position indicator shall be furnished to continuously indicate the position of the gate at and between the fully open and fully closed positions. The indicator shall be driven by gearing driven off of the main worm gear pinion and shall operate when the actuator is in either the electrical mode or manual mode.
- G. A handwheel shall be permanently attached for manual operation. A gear assembly shall be provided between the handwheel and the worm shaft if required to reduce the force necessary to operate the handwheel to less than 40 pounds. A positive declutch mechanism shall engage the handwheel when required. When the actuator is set in the declutched position for handwheel operation, it shall return automatically to electric operation when actuator motor is energized. The handwheel shall not rotate during electric operation nor shall a fused motor prevent handwheel operation.
- H. The drive motor shall be specifically designed for actuator service and shall be characterized by high starting torque and low inertia. Motors shall be 460 volts, three phase, 60 Hz AC reversible squirrel cage induction type motors and shall be specifically designed for modulating service where indicated on the Gate Schedule in Section 15390. Motors shall be totally enclosed, non-ventilated, with NEMA Class F insulation minimum (Class H for modulating actuators) and a maximum continuous temperature rating of 120 degree C (rise plus ambient). A 120 VAC space heater shall be provided in the motor compartment. The electric motor shall have a time rating of at least 15 minutes at 104°F (40°C) or twice the gate stroking time, whichever is longer, at an average load of at least 33% of maximum gate torque. Motor bearings shall be permanently lubricated by premium lubricant. The motor shall have plug and socket electrical connection to facilitate easy removal and replacement. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of gate travel with either phase sequence of the three-phase power supply connected to the actuator. The motor shall include single phase protection. A suitable thermal protection device shall be incorporated in the motor or motor starter circuits, connected to a tripping device. Fast acting fuses shall be provided to protect solid state components. The motor shall be capable of starting against the rated load in either the open or close direction when voltage to the motor terminals is plus or minus ten (10) percent of nameplate rating

1. Open/Close actuators shall be furnished with electro-mechanical reversing starters.
 2. Modulating actuators shall be furnished with solid state reversing starters utilizing thyristors.
- I. Leads from the motor shall be brought to the control circuit (limit switch) compartment without external piping or conduit box. An adequately sized space heater shall be installed in the control circuit compartment to aid in the prevention of damage resulting in from condensation. The following items shall be located in the control circuit compartment.
1. Torque limit switches shall be provided to de-energize the motor control circuit in the event of a stall when attempting to unseat a jammed gate and when torque is exceeded during gate travel. Each actuator shall have an open direction torque switch and a close direction torque switch. The torque switches shall be mechanically operated and able to be set in torque units. Torque switches shall be calibrated prior to the actuator's assembly to the gate.
 2. Travel limit switches shall be provided to de-energize the motor control circuit when the actuator reaches the limits of travel in the open and close directions. The limit switch drive shall be of the counter gear type and "in step" with the actuator output drive at all times in either the electrical or manual mode of operation. A minimum of six (6) contacts, three (3) normally open and three (3) normally closed, shall be supplied at each end of gate travel. Four (4) additional contacts shall be provided to report end of travel or any desired position between ends of travel.
- J. Modulating actuators shall have a position feedback potentiometer mounted directly to the gate actuator gearing inside the gearing compartment. The potentiometer shall provide a 4-20 mA signal corresponding to gate position. Modulating gate actuators shall be designed to respond to either a 4-20mADC analog signal or a digital pulse signal as specified herein or as required to coordinate with the requirements of Division 17.
1. Modulating gate actuators designed to respond to a 4-20mADC signal shall be provided with a gate positioner which shall position the gate proportional to an externally generated 4-20mADC signal. The gate positioning control circuitry shall position the gate by comparing the command signal with the present gate position as indicated by the feedback potentiometer. The positioner shall be field adjustable to fail to the "open," "closed," or "last" position on loss of 4-20 mADC command signal.
 2. Modulating gate actuators designed to respond to "pulse" open/close signals shall operate the gate during the time the open or close pulse signal is high. Modulating actuators designed to respond to "pulse" open/close signals shall have the latching circuitry described above for open/close actuators disabled.
- K. The electrical terminals shall be housed in a double sealed terminal compartment isolated from the rest of the actuator components. The actuators shall be designed to operate from a single 480VAC, 3-phase source. The actuators shall be furnished with

fuses inside of the terminal compartment. A quantity of two – ¾ inch NPT conduit entries shall be furnished.

- L. Actuators shall contain wiring and terminals for the following control functions. All dry contacts shall be rated for 5A at 250VAC.
 - 1. Open, Close, and Stop commands from external dry contacts (utilizing internal 24VDC [120VAC] power supply) and/or from an external signal of 12V to 120V. The inputs for the open, close, stop signals shall be field selectable to be respond to either maintained or momentary remote signals. In momentary mode, the actuator shall have internal latching circuitry that causes the operator to drive the gate to its limit of travel upon receipt of the momentary contact signal unless a stop signal is received.
 - 2. Emergency override input from a normally closed or normally open contact. The actuator shall either open or close (field selectable) upon receiving the emergency override input.
 - 3. Remote Local-Off-Remote selector switch, Open/Close pushbuttons, and Open/Closed pilot lights for a remote manual control station (see below). The remote Local-Off-Remote selector switch and Open/Close pushbuttons shall be a dry contact input to the actuator control circuitry. The Open/Closed pilot lights shall be powered from the gate actuator control power.
 - 4. Four (4) unpowered contacts shall be provided which can be selected to indicate gate “Opened” and “Closed” position, “Remote” status of the actuator, and fail status of the actuator. The fail status contacts shall activate upon motor overtemperature and actuator overtorque as a minimum.
 - 5. Terminals for 4-20mADC position command and 4-20mADC position feedback as described above for modulating actuators.

M. Local Controls

- 1. Actuators shall be furnished with a Local-Off-Remote selector switch; Open, Close, and Stop pushbuttons for local control; a red lamp indicating closed and a green lamp indicating open. L-O-R switch shall be padlockable in any of the three positions.
 - a. When the LOR is in the “Local” position, open/close control shall be by the open and close pushbuttons on the actuator. The stop push button shall stop the actuator travel.
 - b. When the LOR is in the “Off” position, the actuator shall not operate.
 - c. When the LOR is in the “Remote” position, the actuator shall be controlled by remote inputs from the PLC or from the remote manual controls station.
- 2. The local controls shall be arranged so that the direction of travel can be reversed without the necessity of stopping the actuator.

N. Remote Manual Control Station

1. Where indicated in the Gate Schedules in Section 15390 – Schedules, manual actuator controls shall be furnished in a separate NEMA 4X stainless steel enclosure (NEMA 7 if located in a classified area). Manual control station controls shall include Hand–Off-Auto Selector switch; Open, Stop, and Close pushbuttons; a red lamp indicating closed and a green lamp indicating open.
 - a. When the HOA is in the “Hand” position, open/close control shall be by the open and close pushbuttons on the remote manual control station. The stop push button shall stop actuator travel.
 - b. When the HOA is in the “Off” position, the actuator shall not operate.
 - c. When the HOA is in the “Auto” position, the actuator shall be controlled by remote inputs to the actuator from the PLC.

PART 3 -- EXECUTION

3.01 MANUFACTURER’S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

3.02 INSTALLATION

- A. All gate actuators shall be installed in accordance with the manufacturer's published recommendations and the applicable specification sections for gates, and motor controls.
- B. Gate actuators shall be factory coated in accordance with the manufacturer’s standard paint system.

3.03 SHOP TESTING

- A. Shop testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:
 1. Conduct a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment.
 2. Submit written certification that:
 - a. Shop tests for the electrical system and all controls were successfully conducted;

- b. Electrical system and all controls provide the functions specified and required for proper operation of the gate operator system.
3. Each actuator shall be performance tested and individual test certificates shall be supplied free of charge. The test equipment shall simulate each typical gate load and the following parameters should be recorded:
 - a. Current at maximum torque setting
 - b. Torque at maximum torque setting
 - c. Flash Test Voltage
 - d. Actuator Output Speed or Operating Time
 - e. In addition, the test certificate should record details of specification, such as gear ratios for both manual and automatic drive, closing direction, and wiring diagram code number.
 - f. Verification of actuator torque rating with gate.

3.02 FIELD TESTS

- A. Field testing shall be in accordance with Section 11000, Equipment General Provisions and with the following additional requirements:

1. Gate actuators shall be field-tested together with the associated gates.
2. Perform field tests to check and adjust system components, and to test and adjust operation of the overall system.
 - a. Preliminary field tests shall be conducted prior to start-up.
 - b. Final field tests conducted during start-up.
3. Preliminary and final field tests shall be conducted at a time approved by the Engineer.
4. Test all gates at the operating pressures at which the particular line will be used.
5. Test all gates for control operation as directed.
6. Field testing shall include optimization of opening and closing times of the gates. Gate opening and closing times shall be adjusted based on process requirements to optimize operation of the gates. Final gate opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

B. Preliminary Field Tests

1. General: Preliminary field tests shall be conducted prior to start-up and shall

include a functional check of the entire gate operator system and all system components.

2. Scope: Preliminary field tests shall demonstrate that the gate operator system performs according to specifications and that all equipment, gates, controls, alarms, interlocks, etc., function properly.
3. Based on results of preliminary field tests, the Contractor shall make any adjustments required to settings, etc., to achieve the required gate closing time and operation, as specified or otherwise directed.

C. Final Field Tests

1. Final field tests shall be conducted in accordance with the latest revision of AWWA C500.
2. Final field tests shall be conducted simultaneously with the start-up and field testing of the pumps.
3. Final field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. Each of the gates shall be tested at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing.
4. Certification of Equipment Compliance: After the final field tests are completed and passed, submit affidavit according to Section 11000.

- END OF SECTION -

SECTION 15204

SLIDE GATES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all slide gates complete with all accessories, special tools, spare parts, mountings, anchor bolts and other appurtenances as specified herein, as shown on the Drawings, and as required for a complete and operating installation.
- B. Equipment shall be provided in accordance with the requirements of Section 11000 – Equipment General Provisions.
- C. Locations, dimensions, design criteria, number required, etc. for slide gates and stop plates are indicated in the appropriate Schedule in Section 15390, Schedules.
- D. Not used
- E. The Contractor shall coordinate all details, locations, clearances, and other conditions with the various equipment suppliers, so that the slide gates and stop plates function as part of a complete system.

1.02 WARRANTY AND GUARANTEE

- A. Warranty and Guarantee shall be as specified in Section 11000 with the exception that the warranty period shall be for two (2) years.

PART 2 -- PRODUCTS

2.01 GENERAL

- A. Subject to compliance with the Specifications provide products manufactured by Aquinox, Fontaine, Golden Harvest, Hydrogate, Washington Aluminum, or Whipps.
- B. Liberal safety factors shall be used in the design of all of the equipment. Working stresses shall not exceed the lower value of: One-third of the yield strength, or one-fifth of the ultimate strength of the material. The gates and appurtenances shall be designed for installation in the structures shown on the Drawings.
- C. Stainless steel nameplates shall be permanently attached to each of the floorstands or benchstands indicating the invert elevation of the gate.

2.02 SLIDE GATES

- A. Slide gates shall be Type 316 stainless steel fabricated, rising stem, designed to mount on the face of the concrete, or flush within the channel as detailed on the Drawings and the 15390 Schedules.
- B. The guides shall be of extruded Type 316 stainless steel incorporating a dual slot design.
 - 1. The primary slot shall accept the plate of the disc, and the secondary slot shall be sufficiently wide to accept the reinforcing ribs of the disc.
 - 2. The guides shall be designed for maximum rigidity, shall have a weight of not less than four pounds per foot, and shall be provided with holes for anchor bolts every 18-inches.
 - 3. Guides shall be provided with ultrahigh molecular weight polyethylene bearing strips, minimum 3/8-inch thick, with an intrinsic viscosity of 14 or more by test, which shall reduce friction between the sliding disc and the frame.
 - 4. The invert of the frame shall be an angle welded to the lower ends of the guides to form a seating surface for the resilient seal mounted on the disc.
 - 5. Where the guides extend above the operating floor, they shall be sufficiently strong so that no further reinforcing is required.
- C. Not Used.
- D. The disc or sliding member shall be of Type 316 stainless steel plate reinforced with "U"-shaped Type 316 stainless steel extrusions welded to the plate not more than 16-inches apart.
 - 1. The disc shall not deflect more than 1/360 of the span of the gate under the design head.
 - 2. Reinforcing ribs shall extend into the guides so that they overlap the seating surface of the guide.
 - 3. A specially molded resilient seal shall be mounted on the bottom of the disc to provide flush bottom closure, where shown. The shape of the seal shall produce a seating surface having a minimum width of 3/4-inch, and the seal shall extend into the secondary slot of the guide. The vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.
- E. All parts of the gate shall have a minimum thickness of 3/8-inch.
- F. Operating stems shall be of Type 316 stainless steel, of a size to safely withstand, without buckling or permanent distortion, the stresses induced by normal operating forces. The stems shall be designed to transmit in compression at least 2-1/2 times the rated output of the operating mechanism with a 40 pound effort on the crank or handwheel.
 - 1. Slenderness ratio (L/r) shall be less than 200.

2. The threaded portion of the stem shall have machined cut threads of the Acme type.
 3. Stems of more than one section shall be joined by bronze couplings threaded and keyed or bored and pinned, to the stems.
 4. Keys or pins shall be corrosion resistant materials. All threaded and keyed couplings of the same size shall be interchangeable.
- G. All slide gates shall be provided with an adjustable bronze stop collar on the stem above the floorstand or benchstand lift nut.
- H. Stem guides shall be Type 316 stainless steel, bronze brushed, and mounted on Type 316 stainless steel brackets. Anchor bolts for stem guides shall be Type 316 stainless steel.
- I. Materials of construction for gate discs, guides, frames, operators, and all appurtenances shall be as specified herein. Methods of operation shall be as identified in the Gate Schedule.

PART 3 -- EXECUTION

3.01 MANUFACTURER'S FIELD SERVICES

- A. The services of a qualified manufacturer's technical representative shall be provided in accordance with Section 11000, Equipment General Provisions and shall include the following site visits for electric actuators:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	2
Startup and Training	1	2

3.02 INSTALLATION AND TESTING

- A. Installation - The slide gates shall be set carefully in the locations shown on the Drawings in accordance with the installation manual furnished by the gate manufacturer.
1. The stems shall be provided with wall-mounted guides where required.
 2. Floorstands, and wall brackets shall be secured in place with adequately sized anchor bolts.
 3. All gates shall be operated and tested to assure proper installation.
- B. Testing - The completely assembled slide gates, in vertical position, shall be inspected for proper seating.
1. Seat facings shall be machined and wedges adjusted to exclude a 0.004-inch thickness gauge between the frame and disc seating surfaces.

2. The gate disc shall be fully opened and closed in its guide system to insure that it operates freely.
 3. Floorstands shall be shop-operated to ensure proper assembly and operation.
- C. All slide gates shall be certified that at the operating head conditions indicated on the Gate Schedule, leakage shall not exceed that specified in the latest version of AWWA C561.

- END OF SECTION -

SECTION 15390

SCHEDULES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Reference Section 15000, Basic Mechanical Requirements.

1.02 GATE SCHEDULES

- A. Performance Affidavits shall be required for all gates listed in the following schedule(s). Performance Affidavits shall be provided in accordance with Section 11000. Gates shall be tagged by the manufacturer according to locations listed in the Schedule.

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SLIDE GATE SCHEDULE									
NO.	DESCRIPTION	SIZE			DESIGN HEAD*	WALL THIMBLE TYPE	OPERATOR	ACTUATOR	STAND
		WIDTH (in)	HEIGHT (in)	DIAMETER (in)					
1	JUNCTION STRUCTURE 1	84	84	-	18	EXISTING	MOTOR	MODULATING	FLOORSTAND
2	JUNCTION STRUCTURE 1	84	84	-	18	EXISTING	MOTOR	MODULATING	FLOORSTAND
3	JUNCTION STRUCTURE 1	84	84	-	18	EXISTING	MOTOR	MODULATING	FLOORSTAND
4	JUNCTION STRUCTURE 2	84	84	-	18	EXISTING	MOTOR	MODULATING	FLOORSTAND
5	JUNCTION STRUCTURE 2	84	84	-	18	EXISTING	MOTOR	MODULATING	FLOORSTAND
6	JUNCTION STRUCTURE 2	84	84	-	18	EXISTING	MOTOR	MODULATING	FLOORSTAND

* Maximum Design Head is for both seating and unseating head condition as measured from gate centerline to the maximum differential water surface elevation for sluice gates. For slide gates, stop plates and stop planks Maximum Design Head is the depth of water on one side with no water on other side.

- END OF SECTION

SECTION 16000

BASIC ELECTRICAL REQUIREMENTS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.
- B. The electrical scope of work for this project primarily includes, but is not limited to, the following:
1. Furnish and install new 480V electrical service including utility metering equipment and main service entrance breaker.
 2. Furnish and install mini powerzone, and other low voltage electrical power distribution equipment.
 3. Furnish and install all aboveground raceway systems including conduit, fittings, boxes, supports, and other pertinent components.
 4. Furnish and install all underground raceway systems including conduit, fittings, manholes, handholes and other pertinent components.
 5. Furnish and install all low voltage wire and cable resulting in a complete and operable electrical system.
 6. Other electrical work as specified herein and indicated on the Drawings.
- C. All material and equipment must be the product of an established, reputable, and approved manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.
- D. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

- E. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.
- F. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 EQUIPMENT LOCATION

- A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to ensure that proposed equipment will fit properly in spaces indicated.
- B. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings.

1.03 LOCAL CONDITIONS

- A. The Contractor shall examine the site and become familiar with conditions affecting the work. The Contractor shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.
- B. The Contractor is responsible for coordinating all electric utility equipment installations with the serving electric utility. The Contractor shall furnish and install all electric utility equipment required by the electric utility to be installed by the Contractor whether specifically shown on the Drawings or not.
- C. The Contractor shall furnish and install the following electrical utility equipment as a minimum:
 - 1. Concrete transformer pads constructed as instructed by the electric utility.
 - 2. Primary and secondary ductbank and manholes
 - 3. Metering equipment cabinets and/or bases

4. Conduit and wire required from metering cabinet to metering current transformers and potential transformers.
 5. Secondary conductors
 6. Secondary terminations
- D. The electric utility will furnish and install the following equipment:
1. Primary conductors and terminations
- E. The Contractor is responsible for ensuring all electric utility equipment and construction installed by the Contractor is furnished and installed in accordance with the electric utility's design specifications and requirements. The Contractor is fully responsible for coordinating his scope of work with the electric utility. Any additional required electric utility construction or equipment not specified herein or shown on the Drawings shall be supplied by the Contractor at no additional cost to the Owner.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, Section 01300, Submittals and the requirements of the individual specification sections, the Contractor shall obtain from the equipment manufacturer and submit the following:
1. Shop Drawings
 2. Operation and Maintenance Manuals
 3. Spare Parts List
 4. Proposed Testing Methods and Reports of Certified Shop Tests.
 5. Reports of Certified Field Tests.
 6. Manufacturer's Representative's Certification.
- B. Submittals shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements.
- C. Submittals will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which the Contractor has provided no information.
- D. Some individual Division 16 specification sections may require a Compliance, Deviations, and Exceptions (CD&E) letter to be submitted. If the CD&E letter is required and shop drawings are submitted without the letter, the submittal will be rejected. The letter shall include all comments, deviations and exceptions taken to the Drawings and Specifications by the Contractor AND Equipment Manufacturer/Supplier. This letter shall include a copy of this specification section. In the left margin beside each and every paragraph/item, a letter "C", "D", or "E" shall be typed or written in. The letter "C" shall be for full compliance with the requirement. The letter "D" shall be for a deviation from the requirement. The

letter "E" shall be for taking exception to a requirement. Any requirements with the letter "D" or "E" beside them shall be provided with a full typewritten explanation of the deviation/exception. Handwritten explanation of the deviations/exceptions is not acceptable. The CD&E letter shall also address deviations, and exceptions taken to each Drawing related to this Specification Section.

1.05 APPLICABLE CODES AND REQUIREMENTS

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the following:
 - a. Insurance Rating Organization having jurisdiction
 - b. The serving electrical utility company
 - c. The currently adopted edition of the National Electrical Code (NEC)
 - d. The National Electric Manufacturers Association (NEMA)
 - e. The Institute of Electrical and Electronic Engineers (IEEE)
 - f. The Insulated Cable Engineers Association (ICEA)
 - g. The American Society of Testing Materials (ASTM)
 - h. The American National Standards Institute (ANSI)
 - i. The requirements of the Occupational Safety Hazards Act (OSHA)
 - j. The National Electrical Contractors Association (NECA) Standard of Installation
 - k. National Fire Protection Association (NFPA)
 - l. International Electrical Testing Association (NETA)
 - m. All other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.06 PERMITS AND INSPECTIONS

- A. The Contractor shall reference the General Conditions and Section 01010, Summary of Work.

1.07 TEMPORARY LIGHTING AND POWER

- A. The Contractor shall reference the General Conditions and Section 01510, Temporary Utilities.

1.08 TESTS

- A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance, overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.
- B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.
- C. Refer to each individual specification section for detailed test requirements.
- D. The Contractor shall complete the installation and field testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.
- E. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

1.09 INFRARED INSPECTION

- A. Just prior to the final acceptance of a piece of equipment, the Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment terminations.
- B. The infrared inspection shall apply to all new equipment and existing equipment that is in any way modified under this Contract. All heating problems detected with new equipment furnished and installed under the Scope of this Contract shall be corrected by the Contractor. All problems detected with portions of existing equipment modified under this Contract shall also be corrected by the Contractor.

- C. Any issues detected with portions of existing equipment that were not modified under this Contract are not the responsibility of the Contractor. Despite the Contractor not being held responsible for these problems, the Contractor shall report them to the Owner and Engineer immediately for resolution.
- D. The infrared inspection report shall include both digital and IR pictures positioned side by side. Both the digital and IR pictures shall be clear and high quality. Fuzzy, grainy, or poorly illuminated pictures are not acceptable. The IR picture shall be provided with a temperature scale beside it, and an indication of the hot spot temperature in each picture. Reports shall be furnished in a 3-ring binder, with all pages printed in full color, with equipment assemblies separated by tabs.

1.10 PROTECTIVE DEVICE SETTING AND TESTING

- A. The Contractor shall provide the services of a field services organization to adjust, set, calibrate and test all protective devices in the electrical system. The organization shall be a subsidiary of or have a franchise service agreement with the electrical equipment manufacturer. The qualifications of the organization and resumes of the technicians as well as all data forms to be used for the field testing shall be submitted.
- B. All protective devices in the electrical equipment shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.
- C. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.
- D. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.
- E. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.
- F. When completed, the Contractor shall provide a comprehensive report for all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.
- G. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.11 POWER SYSTEM STUDIES

- A. The Engineer will provide the Power System studies to the firm providing the protective device setting and testing services. The Contractor shall notify the Engineer six (6) weeks in advance of the scheduled date for the protective device setting and testing. The testing firm shall submit to the Engineer a tabulated listing of all protective devices requiring setting six (6) weeks prior to the setting and testing date. This table shall include the protective device manufacturer, model number, ampere rating (if applicable), instrument transformer ratios, and all other required information.

1.12 SCHEDULES AND FACILITY OPERATIONS

- A. Since the equipment testing required herein shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one (1) month prior to any work beginning. When testing has been scheduled, the Engineer must be notified 48 hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of facility equipment must be coordinated with the Owner/Engineer so as not to affect proper facility operations.
- B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a facility emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to Owner personnel.
- C. In the event of accidental shutdown of Owner equipment, the Contractor shall notify Owner personnel immediately to allow for an orderly restart of affected equipment.

1.13 MATERIALS HANDLING

- A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material will be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. If space heaters are provided in a piece of electrical equipment, they shall be temporarily connected to a power source during storage. The Contractor shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

1.14 WARRANTIES

- A. Unless otherwise specified in an individual specification section, all equipment and electrical construction materials furnished and installed under Division 16 shall be provided with a warranty in accordance with the requirements of Section 11000, Equipment General Provisions and the General Conditions.

1.15 TRAINING

- A. Unless otherwise specified in an individual specification section, all training for equipment furnished and installed under Division 16 shall be provided in accordance with the requirements of Section 11000, Equipment General Provisions.

PART 2 -- PRODUCTS

2.01 PRODUCT REQUIREMENTS

- A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.
- B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.
- C. All equipment and materials shall be new, unless indicated or specified otherwise.
- D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that are provided under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming to this requirement.

2.02 SUBSTITUTIONS

- A. Unless specifically noted otherwise, any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition.

2.03 CONCRETE

- A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.
- B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on new or existing floors or slabs. The Contractor shall provide all necessary anchor bolts, channel iron sills, and other materials as required. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings and shall conform to standard detail for equipment pads shown on the Contract Drawings. Equipment pads shall not have more than 3" excess concrete beyond the edges of the equipment.
- C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs do not exist and/or are not provided by others under this Contract. The Contractor shall provide all necessary anchor

bolts, channel iron sills, and other materials as required. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

2.04 RUBBER INSULATING MATTING

- A. Rubber insulating matting shall be furnished and installed on the floor and in front of each piece of electrical equipment that is located indoors and installed under this Contract. Rubber insulating matting shall not be installed outdoors. The mat shall be long enough to cover the full length of the equipment. The mat shall be 1/4 inch thick with beveled edges, canvas back, solid type with corrugations running the entire length of the mat. The matting shall meet OSHA requirements and the requirements of ASTM D-178 for Type 2, Class 2 insulating matting. Matting shall be 36 inches wide, minimum. However, matting width shall be no less than the NEC working clearance for the equipment with which it is associated.

PART 3 -- EXECUTION

3.01 CUTTING AND PATCHING

A. Coordination

- 1. The Work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

- 1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building, structure, or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

C. Existing Equipment

- 1. Provide a suitable cover or plug for openings created in existing equipment as the result of work under this Contract. For example, provide round plugs in equipment enclosures where the removal of a conduit creates a hole in the enclosure. Covers and plugs shall maintain the NEMA rating of the equipment enclosure. Covers and plugs shall be watertight when installed in equipment located outdoors.

3.02 EXCAVATION AND BACKFILLING

- A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

- END OF SECTION -

SECTION 16111

CONDUIT

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein, indicated on the Drawings, and as required.
- B. Requirements for conduit clamps, support systems, and anchoring are not included in this Section. Reference Section 16190, Electrical Supporting Devices, for these requirements.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Conduits and conduit fittings shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. American National Standards Institute (ANSI)
 - a. ANSI B1.20.1 – Pipe Threads, General Purpose
 - b. ANSI C80.1 – Electrical Rigid Steel Conduit
 - c. ANSI C80.3 – Steel Electrical Metallic Tubing
 - d. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - e. ANSI FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - 2. Underwriters Laboratories (UL)
 - a. UL 1 – Standard for Flexible Metal Conduit
 - b. UL 6 - Electrical Rigid Metal Conduit-Steel
 - c. UL 6A – Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel
 - d. UL 360 – Standard for Liquid-tight Flexible Metal Conduit
 - e. UL 467 – Grounding and Bonding Equipment
 - f. UL 514B – Conduit, Tubing, and Cable Fittings

- g. UL 651 – Standard for Schedule 40 and 80 Conduit and Fittings
 - h. UL 797 – Electrical Metallic Tubing-Steel
 - i. UL 1203 - Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations
 - j. UL 1479 – Standard for Fire Tests of Penetration Fire Stops
 - k. UL 1660 – Liquid-tight Flexible Nonmetallic Conduit
3. National Electrical Manufacturer’s Association (NEMA)
- a. NEMA RN 1 – PVC Externally Coated Galvanized Rigid Steel Conduit
 - b. NEMA RV-3 – Application and Installation Guidelines for Flexible and Liquid-tight Flexible Metal and Nonmetallic Conduits
 - c. NEMA TC-2 – Electrical PVC Conduit
 - d. NEMA TC-3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing

B. Others

- 1. ACI-318 – Building Code Requirements for Structural Concrete

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300 – Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for conduits and fittings.
 - 2. Conduit identification methods and materials.

3. Evidence of training for all personnel that will install PVC coated rigid metal conduit.

1.05 DEFINITIONS

- A. Conduits are categorized by the circuit type of the wiring to be installed inside. Conduits are defined as follows:
 1. Power Conduits – Conduits that carry AC or DC power wiring from a source to a load. Conduits that carry lighting and receptacle wiring.
 2. Control Conduits – Conduits that carry AC or DC discrete control wiring between devices and/or equipment. Conduits that carry fiber optic cables between devices and/or equipment.
 3. Instrumentation Conduits – Conduits that carry AC or DC analog signal wiring between devices and/or equipment.

PART 2 – PRODUCTS

2.01 GENERAL

- A. Conduit and conduit fitting products are specified in the text that follows this article. Reference Part 3 herein for the application, uses and installation requirements of these conduits and conduit fittings.
- B. All metallic conduit fittings shall be UL 514B and UL 467 Listed, and constructed in accordance with ANSI FB 1. All metallic conduit fittings for use in Class I Division I hazardous areas shall be UL 1203 Listed. All non-metallic fittings shall be UL 651 Listed and constructed in accordance with NEMA TC-3.
- C. Flexible conduit couplings for use in Class I Division I hazardous areas shall have threaded stainless steel end fittings and a flexible braided core. Flexible braid shall be constructed of stainless steel where available in the conduit trade size required for the application. Where stainless steel braid is not available, the braid shall be provided with a PVC coating. No other braid types or materials are acceptable.
- D. Where threading is specified herein for conduit fitting connections, the fittings shall be manufactured to accept conduit that is threaded to ANSI B1.20.1 requirements.
- E. Conduit expansion fittings for all conduit materials of construction shall be capable of 4 inches of movement along the axis of the conduit for trade sizes 2 inches or less. Expansion fittings shall be capable of 8 inches of movement along the axis of the conduit for trade sizes greater than 2 inches.
- F. Conduit deflection fittings for all conduit materials of construction shall be provided with a flexible neoprene outer jacket that permits up to $\frac{3}{4}$ inch of expansion/contraction along the axis of the conduit as well as up to $\frac{3}{4}$ inch of parallel misalignment between the conduit axes. Outer jacket shall be secured to the conduit hubs by stainless steel clamps.

- G. Conduit seals shall either be Listed and labeled for 40% fill, or conduit reducing fittings and a trade size larger conduit seal shall be provided to achieve 25% or less fill within the seal. Percentage fill calculation shall be based on the conductors to be installed. Conduit seals shall be provided with breathers and/or drains where required by the NEC.
- H. Conduit insulating bushings shall be constructed of plastic and shall have internal threading.
- I. Additional conduit and conduit fitting requirements are specified in the articles that follow based on the specific conduit material of construction to be used.

2.02 RIGID NONMETALLIC CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

- 1. Conduit shall be Schedule 40 or 80 (dependent on application) polyvinyl chloride (PVC) construction, manufactured in accordance with NEMA TC-2, UL 651 Listed, and suitable for conductors with 90 degree C insulation.

B. Conduit Bodies for use with Rigid Nonmetallic Conduit

- 1. Conduit bodies shall be constructed of PVC. Conduit hubs shall be integral to the conduit body and shall be smooth inside to accept a glued conduit connection.
- 2. Conduit body shall be provided with cover that is affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings and Unions for use with Rigid Nonmetallic Conduit

- 1. Conduit couplings and unions shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

D. Conduit Expansion and Deflection Fittings for use with Rigid Nonmetallic Conduit

- 1. Conduit expansion fittings and conduit deflection fittings shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection.

E. Conduit Termination Fittings for use with Rigid Nonmetallic Conduit

- 1. Conduit hubs shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. Hubs shall have external threads and an accompanying PVC locknut, and shall be watertight when assembled to an enclosure.
- 2. Conduit locknuts shall be constructed of zinc plated steel. Locknuts shall have internal threading. Locknuts constructed of PVC and locknuts with integral gasket or seal are not acceptable.
- 3. Conduit end bells shall be constructed of PVC and shall be smooth inside to accept a glued conduit connection. End bell shall have a smooth inner surface that curves outward towards the edge of the fitting.

2.03 PVC COATED RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. General

1. Where an external coating of polyvinyl chloride (PVC) is specified for conduit and fittings, the coating shall be 40 mil (minimum) thickness. Where an internal coating of urethane is specified for conduit and fittings, the coating shall be 2 mil (minimum) thickness.
2. All conduit fittings shall have a sealing sleeve constructed of PVC which covers all connections to conduit. Sleeves shall be appropriately sized so that no conduit threads will be exposed after assembly.

B. Conduit

1. Conduit shall be hot dip galvanized on the inside and outside, and made of heavy wall high strength aluminum. Conduit shall be manufactured in accordance with ANSI C80.1, and shall be UL 6 Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.
3. Conduit shall be coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit shall be manufactured in accordance with NEMA RN-1.

C. Conduit Bodies for use with PVC Coated Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.
3. Conduit bodies for all other areas shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Covers shall be affixed in place by stainless steel screws which thread directly into the conduit body and have a plastic encapsulated head. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

D. Conduit Couplings, Nipples, and Unions for use with PVC Coated Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of hot dipped galvanized steel which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Split-type couplings that use compression to connect conduits are not acceptable.
 2. Unions shall be threaded, rain-tight, and constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane.
- E. Conduit Expansion and Deflection Fittings for use with PVC Coated Rigid Aluminum Conduit
1. Conduit expansion fittings and conduit deflection fittings shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Expansion and deflection fittings shall have threaded conduit connections.
 2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.
- F. Conduit Seals for use with PVC Coated Rigid Aluminum Conduit
1. Conduit seals shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Conduit seals shall have threaded conduit connections.
- G. Conduit Termination Fittings for Use with PVC Coated Rigid Aluminum Conduit
1. Conduit hubs shall be constructed of an electro-galvanized malleable iron alloy which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Hubs shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.
 2. Conduit bonding bushings shall be constructed of zinc plated malleable iron which is coated on the exterior with a PVC jacket and coated on the interior with a layer of urethane. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.04 RIGID ALUMINUM CONDUIT AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be made of heavy wall high strength 6063 alloy aluminum with temper designation T1. Conduit shall be manufactured in accordance with ANSI C80.5, and shall be UL 6A Listed.
2. Conduit shall be provided with factory-cut 3/4 inch per foot tapered threads at each end in accordance with ANSI B1.20.1. Threads shall be cut prior to galvanizing to

ensure corrosion protection adequately protects the threads. Conduit shall be provided with a matching coupling on one end and a color-coded thread protector on the other.

B. Conduit Bodies for use with Rigid Aluminum Conduit

1. Conduit bodies shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit bodies shall have integral threaded conduit hubs.
2. Conduit bodies for Class I Division I hazardous areas shall be provided with integrally threaded covers constructed of copper-free aluminum which is coated with an aluminum enamel finish.
3. Conduit bodies for all other areas shall be provided with stamped copper-free aluminum covers that are affixed in place by stainless steel screws which thread directly into the conduit body. Covers that utilize wedge nuts or any other method of attachment to the conduit body are not acceptable. Covers shall be provided with matching gasket.

C. Conduit Couplings, Nipples, and Unions for use with Rigid Aluminum Conduit

1. Couplings and nipples shall be threaded and shall be constructed of heavy wall high strength 6063 alloy aluminum with temper designation T1. Split-type couplings that use compression to connect conduits are not acceptable.
2. Unions shall be threaded, rain-tight, and constructed of copper-free aluminum which is coated with an aluminum enamel finish.

D. Conduit Expansion and Deflection Fittings for use with Rigid Aluminum Conduit

1. Conduit expansion fittings and conduit deflection fittings shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Expansion and deflection fittings shall have threaded conduit connections.
2. Expansion fittings shall have an integral bonding jumper and deflection fittings shall have an external bonding jumper.

E. Conduit Seals for use with Rigid Aluminum Conduit

1. Conduit seals shall be constructed of copper-free aluminum which is coated with an aluminum enamel finish. Conduit seals shall have threaded conduit connections.

F. Conduit Termination Fittings for use with Rigid Aluminum Conduit

1. Conduit hubs shall be constructed of copper-free aluminum and shall have threaded connections to the conduit and enclosure. Hubs shall have a plastic insulated throat and shall be watertight when assembled to an enclosure.

2. Conduit locknuts shall be constructed of copper-free aluminum. Locknuts shall have internal threading. Locknuts with integral gasket or seal are not acceptable. Locknuts shall have integral bonding screw where required for proper bonding.
3. Conduit bonding bushings shall be constructed of copper-free aluminum. Bonding bushings shall have a threaded conduit connection. Bonding bushing shall be provided with properly sized set screw for connecting bonding conductor and an integral plastic insulator rated for 150 degrees C located in the throat.

2.05 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be manufactured using a single strip of hot dip galvanized high strength steel alloy, helically formed into a continuously interlocked flexible metal conduit. Trade size 1-1/4 inch and smaller conduits shall be provided with an integrally woven copper bonding strip.
2. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 360 Listed.

B. Conduit Termination Fittings for use with LFMC

1. Conduit termination fittings shall be constructed of either 304 stainless steel or an electro-galvanized malleable iron alloy which is coated on the exterior with a 40 mil (minimum) PVC jacket and coated on the interior with a 2 mil (minimum) layer of urethane. PVC coated fittings shall have a sealing sleeve constructed of PVC which covers the connection to conduit.
2. Termination fittings shall have a threaded end with matching locknut and sealing ring for termination to equipment, and shall have an integral external bonding lug where required for proper bonding. Termination fittings shall have a plastic insulated throat and shall be watertight when assembled to the conduit and equipment.

2.06 LIQUID TIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC) AND ASSOCIATED FITTINGS

A. Conduit

1. Conduit shall be constructed of rigid polyvinyl chloride (PVC), fabricated to provide flexibility. Conduit shall be covered with an outside PVC jacket that is UV resistant, moisture-proof, and oil-proof. Conduit shall be UL 1660 Listed.

B. Conduit Termination Fittings for use with LFNC

1. Conduit termination fittings shall be constructed PVC and shall have a threaded end with matching locknut and sealing ring for termination to equipment. Termination fittings shall be watertight when assembled to the conduit and equipment.

2.07 CONDUIT BENDS

- A. Rigid conduit bends, both factory fabricated and field fabricated, shall meet the same requirements listed in the articles above for the respective conduit type and material of construction.
- B. Conduit bend radii for standard radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	4-1/2	5-3/4	7-1/4	8-1/4	9-1/2	10-1/2	13	15	16	24	30

- C. Conduit bend radii for long radius bends shall be no less than as follows:

TRADE SIZE (inches)	3/4	1	1-1/4	1-1/2	2	2-1/2	3	3-1/2	4	5	6
MIN. RADIUS (inches)	N/A	12	18	24	30	30	36	36	48	48	60

2.08 MISCELLANEOUS

- A. Conduit Periphery Sealing

1. The sealing of the exterior surface of conduits to prevent water and/or air from passing around the conduit periphery from one space to another (where required) shall be through the use of one of the following:
 - a. A conduit sleeve and pressure bushing sealing system. Acceptable products are FSK by OZ-GEDNEY, Link-Seal by Crouse-Hinds, or Engineer approved equal.
 - b. A conduit sleeve that is two trade sizes larger than the conduit being sealed, with 2-hour fire rated UL 1479 Listed caulk filling the entire void between the conduit and sleeve. This method is only suitable for penetrations in non-fire rated walls and floors between spaces within buildings. This method shall not be used for the sealing of conduits leaving a building and/or structure.
2. Conduit penetrations through fire-rated walls and floors shall be made with an approved UL 1479 Listed product specifically intended for the trade size of the conduit.

- B. Primer and Cement

1. Nonmetallic conduit shall be cleaned with primer and connected to fittings with the manufacturer's recommended cement that is labeled Low VOC.

C. Galvanizing Compounds

1. Galvanizing compounds for field application shall be the cold-applied type, containing no less than 93% pure zinc.

D. Conduit Interior Sealing

1. The sealing of the inside of conduits against water ingress shall be achieved through the use of one of the following:
 - a. Two-part expanding polyurethane foam sealing compound, dispensed from a single tube which mixes the two parts as it is injected into the conduit. Expanding foam shall be compatible with the conduit material of construction as well as the outer jacket of the cables in the conduit. Acceptable products are Q-Pak 2000 by Chemque, FST by American Polywater Corporation, or Hydra-seal S-60 by Duraline.
 - b. Inflatable bag that provides seal around cables and around inside diameter of conduit. Provide appropriate quantity of additional fittings for applications with three or more cables in the conduit to be sealed. Acceptable products are Rayflate by Raychem, or Engineer approved equal. This sealing method is only applicable to conduits trade size 2 inch and larger.
 - c. Neoprene sealing ring provided with the required quantity and diameter of holes to accommodate the cables in each conduit. Sealing ring shall be compressed by two stainless steel pressure plates. Acceptable products are type CSB by OZ-GEDNEY, or Engineer approved equal. This sealing method is only applicable to metallic conduits containing 4 or less cables.
2. The use of aerosol-based expanding foam sealants or any other method of sealing against water ingress not listed above is not acceptable.

E. Pull Rope

1. Pull ropes for empty and/or spare conduits shall be woven polyester, 1/2 inch wide, with a minimum tensile strength of 1250 lbs.
2. Pull ropes for the Contractors use in installing conductors shall be the size and strength required for the pull, and shall be made of a non-metallic material.

PART 3 – EXECUTION

3.01 GENERAL

- A. Minimum trade size for all rigid conduits shall be 3/4 inch in exposed applications and 1 inch in embedded applications. Conduits installed within ductbanks shall be allowed to be

increased in size to trade size 2 inch, at the Contractor's option, to accommodate the saddle size of the ductbank spacers. However, no combining of circuits shall be allowed in the larger conduits.

- B. Minimum trade size for flexible conduits (where specifically allowed herein) shall be 1/2 inch in all applications.
- C. Conduit routing and/or homeruns within structures is not shown on the Drawings. Conduits shall be installed concealed wherever practical and within the limitations specified herein. All other conduits not capable of being installed concealed shall be installed exposed.
- D. Empty and/or spare conduits shall be provided with pull ropes which have no less than 12 inches of slack at each end.
- E. Nonmetallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, cleaned of debris, and primer shall be applied to ready each joint for fusing. Conduits shall then be fused together with the conduit manufacturer's approved cement compound.
- F. Metallic conduits for installations requiring less than a factory length of conduit shall be field cut to the required length. The cut shall be made square, be cleaned of all debris and be de-burred, then threaded. Conduit threading performed in the field shall be 3/4 inch per foot tapered threads in accordance with ANSI B1.20.1.
- G. Conduits shall be protected from moisture, corrosion, and physical damage during construction. Install dust-tight and water-tight conduit fittings on the ends of all conduits immediately after installation and do not remove until conductors are installed.
- H. Conduits shall be installed to provide no less than 12 inches clearance from pipes that have the potential to impart heat upon the conduit. Such pipes include, but are not limited to, hot water pipes, steam pipes, exhaust pipes, and blower air pipes. Clearance shall be maintained whether conduit is installed in parallel or in crossing of pipes.
- I. Where non-metallic instrumentation conduits are installed exposed, the following clearances to other conduit types shall be maintained:
 - 1. Instrumentation conduits installed parallel to conduits with conductors energized at 480V or above shall be 18 inches.
 - 2. Instrumentation conduits installed parallel to conduits with conductors energized at 240V and below shall be 12 inches.
 - 3. Instrumentation conduits installed at right angles to conductors energized at 480V and below shall be 6 inches.
 - 4. Instrumentation conduits installed at right angles to conductors energized at voltages above 480V shall be 12 inches.
- J. Where conduit fittings do not include an integral insulated bushing, an insulated bushing shall be installed at all conduit termination points.

- K. Conduits which serve multi-section equipment shall be terminated in the section where wiring terminations will be made.
- L. Conduits shall not penetrate the floors or walls inside liquid containment areas without specific written authorization from the Engineer. Liquid containment areas are indicated on the Drawings.
- M. In no case shall conduit be supported or fastened to another pipe or be installed in a manner that would prevent the removal of other pipes for repairs. Spring steel fasteners may only be used to affix conduits containing lighting branch circuits within EMT conduits to structural steel members.
- N. All field fabricated threads for rigid galvanized steel conduit shall be thoroughly coated with two coats of galvanizing compound, allowing at least two minutes to elapse between coats for proper drying.
- O. The appropriate specialized tools shall be used for the installation of PVC coated conduit and conduit fittings. No damage to the PVC coating shall occur during installation. Conduit and conduit fittings with damaged PVC coating shall be replaced at the Contractor's cost. The use of PVC coating touch-up compounds is not permitted.
- P. Conduits which emerge from within or below concrete encasement shall be PVC coated rigid galvanized steel in accordance with Standard Detail 1611102 where the conduit is not protected by an equipment enclosure that surrounds the conduit on all sides at the point where it emerges from the encasement.
- Q. Aluminum conduits shall not be installed in direct contact with concrete surfaces. Where aluminum conduits are routed along concrete surfaces, they shall be installed with one-hole electro-galvanized malleable iron alloy straps with matching clamp-backs to space the conduit $\frac{1}{4}$ inch away from concrete surface. Where aluminum conduit passes through concrete, CMU or brick walls, the penetration shall be made such that the aluminum conduit does not come in contact with concrete, CMU, brick or mortar.

3.02 CONCEALED AND EMBEDDED CONDUITS

- A. Conduits are permitted to be installed concealed and/or embedded with the following requirements:
 - 1. Conduits shall not be installed horizontally when concealed within CMU walls, only vertical installation is acceptable.
 - 2. Conduits installed embedded within concrete floors or walls shall be located so as not to affect the designed structural strength of the floor or wall. Embedded conduits shall be installed in accordance with Standard Detail 0331604 and ACI-318.
 - 3. Where conduit bends emerge from concrete embedment, none of the curved portion of the bend shall be visible. Only the straight portion of the bend shall be visible. The straight portion shall emerge perpendicular to the embedment (i.e. neatly oriented 90-degrees to floor/slab/grade). Conduits that emerge in a non-perpendicular orientation are not acceptable.

4. Where multiple conduits emerge from concrete embedment or from concealment below a concrete floor, ample clear space shall be provided between conduits to allow for the appropriate and required conduit termination fittings to be installed.
 5. Conduits installed embedded within concrete encasement of any kind shall be installed such that conduit couplings for parallel conduits are staggered so that they are not side by side.
- B. Conduits are NOT permitted to be installed concealed and/or embedded for the following situations:
1. Conduits shall not be installed embedded within any water-bearing floors or walls. Conduits shall not be installed embedded within any liquid containment area floors or walls.
 2. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to Class I and II hazardous areas (Division I and Division II).
 3. Conduits shall not be installed concealed within CMU walls or gypsum walls that are adjacent to indoor Type 1 or Type 2 chemical storage/transfer areas.

3.03 CONDUIT USES AND APPLICATIONS

A. Rigid Conduit

1. Rigid conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/ SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
All Exposed conduit	Rigid aluminum conduit	Same as Power and Control
Concealed within underground direct-bury or concrete-encased ductbanks	Schedule 40 rigid non-metallic PVC conduit	PVC coated rigid aluminum conduit
Emerging from concealment within or below a concrete floor and transitioning to exposed conduit (Reference Detail 1611102)	PVC coated rigid aluminum conduit	Same as Power and Control

2. Rigid conduit for hazardous areas shall be furnished and installed in the materials of construction as follows:

RIGID CONDUIT FOR HAZARDOUS AREAS		
<u>INSTALLATION AREA HAZARD/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in Class I and II areas (Division I and Division II)	Rigid aluminum conduit	Same as Power and Control
Concealed within concrete slabs in Class I and II areas (Division I and Division II)	PVC coated rigid aluminum conduit	Same as Power and Control
Concealed below concrete slabs (within earth or fill material) in Class I and II areas (Division I and Division II)	PVC coated rigid aluminum conduit	Same as Power and Control
Concealed below concrete slabs encased in at least two inches of concrete and buried 24 inches below top of slab in Class I Division I areas	Schedule 40 rigid non-metallic PVC conduit	PVC coated rigid aluminum conduit

3. The tables for the materials of construction for rigid conduits are intended to exhaustively cover all possible scenarios and installation areas under this Contract. However, if a scenario or installation area is found that is not explicitly governed by these tables, it shall be assumed for bid purposes that the conduit material of construction is to be rigid aluminum. This discrepancy shall be brought to the attention of the Engineer (in writing) immediately for resolution.

B. Conduit Bends

1. All conduit bends shall be the same material of construction as the rigid conduit listed in the tables above, with the following exceptions:
 - a. All 90 degree bends or combinations of adjacent bends that form a 90 degree bend where concealed within concrete or below a concrete slab shall be PVC coated rigid aluminum.
2. Field fabricated bends of metallic conduit shall be made with a bending machine and shall have no kinks. Field fabricated standard radius and long radius bends shall have minimum bending radii in accordance with the associated tables in Part 2 herein.
3. Field bending of non-metallic conduits is not acceptable, factory fabricated bends shall be used.
4. Long radius bends shall be furnished and installed for the following specific applications, all other bends shall be standard radius:
 - a. Where specifically indicated on the Drawings.

C. Flexible Conduit

1. Flexible conduit shall only be installed for the limited applications specified herein. Flexible conduit shall not be installed in any other application without written authorization from the Engineer. Acceptable applications are as follows:
 - a. Connections to motors and engine-generator sets (and similar vibrating equipment)
 - b. Connections to solenoid valves and limit switches
 - c. Connections to lighting transformers
 - d. Connections to instrument transmitters and elements
 - e. Where specifically indicated in the Standard Details
2. Flexible conduit length shall be limited to three (3) feet, maximum. Flexible conduit shall not be installed buried or embedded within any material.
3. Unless otherwise specified herein, flexible conduits shall be installed in accordance with the Installation Guidelines published within NEMA RV-3.
4. Flexible conduit for non-hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR NON-HAZARDOUS AREAS		
<u>INSTALLATION AREA DESIGNATION/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in outdoor areas	Liquid-tight flexible metal conduit	Same as Power and Control

5. For Class I Division I hazardous areas, the NEC does not permit the installation of flexible conduit. In lieu of flexible conduit in these areas, flexible conduit couplings shall be installed as specified in Part 2 herein. Flexible conduit for all other hazardous areas shall be furnished and installed in the materials of construction as follows:

FLEXIBLE CONDUIT FOR HAZARDOUS AREAS		
<u>INSTALLATION AREA HAZARD/SCENARIO</u>	<u>CONDUIT CATEGORY BY WIRING/CIRCUIT TYPE</u>	
	Power and Control	Instrumentation
Exposed in Class I Division II areas	Liquid-tight flexible metal conduit	Same as Power and Control

3.04 CONDUIT FITTING USES AND APPLICATIONS

A. General

1. Conduit fittings shall be furnished and installed in the materials of construction as indicated in Part 2, herein. Conduit fitting materials of construction are dependent on the material of construction used for the associated conduit.
2. Conduit fittings shall be provided in the trade size and configuration required to suit the application.

B. Conduit Bodies

1. Conduit bodies shall be installed where wire pulling points are desired or required, or where changes in conduit direction or breaking around beams is required.
2. Where conduit bodies larger than trade size 2 inches are intended to be used as a pull-through fitting during wire installation, oversized or elongated conduit bodies shall be used. Oversized or elongated conduit bodies shall not be required if the conduit body is intended to be used as a pull-out point during wire installation.

C. Conduit Nipples and Unions

1. Conduits with running threads shall not be used in place of 3-piece couplings (unions) or close nipples. After installation of a conduit fitting of any kind, there shall be no more than $\frac{1}{4}$ inch of exposed threads visible. Factory fabricated all-thread nipples may be used between adjacent enclosures, however, the same restriction applies regarding the length of exposed threads that are visible.

D. Conduit Expansion and Deflection Fittings

1. Conduit expansion fittings shall be installed where required by the NEC and where indicated on the Drawings. Expansion fittings shall also be installed for exposed straight metallic conduit runs of more than 75 feet, in both indoor and outdoor locations. Expansion fittings for runs of non-metallic conduit shall be installed in accordance with the NEC.
2. Conduit deflection fittings shall be installed where required by the NEC and where conduits are installed (exposed and concealed) across structural expansion joints.

E. Conduit Seals

1. Conduit seals shall be installed for conduits installed within or associated with hazardous areas and other areas as required by the NEC. In addition, conduit seals shall also be furnished and installed as follows:
 - a. All conduits entering or leaving enclosed areas which store or distribute chlorine gas.
 - b. All conduits entering or leaving enclosed areas which store or distribute sulfur dioxide gas.

F. Conduit Termination Fittings

1. Where conduits terminate at enclosures with a NEMA 4, 4X, or 3R rating and the enclosure does not have integral conduit hubs, an appropriately sized watertight conduit hub shall be installed to maintain the integrity of the enclosure. The use of locknuts with integral gasket in lieu of watertight conduit hubs is not acceptable.
2. Where conduits terminate at enclosures that do not require conduit hubs, a two-locknut system shall be used to secure the conduit to the enclosure. One locknut shall be installed on the outside of the enclosure, and the other inside, drawn tight against the enclosure wall. The locknut on the interior of the enclosure shall be the type with integral bonding lug, or a conduit bonding bushing may be used in place of the locknut.
3. Conduits shall not be installed such that conduit fittings penetrate the top of any enclosure located outdoors, except in cases where specifically required by the serving electric utility. Conduits which serve outdoor equipment or an enclosure from above shall instead be routed into the side of the enclosure at the bottom. The conduit termination fitting shall be provided with a conduit drain to divert moisture from the raceway away from the enclosure.

3.05 MISCELLANEOUS

A. Conduit Periphery Sealing

1. All conduit penetrations through exterior walls shall be sealed around the periphery using the appropriate products specified in Part 2 herein to prevent air and/or water entry into the structure.
2. All conduit penetrations through interior walls and floors shall be sealed through the use of with conduit sleeves and caulk as specified in Part 2 herein. Alternatively, mortar may be used to seal around the conduit periphery.
3. Conduit penetrations through fire-rated walls as floors shall be made with the appropriate fire rated penetration product.

B. Conduit Interior Sealing

1. All conduits (including spares) entering a structure below grade shall be sealed on the interior of the conduit against water ingress. Sealing shall be at an accessible location in the conduit system located within the building structure and shall be via one of the methods specified in Part 2 herein. If conduit sealing cannot be achieved at an accessible location within the building structure, sealing shall be placed in the conduits in the nearest manhole or handhole outside the structure.

3.06 CONDUIT IDENTIFICATION

- A. Exposed conduits shall be identified at the source, load, and all intermediate components of the raceway system. Examples of intermediate components include but are not limited to junction boxes, pull boxes, and disconnect switches. Identification shall be by means of an adhesive label with the following requirements:

1. Labels shall consist of an orange background with black text. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 2. In addition, at the source end of the conduit, a second line of text shall be included to indicate the load equipment name. This second line shall consist of the word "TO:" and the text in the 'TO' column of the conduit and wire schedule (e.g. TO: Gate No. 1). At the load end of the conduit, a second line of text shall be included to indicate the source equipment name. This second line shall consist of the word "FROM:" and the text in the 'FROM' column of the conduit and wire schedule (e.g. FROM: MPZ-1). This requirement applies only to the source and load ends of the conduit, and not anywhere in between.
 3. For conduits trade sizes 3/4 inch through 1-1/2 inch, the text shall be a minimum 18 point font. For conduits trade size 2 inch and larger, the text shall be a minimum 24 point font.
 4. Label height shall be 3/4 inch minimum, and length shall be as required to fit required text. The label shall be installed such that the text is parallel with the axis of the conduit. The label shall be oriented such that the text can be read without the use of any special tools or removal of equipment.
 5. Labels shall be installed after each conduit is installed and, if applicable, after painting. Labels shall be printed in the field via the use of a portable label printing system. Handwritten labels are not acceptable.
 6. Labels shall be made of permanent vinyl with adhesive backing. Labels made of any other material are not acceptable.
- B. Conduits that are not exposed but installed beneath free standing equipment enclosures shall be identified by means of a plastic tag with the following requirements:
1. The tag shall be made of white Tyvek material, and have an orange label with black text, as described above, adhered to it. Text for the label shall be the conduit number as indicated in the conduit and wire schedules.
 2. The tag shall be affixed to the conduit by means of a nylon cable tie. The tag shall be of suitable dimensions to achieve a minimum text size of 18 points.
- C. Conduits for lighting and receptacle circuits shall not require identification.
- D. Any problems or conflicts with meeting the requirements above shall immediately be brought to the attention of the Engineer for a decision.

3.07 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. All conduit installed below grade or concrete encased shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of a suitable pulling rope.

3.08 TRAINING OF INSTALLATION PERSONNEL

- A. All Contractor personnel that install PVC coated RGS conduit shall be trained by the PVC coated RGS conduit manufacturer. Training shall include proper conduit system assembly techniques, use of tools appropriate for coated conduit systems, and field bending/cutting/threading of coated conduit. Training shall have been completed within the past 24 months prior to the Notice to Proceed on this Contract to be considered valid. Contractor personnel not trained within this timeframe shall not be allowed to install coated conduit, or shall be trained/re-trained as required prior to commencement of conduit installation.

- END OF SECTION -

SECTION 16118

UNDERGROUND ELECTRICAL

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install underground duct systems, electric manholes, and electric handholes as specified herein and as indicated on the Drawings. The work shall be complete and shall include excavation, concrete construction, backfilling, and all materials, items, and components required for a complete system.
- B. The provisions of this Division are applicable to all underground conduit work. All work shall be coordinated with that of the various utility companies and other Contractors. The Contractor shall adhere to all utility company requirements including the serving electric utility.
- C. Reference Section 16000, Basic Electrical Requirements; Section 16111, Conduit; Section 16170, Grounding and Bonding; the applicable sections of Division 2, Sitework; Section 03200, Reinforcing Steel; and 03300, Cast-In-Place Concrete.

1.02 CODES AND STANDARDS

- A. Products specified herein shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. AASHTO H20
 - 2. ANSI/SCTE 77-2010 – Specification for Underground Enclosure Integrity

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit Shop Drawings. Each submittal shall be identified by the applicable Specification Section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

- C. Shop drawings shall include but not be limited to, the following:
1. Product data sheets.
 2. Outline and dimensional drawings including detailed sections of the manholes and/or handholes.
 3. Materials specifications and structural calculations for the manholes sealed by a Professional Engineer in the State of North Carolina.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings.

2.02 DUCT SYSTEM

- A. The underground duct system shall be comprised of conduits, conduit bends, and conduit fittings as specified in Section 16111, Conduit. Conduits shall be encased in reinforced concrete envelopes, unless otherwise specified herein or indicated on the Drawings.
- B. Base and intermediate conduit spacers shall be furnished to provide a minimum of two-inch (2") separation between conduits. Conduit spacers shall be provided in the proper size as required for the conduit that they secure. For example, a 4" conduit spacer shall not be used to secure a 2" conduit. Conduit spacers shall be as manufactured by Carlon Electrical Products Company, Aeroquip Corporation, Underground Devices, Incorporated, or equal.

PART 3 -- EXECUTION

3.01 GENERAL

- A. The underground duct system, manholes, and handholes shall be installed as specified herein, indicated on the Drawings, and in accordance with manufacturers' instructions.

3.02 DUCT SYSTEM

- A. All underground conduit shall be encased in concrete and shall be reinforced. Encasement and reinforcement shall be as indicated in the standard details. Concrete shall be furnished and installed in accordance with Section 03300. Reinforcing steel shall be furnished and installed in accordance with Section 03200. Concrete electrical duct banks shall contain red dye; the red dye shall be mixed into the concrete mix before being poured. Red dye applied to the top of concrete encasement after placement of concrete is not acceptable.

- B. Concrete pours shall be complete from handhole to handhole and from manhole to manhole where practicable. Partial pours in general shall not be permitted. Where a complete pour is impractical, written authorization shall be obtained from the Engineer for the partial pour.
- C. Conduit ductbank elevations at the manholes and handholes shall be based on minimum ductbank cover as indicated in the standard details, or deeper to avoid conflicts with other obstacles. Where deviation is necessary to clear unforeseen obstacles, the elevations may be changed after authorization by the Engineer.
- D. Slope all conduits continuously away from structures and buildings with a minimum slope of 3" per 100' unless otherwise indicated on the Drawings.
- E. The minimum clearance from the top of the concrete encasement and finished grade shall be as indicated in the standard details, except where otherwise accepted in writing by the Engineer or shown on the Drawings.
- F. Care shall be exercised during excavation for the duct banks to prevent digging too deep. Backfilling of low spots with earth fill will not be permitted unless thoroughly compacted and acceptable to the Engineer.
- G. If a specific ductbank arrangement is shown on the Drawings, the conduits in that ductbank shall be arranged as shown. Where no specific ductbank arrangement is shown on the Drawings, the Contractor shall arrange conduits within each ductbank based on field conditions. Spare conduits shown going from ductbanks into buildings or structures shall be stubbed up in the location(s) as indicated on the Drawings.
- H. A minimum of one (1) ground rod, furnished in accordance with Section 16170, shall be driven adjacent to each manhole, handhole, or other concrete box. A No. 4/0 AWG bare copper ground cable shall be connected between this rod and the copper ground strap using a silicon bronze connector. All ground rods shall be interconnected by means of the No. 4/0 AWG bare copper ground cable located within each duct bank. The ends of these cables shall also be connected to substation and/or building ground buses where the conduits terminate.
- I. Care shall be exercised and temporary plugs shall be installed during installation to prevent the entrance of concrete, mortar, or other foreign matter into the conduit system. Conduit spacers shall be utilized to support conduit during the pouring of concrete to prevent movement and misalignment of the conduits. Conduit spacers shall be installed in accordance with manufacturer's instructions unless otherwise noted. Horizontal spacing of conduit spacers along ductbank shall be as indicated on the Standard Details.
- J. Where connections to existing underground conduits are indicated, excavate to the maximum depth necessary. After addressing the existing conductors, cut the conduits and remove loose concrete from the conduits before installing new concrete encased ducts. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines.

- K. Construct concrete-encased conduits connecting to underground structures to have a flared section adjacent to the manhole to provide shear strength. Construct underground structures to provide shear strength. Construct underground structures to provide for keying the concrete encasement of the duct line into the wall of the structure. Use vibrators when this portion of the encasement is poured to ensure a seal between the encasement and the wall of the structure.
- L. Six (6) inches above all duct banks, the Contractor shall furnish and install a two (2) inch wide red plastic electrical hazard tape. Tapes shall be metallic detectable type and shall have a continuous message in bold black letters: "ELECTRIC LINE BURIED BELOW." Tape shall be Detectable Identoline by Brady, or equal.
- M. The Contractor shall perform all earthwork including excavation, backfill, bedding, compaction, shoring and bracing, grading and restoration of surfaces and seeded areas disturbed during the execution of the work.
- N. All conduit joints in the duct system shall be staggered such that adjacent conduits do not have joints in the same location.

3.03 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Field tests
 - a. Field tests for all completed duct systems shall consist of pulling a swab through each conduit followed by a mandrel equal in size to 85% of the conduit inside diameter.
 - b. After testing, all conduits shall be capped after installation of a suitable pull rope. All field tests shall be witnessed by the Engineer.

- END OF SECTION -

SECTION 16123

LOW VOLTAGE WIRE AND CABLE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, all low voltage wire and cable indicated on the Drawings and as specified herein and/or required for proper operation. The work of connecting cables to equipment and devices shall be considered a part of this Section. All appurtenances required for the installation of wire and cable systems shall be furnished and installed by the Contractor.
- B. The scope of this Section does not include internal wiring factory installed by electrical equipment manufacturers.
- C. Reference Section 16000 – Basic Electrical Requirements and Section 16130 – Boxes.

1.02 CODES AND STANDARDS

- A. Low voltage wire, cable, and appurtenances shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. Underwriters Laboratories (UL)
 - a. UL 13 – Standard for Power-Limited Circuit Cables
 - b. UL 44 – Thermoset-Insulated Wires and Cables
 - c. UL 83 – Thermoplastic-Insulated Wires and Cables
 - d. UL 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 - e. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords
 - f. UL 1685 – Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
 - g. UL 2250 – Standard for Instrumentation Tray Cable
 - h. UL 2556 – Wire and Cable Test Methods
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire

- b. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - c. ASTM B33 – Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes
 - d. ASTM D69 – Standard Test Methods for Friction Tapes
 - e. ASTM D4388 – Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes
3. Insulated Cable Engineers Association (ICEA)
- a. ICEA S-58-679 – Standard for Control, Instrumentation and Thermocouple Extension Conductor Identification
 - b. ICEA T-29-250 – Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour
4. Institute of Electrical and Electronics Engineers (IEEE)
- a. IEEE 1202 – Standard for Flame Testing of Cables

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300 – Submittals, the Contractor shall obtain from the wire and cable manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of Field Tests
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for wire and cable, terminations, and pulling lubricant.
 - 2. Cable pulling calculations (if required).
 - 3. Wiring identification methods and materials.

- D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 CABLE PULLING CALCULATIONS

- A. Prior to the installation of the wire and cable specified herein, the Contractor shall submit cable pulling calculations for engineer review and approval when all of the following are true:
 - 1. The amount of cable to be installed will be greater than 200 linear feet between pull points.
 - 2. The installation will have one or more bends.
 - 3. The wire and cable is size #1/0 AWG and larger.
- B. Cable pulling calculations shall be performed by a currently registered professional engineer in the State of North Carolina and shall define pulling tension and sidewall loading (sidewall bearing pressure values).

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years. Wire and cable shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and indicated on the Drawings. Only one (1) manufacturer for each wire and cable type shall be permitted.

2.02 POWER AND CONTROL WIRE AND CABLE

- A. Power and control wire shall consist of insulated copper conductors with a nylon (or equivalent) outer jacket. Conductor insulation shall be rated 90°C for dry locations, 75°C for wet locations, and 600V. Insulated conductors shall be UL 83 Listed as NEC Type THHN/THWN.
- B. Unless specified otherwise herein, conductors shall be stranded copper per ASTM B-8 and B-3, with Class B or C stranding contingent upon the size.
- C. Power conductor size shall be no smaller than No. 12 AWG and Control conductor size shall be no smaller than No. 14 AWG.
- D. Multi-conductor cable assemblies shall include a grounding conductor and an overall PVC jacket. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in

accordance with UL 1277. Multi-conductor cable assemblies shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).

- E. Power wire and cable shall be as manufactured by the Okonite Company, the Southwire Company, General Cable, Encore Wire, or equal.

2.03 INSTRUMENTATION CABLE

- A. For single-analog signal applications, instrumentation cable shall consist of a single, twisted pair or triad of individually insulated and jacketed copper conductors with an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- B. For multiple-analog signal applications, instrumentation cable shall consist of multiple, twisted pairs or triads (i.e. groups) of individually insulated and jacketed copper conductors with individual pair/triad shields (i.e. group shields) and an overall cable shield and jacket. Conductor insulation shall be rated 90°C in both wet and dry locations, and 600V. The jacket shall be PVC and resistant to abrasion, sunlight, and flame in accordance with UL 1277. Cable shall be UL 1277 Listed as NEC Type TC (Power and Control Tray Cable).
- C. Cable and group shields shall consist of overlapped aluminum/polyester tape/foil providing 100% coverage. Instrumentation cables shall include an overall copper shield drain wire. Cables containing multiple twisted pairs or triads shall also include group shield drain wires.
- D. Conductors, including drain wires, shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM B-8, with Class B stranding unless otherwise specified.
- E. Instrumentation signal conductor size shall be no smaller than No. 16 AWG.
- F. Instrumentation cable shall be Okoseal-N Type P-OS (for single pair or triad applications) or Okoseal-N Type SP-OS (for multiple pair or triad applications) as manufactured by the Okonite Company, Belden equivalent, Southwire Company equivalent, or equal.

2.04 CONDUCTOR IDENTIFICATION

- A. Conductors shall be identified using a color coding method. Color coding for individual power, control, lighting, and receptacle conductors shall be as follows:
 - 1. 480/277V AC Power
 - a. Phase A - BROWN
 - b. Phase B - ORANGE
 - c. Phase C - YELLOW
 - d. Neutral – GREY

2. 120/208V or 120/240V AC Power
 - a. Phase A - BLACK
 - b. Phase B - RED
 - c. Phase C - BLUE
 - d. Neutral - WHITE
 3. DC Power
 - a. Positive Lead - RED
 - b. Negative Lead - BLACK
 4. DC Control
 - a. All wiring - BLUE
 5. 120 VAC Control
 - a. 120 VAC control wire shall be RED except for a wire entering a motor control center compartment, motor controller, or control panel which is an interlock. This interlock conductor shall be color coded YELLOW. For the purposes of this Section, an interlock is defined as any wiring that brings voltage into the above mentioned equipment from a source outside that equipment.
 6. 24 VAC Control
 - a. All wiring - ORANGE
 7. Equipment Grounding Conductor
 - a. All wiring - GREEN
- B. Individual conductors No. 2 AWG and smaller shall have factory color coded insulation. It is acceptable for individual conductors larger than No.2 AWG to be provided with factory color coded insulation as well, but it is not required. Individual conductors larger than No.2 AWG that are not provided with factory color coded insulation shall be identified by the use of colored tape in accordance with the requirements listed in Part 3 herein. Insulation colors and tape colors shall be in accordance with the color coding requirements listed above.
- C. Conductors that are part of multi-conductor cable assemblies shall have black insulation. The conductor number shall be printed on each conductor's insulation in accordance with ICEA S-58-679, Method 4. Each conductor No.2 AWG and smaller within the cable assembly shall also be identified with a heat shrink tag with color coded background. Each conductor larger than No.2 AWG within the cable assembly shall also be identified by the use of colored tape. Heat shrink tags and colored tape shall be in accordance with the

requirements listed in Part 3 herein. Tape color and heat shrink tag background color shall be in accordance with the color coding requirements listed above.

2.05 CABLE PULLING LUBRICANTS

- A. Cable pulling lubricants shall be non-hardening type and approved for use on the type of cable installed. Lubricant shall be Yellow #77 Plus by Ideal, Cable Gel by Greenlee, Poly-Gel by Gardner Bender, or equal.

PART 3 -- EXECUTION

3.01 WIRE AND CABLE INSTALLATION

A. General

1. Wire and Cable shall be installed as specified herein and indicated on the Drawings. Unless specifically indicated otherwise on the Drawings, wire and cable shall be installed in separate raceways according to wiring type. For example, power wiring shall not be combined with control wiring, and control wiring shall not be combined with instrumentation wiring.
2. Wire shall be furnished and installed as single conductor cables, with limited exceptions. Multi-conductor cable assemblies shall only be installed where indicated on the Drawings, required by the NEC, or after obtaining written permission from the Engineer.
3. Where instrumentation cables are installed in control panels, motor controllers, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
4. Instrumentation cable shielding shall be continuous and shall be grounded at one point only.

B. Splices

1. Splices shall not be allowed in power or control wire and cable unless approved in writing by the Engineer. If unique field conditions exist or pulling calculations indicate that splices may be required, the Contractor shall submit a detailed request indicating why splices are required to the Engineer. The Engineer shall be under no obligation to grant such request.
2. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. The use of screw-on wire connectors (wire nuts) shall only be permitted for lighting and receptacle circuits.
3. No splicing of instrumentation cable is permitted.

C. Wire and Cable Sizes

1. The sizes of wire and cable shall be as indicated on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop measured from source to load does not exceed 2-1/2%.

D. Additional Conductor Identification

1. In addition to the color coding identification requirements specified in Part 2 herein, individual conductors shall be provided with heat shrinkable identification tags. Identification tags for individual conductors shall have a white background where the conductor insulation is colored. Identification tags for individual conductors shall have a colored background where the conductor insulation is black. Background color shall match that of the taping provided on the individual black conductors.
2. Multi-conductor cables shall be provided with heat shrinkable identification tags in accordance with Part 2 herein.
3. All wiring shall be identified at each point of termination. This includes but is not limited to identification at the source, load, and in any intermediate junction boxes where a termination is made. The Contractor shall meet with the Owner and Engineer to come to an agreement regarding a wire identification system prior to installation of any wiring. Wire numbers shall not be duplicated.
4. Wire identification shall be by means of a heat shrinkable sleeve with appropriately colored background and black text. Wire sizes #14 AWG through #10 AWG shall have a minimum text size of 7 points. Wire sizes #8 AWG and larger shall have a minimum text size of 10 points. Sleeves shall be of appropriate length to fit the required text. The use of handwritten text for wire identification shall not be permitted.
5. Sleeves shall be suitable for the size of wire on which they are installed. Sleeves shall not be heat-shrunk onto control cables. Tags shall remain loose on cable to promote easier identification. For all other applications, sleeves shall be tightly affixed to the wire and shall not move. Sleeves shall be heat shrunk onto wiring with a heat gun approved for the application. Sleeves shall not be heated by any means which employs the use of an open flame. The Contractor shall take special care to ensure that the wiring insulation is not damaged during the heating process.
6. Sleeves shall be installed prior to the completion of the wiring terminations and shall be oriented so that they can be easily read.
7. Sleeves shall be polyolefin as manufactured by Brady, Seton, Panduit, or equal.
8. Wire identification in manholes, handholes, pull boxes, and other accessible components in the raceway system where the wiring is continuous (no terminations are made) shall be accomplished by means of a tag installed around the bundled group of individual conductors or around the outer conductor jacket of a multi-conductor cable. Identification shall utilize a FROM-TO system. Each group of conductors shall consist of all of the individual conductors in a single conduit or duct. The tag shall have text that identifies the bundle in accordance with the

'FROM' and 'TO' column for that particular conduit number in the conduit and wire schedule. Minimum text size shall be 10 point. The tag shall be affixed to the wire bundle by the use of nylon wire ties, and shall be made of polyethylene as manufactured by Brady, Seton, Panduit, or equal.

9. Where colored tape is used to identify cables, it shall be wrapped around the cable with a 25% overlap and shall cover at least 2 inches of the cable.

E. Wiring Supplies

1. Rubber insulating tape shall be in accordance with ASTM D4388. Friction tape shall be in accordance with ASTM D69.

F. Training of Cable in Manholes, Handholes, and Vaults

1. The Contractor shall furnish all labor and material required to train cables around cable vaults, manholes, and handholes. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. The training shall be done in such a manner as to minimize chaffing.
2. Instrumentation cable shall be racked and bundled separate from AC wiring to maintain the required separation as follows:
 - a. 18 inches for 480/277 VAC wiring
 - b. 12 inches for 208/120 VAC wiring
 - c. 6 inches for 24 VAC wiring

G. Conductor Terminations

1. Where wires are terminated at equipment which requires lugs, connections shall be made by solderless mechanical lug, crimp type ferrule, or irreversible compression type lugs. Reference individual equipment specification sections as applicable for additional termination requirements.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make terminations impractical due to the size of the field wiring, the Contractor shall terminate field wiring in an adjacent junction box per the requirements of Section 16130 – Boxes, complete with terminal strips. Contractor shall install the smaller wiring from the device to the junction box in a conduit, using the terminal strip as the means for joining the two different wire sizes. Splicing of wires in lieu of using terminal strips is not acceptable.
3. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

4. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.
5. All spare conductors shall be terminated on terminal blocks mounted within equipment or junction boxes. Unless otherwise noted, coiling up of spare conductors within enclosure is not acceptable.

H. Pulling Temperature

1. Cable shall not be installed when the temperature of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature of 40°F or less within a three (3) day period prior to pulling, the cable reels shall be stored three (3) days prior to pulling in a protected storage area with an ambient temperature of 55°F or more. Cable pulling shall be completed during the work day for which the cable is removed from the protected storage. Any cable reels with wire remaining on them shall be returned to storage at the completion of the workday.

3.02 FIBER OPTIC CABLE INSTALLATION

- A. The Contractor shall install the fiber optic cable furnished by the General Contractor and/or the Instrumentation and Control Subcontractor. The cable shall be installed in its respective raceway system(s) as specified herein, indicated on the Drawings, and in accordance with the cable manufacturer's instructions. Reference Division 17 for additional information regarding the fiber optic cable.

3.03 TESTING

- A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Shop Test
 - a. Wires and cables shall be tested in accordance with the applicable ICEA Standards. Wire and cable shall be physically and electrically tested in accordance with the manufacturer's standards.
 2. Field Tests
 - a. After installation, all wires and cables shall be tested for continuity. Testing for continuity shall be "test light" or "buzzer" style.
 - b. After installation, some wires and cables shall be tested for insulation levels. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
 - i. For #8 AWG and larger 600V wire and cable, apply 1,000 VDC from a Megohmmeter for one (1) minute. Resistance shall be no less

than 100 Megohms. Insulation testing is not required for power and control cables smaller than #8 AWG.

- ii. Instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megohms or greater.
- B. Wires and cables shall be tested after required terminations are made, but before being connected to any equipment.
- C. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner. All conductors of a multi-phase circuit shall be replaced if one conductor fails the required testing. If part of a multi-set (parallel conductors per phase) circuit fails testing, only the set containing failure shall be replaced.
- D. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment. Test reports shall be submitted to the Engineer.

(EXHIBIT A)
TEST DATA - MEGOHMS
TEST NO. _____

Part Tested:				Test Performed: _____ Hours/Days: _____ After Shutdown: _____					
Grounding Time:				Dry Bulb Temperature: _____ Wet Bulb Temperature: _____					
Test Voltage:				Equipment Temperature: _____ How Obtained: _____ Relative Humidity: _____ Absolute Humidity: _____ Dew Point: _____					
Megohmmeter:		Serial Number: _____		Range: _____		Voltage: _____		Calibration Date: _____	
Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	Test Connections	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground	To Line To Earth To Ground
1/4 Minute				5 Minutes					
1/2 Minute				6 Minutes					
3/4 Minute				7 Minutes					
1 Minute				8 Minutes					
2 Minutes				9 Minutes					
3 Minutes				10 Minutes					
4 Minutes				10/1 Minute Ratio					
Remarks:									

- END OF SECTION -

SECTION 16130

BOXES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The scope of work under this Section includes furnishing and installing all pull boxes, junction boxes, and outlet boxes.
- B. Requirements for other boxes and enclosures are not included in this Section. Reference each specific Division 16 equipment Section for requirements related to that equipment's respective enclosure.
- C. Reference Section 16000, Basic Electrical Requirements, and Section 16111, Conduit.

1.02 CODES AND STANDARDS

- A. Boxes shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 514A - Metallic Outlet Boxes
 - 2. UL 514C - Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers
 - 3. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - 4. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations
 - 5. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.
 - 6. NEMA 250 – Enclosures for Electrical Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer(s) and submit the following:
 - 1. Shop Drawings
- B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete or illegible Submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets for boxes, terminal strips, and all accessories

1.05 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.
- B. As-built drawings showing dimensions, internal box layout, terminal strip information, and terminal strip identification information shall be provided for all junction boxes. As-built drawings are not required for pull boxes or outlet boxes.

1.06 IDENTIFICATION

- A. Each pull and junction box shall be identified with the box name as indicated on the Contract Drawings or as directed by the Engineer. A nameplate shall be securely affixed in a conspicuous place on each box. Nameplates shall be as specified in Section 16195, Electrical – Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 PULL AND JUNCTION BOXES

- A. General
 - 1. All pull and junction boxes shall be UL listed and labeled.
 - 2. Pull and junction boxes shall not be provided with eccentric or concentric knockouts.
 - 3. Pull and junction boxes mounted embedded in concrete shall be UL listed for embedment.

4. Where metallic boxes are used they shall be of all welded construction. Tack welded boxes are not acceptable.

B. Pull Boxes

1. All pull boxes shall be provided with a matching gasketed cover. For covers with dimensions of 24 inches by 24 inches or less, the cover shall be held in place by machine screws. Other screw types are not acceptable. For covers with dimensions greater than 24 inches by 24 inches, the cover shall be hinged and held in place by screw-operated clamp mechanisms. Hinge pins shall be removable. Clamp mechanism material of construction shall match that of the associated box.
2. Pull boxes shall not have any wire terminations inside, other than those for grounding/bonding. A ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the pull box (minimum of two) shall be provided as spare terminations. Boxes requiring any other wire terminations shall be furnished and installed in accordance with the requirements for junction boxes herein.
3. Pull boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC.
4. Barriers shall be provided in pull boxes to isolate conductors of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring

C. Junction Boxes

1. Junction boxes used for lighting and receptacle circuits only shall be provided with a matching gasketed cover held in place by machine screws. Other screw types are not acceptable.
2. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with a hinged, gasketed cover. Hinge pins shall be removable. Cover shall be held in place by screw-operated clamp mechanisms. Clamp mechanism material of construction shall match that of the associated box.

3. Barriers shall be provided in junction boxes to isolate conductors and terminal blocks of different voltages, types, and functions. Barrier material of construction shall match that of the box. Isolation shall be provided between the following groups:
 - a. Power wiring
 - b. AC control wiring
 - c. DC control wiring
 - d. Instrumentation wiring
4. Junction boxes used for lighting and receptacle circuits only shall be allowed to have screw-on (wire nut) type connectors for wire terminations/junctions.
5. Junction boxes for all uses other than lighting and receptacle circuits shall be provided with terminal strips, consisting the necessary number of screw type terminals. Current carrying parts of the terminal blocks shall be of ample capacity to carry the full load current of the circuits connected, with a 10A minimum capacity. Terminal strips shall be rated for the voltage of the circuits connected. A separate ground bar shall be provided with the necessary number of screw type terminals. Twenty (20) percent of the total amount of terminals otherwise required for the junction box (minimum of two) shall be provided as spare terminations. When barriers are provided within the box, separate terminal strips shall be provided in each barrier area. Terminals shall be lettered and/or numbered to conform to the wiring labeling scheme in place on the project.
6. Junction boxes shall be 6 inches wide by 6 inches tall by 4 inches deep, minimum. For applications requiring larger boxes, the box shall be sized in accordance with the fill requirements and dimensional requirements of the NEC. Terminal blocks (including spare terminals) shall be considered when sizing the junction box.

D. Enclosure Types and Materials

1. In non-hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Type 304 Stainless Steel
Indoor Dry Process Area	NEMA 12, Painted Steel
Indoor Dry Non-process Area	NEMA 1, Painted Steel
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, Fiberglass or PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Type 304 Stainless Steel
All Outdoor Areas	NEMA 4X, Type 304 Stainless Steel

2. In hazardous locations, pull and junction boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Type 304 Stainless Steel
Class 2, Division 1, Group F	NEMA 9, Die Cast Aluminum
Class 2, Division 2, Group F	NEMA 4X, Type 304 Stainless Steel

3. Non-metallic enclosures, NEMA 7 enclosures, and NEMA 9 enclosures shall be provided with threaded integral conduit hubs.

2.03 OUTLET BOXES

A. General

1. Outlet boxes shall be provided with a trim appropriate for the wiring device installed inside. Reference Section 16141, Wiring Devices, for outlet box trim requirements. An appropriate outlet box trim is required to achieve the NEMA rating of the outlet boxes as specified herein.

B. Surface Mount Outlet Boxes

1. Outlet boxes shall be the deep type, no less than 2.5 inches deep.
2. Outlet boxes shall be provided in single or multi-gang configuration as required, sized in accordance with the requirements of the NEC.
3. In non-hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	ENCLOSURE TYPE AND MATERIAL
Indoor Wet Process Area	NEMA 4X, Cast Aluminum
Indoor Dry Process Area	NEMA 1, Cast Aluminum
Indoor Dry Non-process Area	NEMA 1, Cast Aluminum
Indoor Type 1 Chemical Storage/Transfer Area	NEMA 4X, PVC
Indoor Type 2 Chemical Storage/Transfer Area	NEMA 4X, Cast Aluminum
All Outdoor Areas	NEMA 4X, Cast Aluminum

4. In hazardous locations, outlet boxes shall be furnished with the following enclosure type and material of construction, dependent upon the classification of the area in which they are to be installed. Area classifications are indicated on the Drawings.

AREA CLASSIFICATION	ENCLOSURE TYPE AND MATERIAL
Class 1, Division 1, Group D	NEMA 7, Die Cast Aluminum
Class 1, Division 2, Group D	NEMA 4X, Cast Aluminum

5. Outlet boxes shall be provided with integral threaded conduit hubs mounted external to the box. Boxes with threaded conduit hubs mounted internal to the box or as a part of the box wall are not acceptable.

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Pull and Junction Boxes

1. Pull boxes and junction boxes shall be solidly attached to structural members prior to installation of conduit and set true and plumb. Boxes shall not be supported by their associated conduits.
2. Wooden plugs are not permitted for securing boxes to concrete. Appropriately rated anchors specifically suited for use in concrete shall be used.
3. Box penetrations for conduits shall be made with a punch tool, and penetrations shall be of the size required for the conduit entry and/or hub. Oversized penetrations in boxes are not acceptable.
4. Watertight conduit hubs shall be provided for boxes where a NEMA 4X enclosure rating is specified. Reference Section 16111, Conduit, for conduit hub requirements.
5. Pull and junction boxes may be installed flush mounted in gypsum, concrete or CMU walls where appropriate provided that covers are easily removed or opened.
6. Pull and junction boxes shall be provided in the enclosure type and material of construction required for the area in which it is installed. Reference the requirements in Part 2 herein, and the area designations indicated on the Drawings.

- END OF SECTION -

SECTION 16141

WIRING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install all switches, occupancy sensors, and receptacles as shown on the Drawings.
- B. All switches and receptacles shall be furnished and installed in outlet boxes. Reference Section 16130, Boxes, for outlet box requirements.
- C. Reference Section 16000, Basic Electrical Requirements, and Section 16123, Low Voltage Wire and Cable.

1.02 CODES AND STANDARDS

- A. Wiring devices shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 20 – General Use Snap Switches
 - 2. UL 498 – Standard for Attachment Plugs and Receptacles
 - 3. UL 943 – Ground Fault Circuit Interrupters
 - 4. UL 1203 – Standard for Explosion-proof and Dust-ignition-proof Electrical Equipment for use in Hazardous (Classified) Locations.

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

1.05 SPARE PARTS

A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.

B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.06 IDENTIFICATION

A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall use the products of a single manufacturer for each type of wiring device.

C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:

1. Where the selected plate manufacturer does not manufacture a suitable finish plate.

2. For heavy-duty receptacles rated at more than 30A.

3. Where non-standard plates are required, specified, or shown.

D. The Contractor shall furnish and install all wiring devices and device plates.

E. In non-hazardous areas, provide specification grade devices manufactured by Appleton, Crouse-Hinds, Leviton, Hubbell, Pass & Seymour, or Engineer approved equal.

- F. In hazardous areas, provide devices manufactured by Appleton, Cooper Crouse-Hinds, Hubbell-Killark, or Engineer approved equal.

2.02 WIRING DEVICES

- A. Wall switches for non-hazardous areas shall be rated for the current required to suit the application, but not less than 20A. Double pole, three-way, and four-way switches shall be provided where indicated on the Drawings, and as required. Switches shall be rated for 120-277VAC and shall be UL 20 Listed.
- B. Convenience receptacles for non-hazardous areas shall be rated for 20A at 125VAC and shall be UL 498 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.
- C. Special purpose receptacles (welders, lab equipment, etc.) shall be provided with the proper NEMA configuration and ampacity as indicated on the Drawings. The coordinating plug for each special purpose receptacle shall be provided with the equipment which it is serving.
- D. Ground fault circuit interrupter receptacles shall be rated for 20A at 125VAC and shall be UL 943 Listed. Receptacles shall be weather resistant where installed in wet or damp locations.
- E. Wall switches for hazardous areas shall be the factory sealed type, UL 1203 Listed for use in the hazardous area. Wall switches shall be rated for 120-277VAC, and shall be rated for the current required to suit the application, but not less than 20A.
- F. Receptacles for hazardous areas shall be rated 20A at 120-240VAC. Receptacles shall be UL 1203 listed for use in the hazardous area, utilizing delayed-action construction.
- G. All wiring devices shall be approved for use with stranded conductors, if stranded conductors are to be used with the device. Reference Section 16123, Low Voltage Wire and Cable for conductor requirements.

2.03 DEVICE PLATES

- A. Device plates for indoor flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.032 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Device plates shall be provided with a gasket.
- B. Device plates for outdoor installations, indoor wet process areas, and chemical storage/transfer areas shall be Appleton Type FSK, Crouse-Hinds #DS185, or equal for wall switches. Device plates for receptacles shall be "in-use" style. "In-use" weatherproof covers shall be rugged, minimum 3 ¼" depth, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," Intermatic International, Inc., or equal.
- C. Device plates for indoor dry process and non-process areas with surface mounted boxes shall be Crouse-Hinds DS32, or equal for switches, and Crouse-Hinds DS23 or equal for receptacles.

2.04 PLUGS

- A. The Contractor shall furnish suitable plugs with equipment furnished under the respective specification Section. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 PROCESS INSTRUMENTS

- A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be UL 1203 Listed.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Where more than one (1) switch occurs at one (1) location, gang plates shall be used.
- B. All device plates shall be set true and plumb and shall fit tightly against the finished wall surfaces and outlet boxes.
- C. Wiring device box (outlet box) mounting heights shall be as specified in Section 16130, Boxes.
- D. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Contractor shall bring it to the attention of the Engineer for a decision.
- E. Receptacles installed in toilet, locker, and bathrooms, and within 6 feet of a sink, shall be of ground fault interrupter type. Ground fault circuit interrupter receptacles shall also be furnished and installed in additional locations where indicated on the Drawings, and as required by the NEC.
- F. All receptacles shall have a self-adhesive label installed on the top at the respective device plate that indicates which panel and which circuit number the receptacle is supplied from. Labels shall have a white background and black lettering in 14 point font.

3.02 CIRCUITING

- A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience receptacles are permitted per 20A, 120V circuit, unless otherwise indicated on the Drawings.

- END OF SECTION -

SECTION 16170

GROUNDING AND BONDING

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered a minimum requirement for compliance with this Specification.
- B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100. Conflicts shall be promptly brought to the attention of the Engineer.
- C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:
- D. Reference Section 16000, Basic Electrical Requirements

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. UL 467 – Grounding and Bonding Equipment
 - 2. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - 3. IEEE 1100 – Recommended Practice for Power and Grounding Electronic Equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Reports of certified field tests.
- B. Each submittal shall be identified by the applicable specification section.

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1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 GROUND RODS AND GRID

- A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod. Ground rods shall be UL 467 listed. The ground rods shall be manufactured by Erico Products, Blackburn, or equal.
- B. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.
- C. The ground connection shall be made at the main service equipment and shall be extended to the ground grid surrounding the structure. The ground grid shall also be connected to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection.
- D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 FITTINGS

- A. Grounding connections to equipment shall be bolted. Cable end connections shall be made by hydraulic crimp or exothermically welded. Split bolt type connectors are not acceptable. Fittings shall be UL 467 listed.

2.04 EQUIPMENT GROUNDING CONDUCTORS

- A. An insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Insulation shall be of the same type as the ungrounded conductors in the raceway and shall be green in color. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 EQUIPMENT GROUNDS

- A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.
- B. For all control panels, disconnect switches, and other electrical enclosures, equipment grounds and bonding jumpers shall be terminated individually on a ground bar or mechanical lugs. No wire nuts will be permitted.

2.06 EXOTHERMIC WELDS

- A. All exothermic welding shall be completed per welding kit manufacturer's instructions. Exothermic welds shall be CadWeld by Erico or ThermoWeld.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.
- B. Ground Grid
 - 1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods as shown on the Drawings. Ground rods shall be driven straight down into the earth, or if objects are encountered, at an angle to avoid the obstruction.
 - 2. The ground rods shall be interconnected by the use of copper cable exothermically welded to the rods. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtailed" shall be connected to the ground grid and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to

provide a complete grounding system. The copper pigtails shall be exothermically welded to the ground grid, and connected to building reinforcement steel by hydraulic crimp.

3. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
4. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.
6. Buried exothermic welds and ground ring shall not be backfilled until inspected by Engineer.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

3.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 1. Witnessed Shop Tests
 - a. None required.
 2. Field Tests
 - a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA Acceptance Testing Specifications, latest edition.
 - b. Fall of potential tests shall be performed on the ground grid per IEEE81 recommendations by a third party, independent testing firm. A fall of potential plot shall be submitted at the conclusion of testing for Engineer review. Documentation indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made shall be submitted. Testing shall show that the ground grid has 5 ohms resistance or less. Due to soil conditions and/or unforeseen field conditions, ground resistances greater than 5 ohms may be acceptable if specifically approved in writing by the Engineer. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground grid under test isolated from other grounds.

- c. Continuity tests for the grounding electrode conductor shall be performed. Test will be accepted when a resistance of less than 1 ohm is shown for this conductor.

- END OF SECTION -

SECTION 16190
SUPPORTING DEVICES

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install structural supports for mounting and installing all conduit, electrical equipment, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.
- B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.
- C. Reference Section 16000, Basic Electrical Requirements.

1.02 CODES AND STANDARDS

- A. Equipment and materials covered under this Section shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. ASTM A123 – Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153 – Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 3. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 4. ASTM A276 – Standard Specification for Steel Bars and Shapes
 - 5. ASTM B783 – Standard Specification for Materials for Ferrous Powder Metallurgy Structural Parts

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop drawings
 - 2. Structural support calculations (if required)

- B. Each submittal shall be identified by the applicable Specification section.

1.04 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.
 - 2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 MATERIALS

- A. Support channel shall be 1-5/8" by 1-5/8" minimum, with 12 gage material thickness.
- B. Support channel, support channel fittings, and threaded rod shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

- C. Fastening hardware (bolts, nuts, washers, and screws) shall be furnished with the following material of construction, dependent upon the designation of the area in which they are to be installed. Area designations are indicated on the Drawings.

AREA DESIGNATION	MATERIAL OF CONSTRUCTION
All Outdoor Areas	Type 304 Stainless Steel
All Hazardous Areas	Type 304 Stainless Steel

PART 3 -- EXECUTION

3.01 INSTALLATION

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling channels for all switchgear, switchboards, motor control centers, and similar floor mounted equipment. The leveling channels shall be provided for embedment in the equipment housekeeping pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain concrete coverage of the reinforcement bars while not causing associated equipment to exceed the maximum mounting height requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel.
2. Unless otherwise indicated on the Drawings or in the Specifications, handrails/guardrails shall not be utilized as supports for electrical equipment, devices, or appurtenances. Handrails/guardrails shall not be cut, drilled, or otherwise modified in order to accommodate electrical supports without written approval from the Engineer.
3. All holes made in reflected ceilings for support rods, conduits, and other equipment shall be made adjacent to ceiling grid bars where possible, to facilitate removal of ceiling panels.
4. Support channel shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
5. All equipment, devices, and raceways that are installed on the dry side of a water bearing wall shall not be installed directly onto the wall. Support channel shall be used to allow ventilation air to pass behind the equipment, devices, or raceway.
6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework.

7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
 8. Actual designs for supporting framework should take the nature of a picture frame of support channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; Contractor shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
 9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.
 10. For all installations where fiberglass supporting materials are required, the Contractor shall submit structural calculations and the details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the state in which the project is located.
 11. For the following installations where conduits are provided with a support system suspended from the above or attached to a vertical structure, the Contractor shall submit structural calculations and details of the proposed system of support. Structural calculations shall be signed and sealed by a registered professional engineer in the state in which the project is located.
 - a. A quantity of twelve (12) or more conduits trade size 1" and smaller are proposed for a conduit support rack.
 - b. A quantity of eight (8) or more conduits trade sizes 1 1/2" to 2 1/2" are proposed for a conduit support rack.
 - c. A quantity of four (4) or more conduits trade sizes 3" and larger are proposed for a conduit support rack.
 12. Single conduits installed exposed along walls and ceilings shall be secured to the wall or ceiling with a one-hole conduit clamp and clamp-back. Where multiple conduits are installed exposed together, support channel and conduit clamps shall be used.
- C. Equipment, boxes, and enclosures which are factory-constructed with integral mounting provisions (such as brackets, mounting feet, bolt holes, etc.) shall be installed/supported utilizing those mounting provisions. Equipment, boxes and enclosures shall not be field modified to enable mounting by any other means. Equipment, boxes, and enclosures that are field-modified by any means which compromises the UL Listing or NEMA rating of the enclosure/assembly shall be removed and replaced by the Contractor at no additional cost to the Owner

- END OF SECTION -

SECTION 16195

ELECTRICAL - IDENTIFICATION

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull and junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.
- B. The types of electrical identification specified in this section include, but are not limited to, the following:
 - 1. Operational instructions and warnings.
 - 2. Danger signs.
 - 3. Equipment/system identification signs.
 - 4. Nameplates.

1.02 SIGNS

- A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 LETTERING AND GRAPHICS

- A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 SHOP DRAWINGS

- A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
- B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.
- C. Shop drawings shall include but not be limited to:
 - 1. Product data sheets.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 NAMEPLATES

- A. Nameplates shall be engraved, high pressure plastic laminate, white with black lettering.
- B. Nameplates shall be attached to NEMA 4X enclosures utilizing UL-recognized mounting kits designed to maintain the overall UL Type rating of the enclosure. Mounting kit fasteners shall be stainless steel Type AHK10324X as manufactured by Hoffman, or equal.

2.03 HIGH VOLTAGE SIGNS

- A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate identification.

2.04 CONDUIT IDENTIFICATION

- A. Conduit identification shall be as specified in Section 16111, Conduit.

2.05 WIRE AND CABLE IDENTIFICATION

- A. Field installed wire and cable identification shall be as specified in Section 16123, Low Voltage Wire and Cable.
- B. A plastic laminate nameplate shall be provided at each panelboard, motor control center, switchgear assembly, and switchboard assembly. This nameplate shall be used to clearly

convey the conductor identification means used at that piece of equipment (i.e. Phase A=Brown, Phase B=Orange, C = Yellow).

- C. Wiring identification for factory installed wiring in equipment enclosures shall be as specified in the respective section.

2.06 BOX IDENTIFICATION

- A. Pull, junction and device box identification shall be as specified in Section 16130 – Boxes.

PART 3 -- EXECUTION

3.01 NAMEPLATES

- A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 OPERATIONAL IDENTIFICATION AND WARNINGS

- A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.03 POWER SOURCE IDENTIFICATION

- A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.
- B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.
- C. Nameplates shall be as specified herein.

- END OF SECTION -

SECTION 16470

PANELBOARDS

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install panelboards of voltage and current ratings as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming to the panelboard schedules on the Drawings.
- B. Reference Section 16000, Basic Electrical Requirements; and Section 16195, Electrical Identification.

1.02 CODES AND STANDARDS

- A. Panelboards shall be designed, manufactured, and/or listed to the following standards as applicable:
 - 1. Underwriters Laboratories
 - a. UL 50 – Enclosures for Electrical Equipment, Non-environmental Considerations
 - b. UL 67 – Standard for Panelboards
 - c. UL 489 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures
 - d. UL 943 – Ground Fault Circuit Interrupters
 - e. UL 1449 – Standard for Surge Protective Devices
 - 2. NEMA PB1 - Panelboards
 - 3. National Electrical Contractors Association (NECA) Standard 407 – Standard for Installing and Maintaining Panelboards

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:
 - 1. Shop Drawings.
 - 2. Spare Parts List.

3. Operation and Maintenance Manuals.

4. Reports of Field Tests.

B. Each submittal shall be identified by the applicable specification section.

1.04 SHOP DRAWINGS

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard.

3. Complete panelboard schedules indicating circuit designations as shown on the Drawings for each panelboard.

4. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., PP-1, MPZ-1, etc.).

1.05 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1. The manuals shall include:

1. Instruction books and/or leaflets.

2. Recommended spare parts list.

3. Final as-built construction drawings included in the shop drawings incorporating all changes made in the manufacturing process and during field installation.

1.06 SPARE PARTS

A. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer. All spaces in the panelboards shall be furnished with a spare breaker as indicated in the panelboard schedules shown on the Drawings.

B. Spare parts lists shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

- C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.07 IDENTIFICATION

- A. Each panelboard shall be identified with the identification name/number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each panelboard. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 -- PRODUCTS

2.01 MANUFACTURERS

- A. The Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 CONDUCTORS (MAIN BUS AND BRANCH CONNECTORS)

- A. All main bus shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above a maximum ambient temperature of 40 degrees C.

2.03 POWER DISTRIBUTION PANELBOARDS

A. General

1. Power distribution panelboards shall be of the configuration and rating as specified herein and as indicated on the Drawings. The panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal overload branch circuit breakers. Panelboards shall be UL 67 Listed and shall be constructed to NEMA PB1 standards. Panelboards shall be service entrance rated where indicated on the Drawings.
2. Power panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers as indicated on the Drawings. The panelboards shall be suitable for flush or surface mounting.
3. Power distribution panelboards shall be fully rated and shall have a minimum short circuit rating of 65,000 amperes symmetrical unless otherwise indicated on the Drawings.
4. Power distribution panelboards shall be Eaton Pow-R-Line Series, the Square D Company equivalent, the General Electric Company equivalent, or Siemens Energy and Automation, Inc. equivalent.

B. Enclosures

1. Enclosures shall be UL 50 listed and have a NEMA rating as indicated on the Drawings. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet. Enclosures designated as NEMA 4X shall be constructed of 304 stainless steel. Enclosures with all other NEMA ratings shall be constructed of No. 12 U.S.S. code gauge galvanized steel, painted ANSI #61 light gray. The enclosure shall have wiring gutters on sides and shall be at least 5-3/4 inches deep.
2. The door shall be fastened to the enclosure with concealed hinges and shall be equipped with flush-type catches and locks. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism. All locks shall be keyed alike. The panelboard trim shall have a removable hinge assembly, in addition to the door hinge, that allows work inside the enclosure without the need to remove the trim.
3. The panelboard shall be provided with an information label. The information label shall include the panelboard designation, voltage, phase, wires, and bus rating.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1,000 amperes per square inch of cross section will be attained. This current density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.
2. Solid neutral bus bars, where required, shall be provided. Neutral bus shall have the same ampacity as the main bus, unless otherwise indicated. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper and shall extend the entire useable length of the panelboard, including spaces. Panelboards Listed and Labeled as a four-wire panel shall not be used in place of a three-wire panel where a neutral conductor does not exist in the supply conductors to that panel.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type and UL 489 Listed. All circuit breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation.
2. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD" where required by Article 440 by the NEC. Circuit breakers installed for air conditioning units shall be HACR type.
3. Circuit breaker voltage rating shall meet or exceed the panelboard voltage indicated on the Drawings. Trip elements of circuit breakers shall be 20A, unless otherwise indicated on the Drawings. Circuit breakers shall have an interrupting rating at 480 VAC that matches the panelboard short circuit rating.
4. Main circuit breakers shall be individually mounted. Branch mounted circuit breakers are not acceptable unless specifically indicated on the panel schedules. Coordinate top or bottom mounting of main circuit breaker with incoming conduit location.
5. Where indicated on the Drawings, branch circuit breakers shall be provided with a padlockable hasp or handle padlock attachment for padlocking in the off position as required to meet the NEC requirement for disconnecting means and/or OSHA lock-out/tagout standard. Locking hardware shall remain in place even when the padlock is removed. Branch circuit breakers shall be provided with a similar lock-on device where indicated on the Drawings.

E. Directories

1. Approved directories with noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be provided in each panel. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform to the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.

2.04 COMBINATION POWER UNITS

- A. Combination power units shall be installed as specified herein and indicated on the Drawings. The unit shall be a combination of a transformer and a lighting panelboard. Transformer rating, primary circuit breaker rating, secondary circuit breaker rating, and panelboard bus rating shall be as indicated on the Drawings. The transformer and panelboard shall meet the requirements for these products as specified herein and elsewhere in these Specifications.
- B. Combination power units located outdoors shall be suitable for outdoor use and be provided in a NEMA 3R enclosure unless otherwise indicated on the Drawings.

- C. Combination power units shall have all copper windings and terminations. The transformer shall be 115°C temperature rise and epoxy resin encapsulated.
- D. The combination power unit shall be a Mini-Power Zone as manufactured by the Square D Company, a Mini-Power Center as manufactured by Eaton, Servicecenter as manufactured by General Electric Company, or Siemens Energy and Automation, Inc. equivalent.

2.05 SURGE PROTECTIVE DEVICES

- A. The panelboards shall be furnished with integrated Type II surge protective devices (SPD). SPDs shall be provided in the location and quantity as shown on the Drawings. SPD shall be installed within the panelboard enclosure in a location that allows the required quantity and rating of branch circuit breakers to be installed. Reducing the quantity of branch circuit breakers to less than that required by the panel schedules is not acceptable.
- B. The SPD shall be rated, designed, tested, listed, and labeled in accordance with UL-1449, latest edition.
- C. The SPD shall be factory installed by the panelboard manufacturer using a direct bus connection. There shall be no cable connection between the bus bar and the SPD device.
- D. The SPD shall have a fault current rating equal to or greater than that of the fault current rating of the panelboard. The SPD shall employ metal-oxide varistor (MOV) technology. If integral fusing is used, the fuses shall allow the maximum rated surge current to pass without fuse operation.
- E. The SPD shall have a maximum continuous operating voltage (MCOV) of at least 115% of the nominal voltage of the panelboard. The Voltage Protection Rating (VPR) of each SPD shall not exceed the following:

SYSTEM VOLTAGE	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V
480 DELTA	N/A	1200V	2000V	N/A
240 DELTA	N/A	1200V	1200V	N/A
120/240	700V	700V	1200V	700V

- F. The Nominal Discharge Current (In) of the SPD shall be 20kA. Peak surge current ratings shall not be used as a basis for applying the SPD to the system.
- G. The surge current rating for each SPD shall be as indicated on the Drawings. Surge current ratings are indicated in panel schedules. Surge current rating indicated is on a per phase basis.
- H. Each SPD system shall provide surge protection in all possible modes. Surge protection shall be as follows:

SYSTEM CONFIGURATION	MODES OF PROTECTION	NUMBER OF MODES
-----------------------------	----------------------------	------------------------

3-Phase Wye	L-N, L-G, N-G	7
3-Phase Delta	L-L, L-G	6
3-Phase Impedance Grounded	L-L, L-G	6
Single-Phase	L-N, L-G, N-G	3

- I. The SPD shall be furnished with an audible alarm and silence pushbutton, integral SPD status LEDs (one per phase), and a Form C dry contact for remote indication of alarm. A surge counter shall also be provided.
- J. The SPD equipment shall be SPD Series by Eaton, SurgeLogic by the Square D Company, Tranquell by the General Electric Company, Siemens Energy and Automation Inc. equivalent, or equal.

PART 3 -- EXECUTION

3.01 INSTALLATION

- A. Panelboards and combination power units shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer, and as required by NECA 407.
- B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six (6) feet above finished floor elevation.
- C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.
- D. The Contractor shall not use factory furnished knockouts with surface mounted back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush mounted back boxes with manufacturer's standard pattern of knockouts.
- E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush mounted enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.
- F. Bus loads in all panelboards shall be balanced between phases to within a tolerance of one (1) KVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practical.
- G. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

3.02 TESTING

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Field Tests

- a. Prior to termination of any conductors to the circuit breakers , all bus work and circuit breakers shall be tested from phase to phase and phase to ground with a 1000 VDC megaohmmeter for 1 minute in accordance with NECA 407. Resistance values shall be recorded and shall not be less than 100 megohms.
- b. Prior to terminating any wires to the circuit breakers, the resistance of the connection between the bus work and each circuit breaker shall be tested through the use of a low-resistance ohmmeter. Record the resistance values for each circuit breaker.

- END OF SECTION -